A CONCEPTUAL MODEL EVALUATION FRAMEWORK FOR ADAPTIVE GOVERNANCE AND ADAPTIVE MANAGEMENT IN LARGE-SCALE RESTORATION PROGRAMS

by

Chadwin B. Smith

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Chadwin B. Smith, Ph.D.

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Advisor: Craig Allen

Adaptive management (AM) has become a kind of plastic phrase applied as a formulaic panacea for most major species recovery and ecosystem restoration efforts now underway across the United States. AM emerged as an application of the scientific method to resource management, closely tying management to science learning through experimental actions. The phrase "learning by doing" best captures the premise behind developing an experimental management approach that could be applied on the larger scale of a river system or ecosystem. In nearly five decades application, however, examples of successful AM implementation at large scales are few and conflict remains over how to achieve the most essential elements of true adaptive management. Emerging theory on governance structures and the ability of those structures to adapt to a changing environment led to development of adaptive governance (AG). With a focus on polycentric structures, self-organization, and decision-making made more inclusive and less top-down, AG appears linked to the notions of AM grounded in constant learning, implementing management actions as experiments, and embracing uncertainty. AG has thus emerged as an integral approach to tackling the challenges of moving large-scale AM programs forward. But few analytical frameworks exist to evaluate governance

performance and point to necessary reforms. Similarly, assessment frameworks for AM focus on improving the steps of the AM process but do not capture related linkages to the governance structure under which those AM processes are operated. The central proposition of my dissertation is that governance of a large-scale aquatic system adaptive management program is determinative in successful implementation of adaptive management thus predicating program success. To explore this proposition, I developed and field-trialed a new conceptual model restoration program evaluation framework that incorporates a performance assessment of multiple components and subcomponents of AG and AM; a risk assessment of these AG and AM components; and a typology to place restoration programs in quadrants of possible success, all resulting in recommendations for restoration program reform.

DEDICATION

This dissertation is dedicated to two people in particular:

Dr. Jerry F. Kenny (1955-2018) – Jerry launched my career formally working with AM in large scale programs when he took a chance and brought me on as his first employee while building his staff as Executive Director of the Platte River Recovery Implementation Program. Jerry gave me the freedom to learn on the job, grow, and explore what it means to successfully implement adaptive management and adaptive governance in big restoration programs. He was a constant champion for my completing my Ph.D. and always gave me the freedom to do what was necessary to achieve that goal. Jerry's guidance was the starting point for my explorations into the concepts and practicalities of AG and AM in my studies, in my work, and in my connections with colleagues around the country working in this field. I owe my place in this community to Jerry. I miss him, and I can never repay my debt of gratitude.

Dr. Kelli Smith – my wife and life partner, Kelli has always been my most consistent advocate for finishing my Ph.D. with constant support and encouragement. It takes a good bit of resolve to complete this journey while working full time, raising a family, and dealing with the challenges of life, not to mention a global pandemic. No way could I have done it without Kelli. I cannot thank her enough for her love and wisdom, and even procedural guidance having completed her own Ph.D. while working, being a mom, and being pregnant with our second daughter. She is an inspiration and helped push/carry me over the finish line. All my love.

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I want to posthumously thank Dr. Kyle Hoagland (1951-2020). Kyle was my initial advisor, got me started down this road, and was a source of support and guidance that kept me going. Sandi Zellmer was there for my first meeting with Kyle as well, was the professor for my first Ph.D. class, was on my committee for most of my program, and participated in my written and oral comprehensive exams. Her insight has always been valuable to my research and my work, and I appreciate the time she took to invest in my doctoral program.

Sincerest thanks to my Headwaters Corporation family, especially my partners

Dr. Bridget Barron and Jason Farnsworth. They have been constant sources of support and encouragement, giving me space to read, think, and generally work on my PhD while also trying to grow and maintain a business and do our work well together in service to the Platte River Recovery Implementation Program (PRRIP), Trinity River Restoration Program (TRRP), and the other places where we work. As an extension, I owe a sincere debt of gratitude to the participants in the PRRIP and the TRRP. They have given of their time, knowledge, and expertise as research material for my dissertation; they have given me employment as clients for my work in large-scale AG and AM; and they have helped make me a better student and practitioner by revealing the best ways to make these large restoration program work. And thanks to the people that work in the other programs I have had the good fortune to engage with, including the Comprehensive Everglades Restoration Program, the Middle Rio Grande Endangered Species Recovery Program, the Missouri River Recovery Program, the San Joaquin River Restoration Program, and restoration efforts in the Gulf of Mexico and coastal Louisiana. It is an ongoing privilege to work with these people and these programs.

So many colleagues from around the country have made an indelible mark on my understanding of science, AG, AM, and how to communicate to and work with decision-makers. Thanks to my friends and colleagues at ESSA Technologies, Inc. in Canada, especially Dave Marmorek, Carol Murray, and Darcy Pickard. Additional special thanks to Dave Marmorek for being a friend, mentor, business partner, and general champion for me for so many years. I have learned much of what I know about AM from Dave, appreciate the spiritual connection to Carl Walters I have through Dave, and am so thankful for the work we continue to do together. Thanks to David Galat who continues to be a mentor and supporter, who introduced me to and taught me about the Missouri River and big river ecology and remains a trusted confidant. Thanks to the other current and former members (in addition to Dave Marmorek and David Galat) of the PRRIP Independent Scientific Advisory Committee: Jennifer Hoeting, Brian Bledsoe, Ned Andrews, Adrian Farmer, John Nestler, Kent Loftin, and Robb Jacobson. I have learned so much from all of you and appreciate your support. And special thanks to Kent for helping me the wisdom of using the concept of risk as a lens through which to view AG and AM; that became a core component of my dissertation. The list of friends and colleagues in the world of AG, AM, and restoration programs that have had a profound influence on me and have helped me gain the knowledge and understanding I have today is long and I will certainly forget important people, but some that deserve to be thanked include Jim Berkley, Tom St. Clair, Steve Light, Nick Aumen, and Scott McBain.

And a final thanks to my daughters, Karson, Rowen, and Harper. You are the loves of my life and I am so thankful for you every day. I really appreciate you understanding the times when I have been locked in my basement office studying for comps or writing this dissertation. You are the best!

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CHAPTER 1

INTRODUCTION

This research presents a conceptual model restoration program evaluation framework for large-scale aquatic adaptive management (AM) programs. The evaluation framework was developed in response to: 1) personal experience with adaptive management failure in large-scale restoration programs, governance structure failure or absence in these programs, and observation of critical overlap between good governance and adaptive management success; and 2) recent literature and scholarship calling for more empirical case studies and analysis, particularly in U.S. river basins, of governance and adaptive management. These information sources suggest a fair exploration of the relationship between adaptive management and governance structure is warranted as it pertains to the implications for successful adaptive management at a large scale. It is intended that the methodology, results, and conclusions provided in this dissertation will serve as an impetus for applying the evaluation framework in other programs to further explore the relationship between governance structure and the successful application of adaptive management in large-scale restoration programs.

Problem Statement

Adaptive management has become a "plastic" phrase (Poerksen, 1995) applied as a formulaic panacea for most major species recovery and ecosystem restoration efforts now underway across the United States (Ostrom, 2007; Young et al., 2018). This refers to using the phrase adaptive management so frequently and so broadly as to render it merely a rhetorical device often misapplied for the task at hand or not actually applied at all. As a concept, adaptive management has long been intriguing for resource managers and decision-makers working in complex ecosystems and facing a high degree of uncertainty. Adaptive management emerged as an application of the scientific method to resource management, closely tying management to science learning through experimental actions (Holling, 1978; Walters, 1986). At larger scales, the phrase "learning by doing" seemed to best capture the premise behind developing an experimental management approach that could be applied on the scale of a river system or ecosystem like the Everglades (Walters and Holling, 1990). In nearly five decades of discussion and application, however, examples of successful adaptive management implementation at large scales are few and conflict remains over how to achieve the most essential elements of a true adaptive management approach (Gregory et al., 2006; Walters, 2007) – a rigorous process of learning by designing management actions as experiments. In the case of large-scale ecosystem rehabilitation and species recovery program efforts, the application of adaptive management as a guiding framework for science has had mixed success at best (Lee, 1999; Walters et al., 1992; Lee, 1993; Allan and Curtis, 2005; Zellmer and Gunderson, 2009; Murray et al., 2015).

As scholarship on and implementation of adaptive management grew, so did the field of investigating the social element of ecosystem management and restoration. Berkes (2012) and Folke et al. (2005) began to use the term "social ecological system" to identify the pairing of ecological science with social science and to delve into the relationships between humans and nature. This work hinged on the interconnectedness of humans and ecosystems, the impacts of humans on ecosystems, adaptation, and using this information to develop better approaches to management. This approach was a bridge to resilience theory and adaptive management, and to the organizing principles of human behavior and governance (Folke et al., 2005). Emerging theory on governance structures and the ability of those structures to adapt to a changing environment led to development of the terminology “adaptive governance” (Dietz et al., 2003). With adaptive governance centering on polycentric structures, self-organization, and decision making made more inclusive and less top-down, it seemed to fit the notions of adaptive management grounded in constant learning, implementing management actions and experiments, and embracing uncertainty. As has been stated, now that adaptive management in many ways “*is* natural resources policy” (Ruhl and Fischman, 2010) clear success at a large scale is hard to discern.

Emerging scholarship on governance identifies several overlapping themes between AM and adaptive governance (AG) with AG holding promise as an approach to tackling the challenges of moving large-scale adaptive management programs forward (Gunderson and Light, 2006; Chaffin et al., 2014; Cosens et al., 2014). As noted by Chaffin et al. (2014), most of the recent research on adaptive governance has been theoretical in nature, building on the early work of Elinor Ostrom with polycentric forms of governance, finding a common definition in Dietz et al. (2003), and branching off into how governance structures take on complexities like resilience and climate change (Cosens et al., 2014; Chaffin and Gunderson, 2016). Addressing these challenges points to the need to focus on governance and its role in water planning and policy (Pahl-Wostl et al., 2012a; Heikkila, 2016), but there are few “analytical frameworks” that can be applied to evaluate governance performance and point to necessary reforms (Dale et al., 2013). Similarly, assessment frameworks for AM focus on improving the steps of the

AM process but do not capture related linkages to the governance structure under which those AM processes are operated (Chaffin and Gosnell, 2015).

Research Focus and Scope

The central proposition of my dissertation is that governance of a large-scale aquatic system adaptive management program is determinative in successful implementation of adaptive management thus predicating program success. A new conceptual model evaluation framework is proposed based on a combination of scholarship and methodological application from the disciplines of risk analysis, governance analysis, and adaptive management analysis. The new evaluation framework developed in this dissertation tests my central proposition by:

1) Specifying key AG and AM components and subcomponents, based on a traditional narrative literature review, other related evaluation methods, and personal experience.
2) Utilizing case study research on two case studies (the Trinity River Restoration Program and the Platte River Recovery Implementation Program) involving multiple lines of evidence and multiple sources of data.
3) Conducting a performance assessment of 30 subcomponents of AG and AM in both base studies.
4) Conducting a risk assessment of 30 components of AG and AM in both case studies.
5) Placing the case studies in a proposed AG/AM risk typology.
6) Recommending reforms for both case study restoration program suggested by

the results of the performance assessment, risk assessment, and typology placement.

The field trial application of the conceptual model restoration program framework is described in detail in my dissertation. The analysis from this field trial application suggest the results can serve as benchmark analyses for the two case studies over time and that with refinement the conceptual model evaluation framework can be used as a tool for application by other programs (existing and proposed) as a next step from this original research.

Novel Theory

Large river restoration and adaptive management programs in the United States today have generally been operating for many years and are largely built on the thinking of engineering resilience where it is assumed humans can control the fate of species and managers in these systems have restoration options (Craig, 2017). This is often the result of how the Endangered Species Act (ESA) is applied in these programs. Craig (2017) points to the need to think about ecological resilience where intervention or management occurs before the systems cross important ecological thresholds. The adaptive cycles and panarchy of resilience theory suggest a new approach to natural resources management directives, laws, and policies is needed that is responsive to the notion of management implemented as a form of experimentation with constant monitoring, evaluation, and adjustment – the hallmarks of adaptive management (Craig, 2017) For those restoration programs that are (or claim to be) implementing adaptive management (AM), the evaluation framework described and tested in this dissertation is a unique way to assess whether AM and, by extension, resilience theory, are operational.

Baho et al. (2017) recently developed quantitative framework for assessing ecological resilience. The issues of capacity and scale identified in that framework are analogs to similar components of AM and governance that form the basis of the evaluation framework described and tested in this dissertation. Berkes (2017) identifies AM and adaptive governance as being about “ongoing processes” and their collaborative nature being necessary for dealing with resilience in social-ecological systems. The evaluation framework described and tested in this dissertation is presented as a tool to assess governance and AM in U.S. restoration programs and to serve as an indicator of the likelihood of a bridge between the engineering resilience and ecological resilience of many of these programs. Berkes (2017) says AM has “informed” adaptive governance. If the evaluation framework in this dissertation could be used to evaluate the effectiveness of collaborative learning and management in large-scale AM programs, it could be a tool to help assess the linkages between the perspectives of social-ecological systems and resilience thinking in these same programs.

There have been recent efforts to conduct resilience assessments in basins directly and indirectly discussed in this dissertation (Platte River Basin and Klamath River Basin, of which the Trinity River is the largest tributary) (Gunderson et al., 2017). These basin-wide assessments explore the origins of adaptive governance in regulated social-ecological systems. The evaluation framework in this dissertation is a unique step in this assessment process, looking specifically at how governance and AM function (or do not function) together in these basins to achieve management objectives, program goals, and restoration success. The evaluation framework is also a unique way to explore whether adaptive governance and AM work “on the ground” (Craig et al., 2017) as flexible and responsive processes in social-ecological systems.

Professional Significance

This research contributes to the fields of AG and AM in several important ways. Most substantially, this dissertation presents an evaluation framework for large-scale aquatic adaptive management programs that has been successfully field-trialed, refined, and made ready for application beyond the two evaluated programs. This tool can be replicated and applied in other programs for use by decision-makers to consider how existing or proposed AM programs could be reformed and implemented to ensure a greater likelihood of success.

Secondly, given personal observation and literature-defined failure of governance and adaptive management; the enormous amount of money spent annually in the U.S. on large-scale aquatic restoration programs; and the pervasiveness of AM in these programs being a key to success, there is an urgent need to better understand why these programs fail and how to improve them. However, despite growing scholarship on governance system analysis and measuring the success of adaptive management, there is still no obvious tool for analysis of these programs by decision-makers. This dissertation presents that tool.

Thirdly, by presenting the results of this research to decision-makers and managers in other large-scale AM programs, giving presentations at relevant national conferences, and publishing in diverse journals, the evaluation tool can be further refined and made available for expanded use beyond programs confined to the Bureau of Reclamation to programs administered by the U.S. Army Corps of Engineers or other key oversight agencies.

Finally, successful development and application of the evaluation framework through the course of this research will not only allow use in other programs but furthers the state of knowledge of governance analysis, AM, and the role of cross-disciplines like risk analysis and management. This is important for my own professional development in the fields of AG and AM implementation in these large-scale programs and for expanded future scholarship in these fields for professors and students in the Adaptive Management Specialization in the School of Natural Resources at the University of Nebraska-Lincoln.

Dissertation Overview

This dissertation is written in a non-traditional format. Chapter 2 presents an integrative narrative literature review of AG, AM, large-scale implementation, collaboration, and the interrelationships between these concepts. Chapter 3 is a stand-alone chapter for potential publication probing aspects of panarchy, resilience, AG, and AM in two case-study Bureau of Reclamation restoration programs, the Platte River Recovery Implementation Program (PRRIP) and the Trinity River Restoration Program (TRRP). Chapter 4 presents a conceptual model evaluation framework for restoration programs that forms the basis of my dissertation research. Chapter 5 presents the methodology for field trial application of the conceptual model restoration program evaluation framework in two case studies, the TRRP and the PRRIP. Chapter 6 presents the results of the field trial application in the TRRP and the PRRIP. Chapter 7 summarizes overall conclusions and implications. A potential publication of information combined from Chapters 4-7 is possible. All references are included in alphabetical order following each chapter.

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CHAPTER 2

AN INTEGRATIVE NARRATIVE LITERATURE REVIEW OF CONCEPTS RELATED TO ADAPTIVE GOVERNANCE AND ADAPTIVE MANAGEMENT IN LARGE-SCALE RESTORATION PROGRAMS

Introduction

Adaptive management has become a “plastic” phrase (Poerksen, 1995) applied as the science du jour for most major species recovery and ecosystem restoration efforts now underway across the United States. This refers to using the phrase adaptive management so frequently and so broadly as to render it merely a rhetorical device often misapplied for the task at hand or not actually applied at all. As a concept, adaptive management has long been intriguing for resource managers and decision-makers working in complex ecosystems and facing a high degree of uncertainty. Adaptive management emerged as an application of the scientific method to resource management, closely tying management to science learning through experimental actions (Holling, 1978; Walters, 1986). At larger scales, the phrase “learning by doing” seemed to best capture the premise behind developing an experimental management approach that could be applied on the scale of a river system or ecosystem like the Everglades (Walters and Holling, 1990). In nearly five decades of discussion and application, however, examples of successful adaptive management implementation at large scales are few and conflict remains over how to achieve the most essential elements of a true adaptive management approach (Gregory et al., 2006; Walters, 2007) – a rigorous process of learning by designing management actions as experiments. In the case of large-scale ecosystem rehabilitation and species recovery program efforts, the application of adaptive management as a guiding framework for science has had mixed success at best (Lee, 1999; Walters et al., 1992; Lee, 1993; Allan and Curtis, 2005; Zellmer and Gunderson, 2009; Murray et al., 2015).

As scholarship on and implementation of adaptive management grew, so did the field of investigating the social element of ecosystem management and restoration. Berkes (2012) and Folke et al. (2005) began to use the term "social ecological system" to identify the pairing of ecological science with social science and to delve into the relationships between humans and nature. This work hinged on the interconnectedness of humans and ecosystems, the impacts of humans on ecosystems, adaptation, and using this information to develop better approaches to management. This approach was a bridge to resilience theory and adaptive management, and to the organizing principles of human behavior and governance (Folke et al., 2005). Emerging theory on governance structures and the ability of those structures to adapt to a changing environment led to development of the terminology "adaptive governance" (Dietz et al., 2003). With adaptive governance centering on polycentric structures, self-organization, and decision making made more inclusive and less top-down, it seemed to fit the notions of adaptive management grounded in constant learning, implementing management actions and experiments, and embracing uncertainty. As has been stated, now that adaptive management in many ways "*is* natural resources policy" (Ruhl and Fischman, 2010) clear success at a large scale is hard to discern.

Methods

I conducted a narrative literature review to explore and better understand relevant theories, concepts, and experiences related to adaptive management (AM), restoration at a large scale, and adaptive governance (AG). I used the results of this critical review of literature in these fields to assist in my evaluation of a large previous body of work and to aid in development of my central research question and the conceptual model framework described in Chapter 4 (Grant and Booth, 2009). This more traditional review of qualitative evidence is consistent with my intent to explore relevant literature in a configurative attempt to further refine the central proposition of my dissertation research and identify areas of emphasis for evaluating AG and AM in large-scale restoration programs (Haddaway et al., 2015).

I focused the literature review on a defined set of topical areas of most interest to me in further scoping my research question and through experience working with colleagues across the U.S. and Canada on implementation of AM and AG. Reviewed literature included original and older documents through current-day publications as the body of scholarly work on AM and AG continues to grow. I organized the logical structure (Pautasso, 2013) of my review according the following conceptual themes:

- AM origin and definitions
- AM and restoration at a large scale
- Challenges to AM implementation and success
- AG and AM
- Collaboration in AG and AM

Multiple collections of scholarly and practical work on AM and AG were used to build a database of articles, books, official restoration program documents, grey literature, and other sources of information for my narrative review: Google Scholar searches with the terms “adaptive management,” “adaptive governance,” and “large scale restoration”; seminal works of literature recommended by my doctoral committee during my program of study; references from my doctoral program coursework in AM, ecology, resilience, and water policy and management; references recommended by colleagues in AM and large-scale restoration; extensive documents and literature from the Platte River Recovery Implementation Program (PRRIP), Trinity River Restoration Program (TRRP), and multiple other restoration programs around the country; government literature sources on restoration program budgets and technical guidance on AM in federal programs; literature compilations from AM experts and panel discussions; documents from members of the PRRIP Independent Scientific Advisory Panel; AM literature compiled from personal work with AM in large-scale programs across the country including the PRRIP, TRRP, Middle Rio Grande Endangered Species Collaborative Program (MRGESCP), the Comprehensive Everglades Restoration Program (CERP), the Missouri River Recovery Program (MRRP), and restoration programs in the Gulf of Mexico and coastal Louisiana; and a general compilation of additional AM and AG literature acquired through two decades of my own work in large-scale restoration programs.

I collected 491 references during the course of my narrative literature review. This includes 470 literature references from refereed journals, restoration program documents, and gray literature and 21 published books on the topics of AG, AM, panarchy, and resilience. Nearly all of these documents are in my possession as both printed and downloaded PDF files, with some articles, program documents, and books remaining in hard copy only. The electronic documents are stored both in a large, comprehensive Google Drive folder and then further broken down in folders of several topical areas. I reviewed each document for themes of interest related to AG, AM, panarchy, and resilience; made notations to highlight key points in printed copies of literature; kept electronic notes by topical area; and used this review process to narrow the set of literature into the most informative and explanatory set of documents based on the areas of interest identified above.

Results

I filtered my set of 491 references into a categorical set of 153 of the most relevant literature in the four topical areas of AM (87 references), AG (47 references), panarchy (4 references), and resilience (15 references). I used this more focused set of literature to summarize key points of interest and suggest direction for exploration with my dissertation research. The results of this narrative review are provided below, organized according to the logical structure of conceptual themes related to the central proposition of my dissertation and potential areas of emphasis in evaluating AG and AM in large-scale restoration programs.

AM Origin and Definitions

The origin of adaptive management dates back to early discussions of what can be termed adaptive decision making related to fisheries (Beverton and Holt, 1957; Williams, 2011; Allen et al., 2013). Their research focused on North Sea demersal fisheries like cod and sole populations influenced by complex interactions of the ocean, climate, and fishing (Beverton and Holt, 1957). Decision making for fish populations of this size does not occur at the small scale of a single fisheries resource agency but rather at a large scale between fishing fleets and multi-national governments. The ideas of uncertainty, flexibility, monitoring, and collaboration are the roots of adaptive management and these components are wrapped up in decision making at a large scale in fisheries management, possibly at the scale of a "global panarchy" (Jacques, 2015).

The formal construction of adaptive management in name and in application followed in the 1970s from the work of C.S. Holling (Williams, 2011; Allen et al., 2013). Holling's development of adaptive management stemmed from decision making in a wide variety of fields including business, medicine, and systems theory (Allen et al., 2013). It also came from Holling's background in resilience theory that recognized different stable states of ecosystems and led to research on "large scale ecosystems" and deep thinking about management of "ecological systems" (Holling, 1978; Allen et al., 2013). Holling looked to management for resilience as a "way to view events in a regional rather than a local context" (Holling, 1973). More recent scholarship on resilience promotes the notion of understanding an entire system (Folke, 2005) and using adaptive management to enhance the operational pieces of resilience within an ecosystem (Allen et al., 2011a).

Carl Walters followed early steps of adaptive management and continued to build on management and decision making related to fisheries, particularly Pacific salmon fisheries inhabiting both freshwater and saltwater systems (Walters, 1986). Early in broadening the underpinnings of adaptive management, Walters identified three ways to structure management in a way considered adaptive. The first was trial and error, meaning implementation of management activities without deliberate experimentation and simply changing in response to information as it comes along. Secondly, passive adaptive management, where retrospective analyses of historic data are used to develop and then implement a selected management alternative. Passive adaptive management is cautious, focused on a single approach to management chosen as the "best" or "preferred" alternative (Marmorek et al., 2010). The management approach, often negotiated and in place before management actions begin, is heterogeneous and paired with strategic monitoring that, once evaluated, should theoretically help lead to adjustments in future management (Hansen et al., 2015). The final way Walters structured management was active adaptive management, which in full form favors implementing a range of management alternatives as deliberate experiments to reduce uncertainty and inform future management (Walters, 1986; Walters and Holling; 1990). Active adaptive management incorporates "probing" of the system, providing a more direct link to distinguishing between competing hypotheses (Marmorek et al., 2010). From a pure learning standpoint, active adaptive management holds the most promise to collect and evaluate information quickly and to test a wider array of hypotheses.

Lee (1993) built on the work of Holling and Walters by contemplating the potential of adaptive management as a useful tool at a large scale in the Columbia River Basin in the Pacific Northwest. Lee called adaptive management the "compass" for its role in valuing uncertainty, exploring learning through implementation, and rolling this learning up into decision making and into changing policy to lead toward a "sustainable future" (Lee, 1993). His "gyroscope" was conflict bounded by politics and reality to force discipline into the process of evaluating management alternatives and making management choices (Lee, 1993). Lee saw this fusion of science and policy as "social learning" and concluded large ecosystems were the most in need of improved social learning. His idea that large ecosystems were "socially constructed" because of multiple uses, multiple boundaries, and complex social dynamics pointed to a need for adaptive management and a governance regime that could promote learning (Lee, 1993). In total, the foundations of adaptive management built through the works of Holling, Walters, and Lee clearly lie in tackling management problems that are 'large scale' in terms of geography (Lee, 1999), but also in terms of levels of decision making and importance.

In operational terms, the framework that generally describes the technical process of adaptive management is considered a six-step cycle: (1) problem assessment; (2) designing management experiments; (3) implementation; (4) monitoring; (5) evaluation; and (6) adjustment of management decisions (Murray et al., 2011; Williams et al., 2009; Nyberg, 1998). Figure 2.1 represents this cycle which is generally considered to be iterative and may need to be repeated more than once to continue to reduce uncertainty and answer related questions important to management decision making. The adaptive management cycle has been extended to more than six steps when fused with existing agency planning processes such as those developed by the U.S. Army Corps of Engineers (RECOVER, 2010) or as a total of ten steps when combined with the more formal process of structured decision making (Allen at al., 2011b).

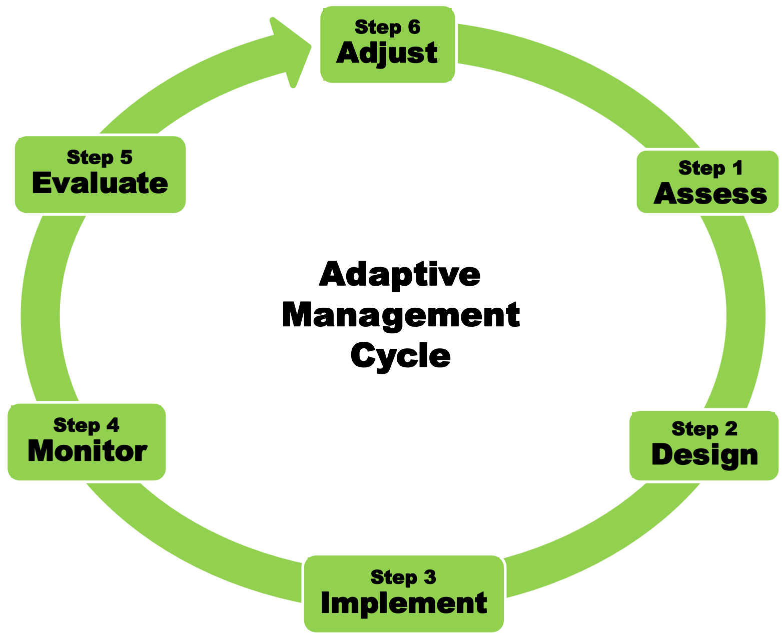
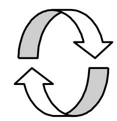
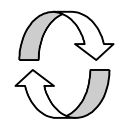


Figure 2.1. Adaptive management cycle (reproduced from Murray et al., 2011).

Table 2.1 outlines detailed elements within each of the typical six steps of adaptive management. The rigor of this process comes in the form of stating goals and objectives at the outset, clearly identifying uncertainties and questions to be explored, and learning through management experiments linked to monitoring results and associated data analyses. The detailed elements in Table 2.1, when fully implemented, represent a systematic process of active adaptive management.

Table 2.1. Ideal elements of active adaptive management (reproduced from Murray et al., 2011).

AM Steps	Ideal Elements within each Step
Step 1. Assess and define the problem	a. Clearly state management goals and objectives b. Review existing information to identify critical uncertainties and management questions c. Build conceptual models d. Articulate hypotheses to be tested e. Explore alternative management actions (experimental 'treatments') f. Identify measurable indicators g. Identify spatial and temporal bounds h. Explicitly state assumptions i. State up front how what is learned will be used j. Involve stakeholders, scientists, and managers 
Step 2. Design management actions and monitoring	a. Use active AM b. When and where possible, include contrasts, replications, controls c. Obtain statistical advice, building on analyses of existing data d. Predict expected outcomes and level of risk involved e. Consider next steps under alternative outcomes f. Develop a data management plan g. Develop a monitoring plan h. Develop a formal AM plan for all the remaining steps i. Peer-review (internal, external) the design j. Obtain multi-year budget commitments k. Involve stakeholders 
Step 3. Implement management actions	a. Implement contrasting treatments b. Implement as designed (or document unavoidable changes) c. Monitor the implementation
Step 4. Monitor	a. Implement the Monitoring Plan as it was designed b. Undertake baseline ('before') monitoring c. Undertake effectiveness and validation monitoring
Step 5. Evaluate results	a. Compare monitoring results against objectives b. Compare monitoring results against assumptions, critical uncertainties, and hypotheses c. Compare actual results against model predictions d. Receive statistical or analysis advice e. Have data analysis keep up with data generation from monitoring activities
Step 6. Adjust hypotheses, conceptual models, & management	a. Meaningful learning occurred, and was documented b. Communicate this to decision makers and others c. Actions or instruments changed based on what was learned

Any quick perusal of literature related to adaptive management yields a bounty of definitions and explanations. Readers can find definitions focusing on a variety of aspects of adaptive management, including, as Williams (2011) notes, “experimentation, uncertainty, science, complexity, management adjustments, monitoring, and stakeholder involvement”. Learning is always at the heart of these definitions, though the learning involved is not intended to be trial and error, but hopefully learning through purposeful design, implementation, and evaluation. Adaptive management and related concepts such as structured decision-making have recently become integral to several large-scale restoration programs and smaller-scale management activities led by federal agencies housed in the United States Department of the Interior. An adaptive management Technical Guide (Williams et al., 2009) provides an “operational definition” of adaptive management, and an associated Applications Guide (Williams and Brown, 2012) provides guidance on when and how to utilize adaptive management. In both cases, the definition of adaptive management used by the Department of Interior originates from a National Research Council (2004) report on adaptive management, which states:

> “Adaptive management [is a decision process that] promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process.”

Exploring the definition of adaptive management also leads to an assessment of “true” versus “pretend” adaptive management (Marmorek et al., 2010). True adaptive management harkens back to the origins of adaptive management and focuses on a systematic, rigorous process of learning through multiple hypotheses, multiple alternatives, and ultimately learning through the application of management actions as experiments – the classic “learning by doing” approach. This has also been described as adaptive management “stout” (Galat, 2011).

The alternative is “pretend” adaptive management or adaptive management “lite”, where little effort is made to learn through experimentation, to link science to decision-making, or to focus implementation on measurable, achievable objectives (Marmorek, 2010; Allen et al., 2011b; Galat, 2011; Ruhl and Fischman, 2010). Ruhl and Fischman (2010) describe adaptive management lite as little more than “ad hoc contingency planning”. In many cases, this is the classic case of building a “science pile” – conducting monitoring and research and amassing large amounts of data but failing to ever use the data to tell a story about what is being learned and communicating learning to decision makers in a helpful or useful way. This lack of rigor focuses on information gathering in the “nice to know” category as opposed to staying squarely in the true adaptive management realm of “need to know.”

A recent, more formal treatment of adaptive management identified two main “schools of thought” – Resilience-Experimentalist and Decision-Theoretic (McFadden et al., 2011). The Decision-Theoretic school is largely built on the principles of structured decision making where decision theory and related tools are utilized to develop specific management objectives and then build simple ecological process models to quantitatively evaluate the potential outcomes and tradeoffs of management alternatives. This approach is gaining favor within the U.S. Department of Interior and has been applied and termed “adaptive management” in examples like the North American Waterfowl Management Plan and specific wildlife management cases like horseshoe crabs in Delaware Bay (McFadden et al., 2011).

The alternative Resilience-Experimentalist school is focused on shared understanding, more complex ecological models, and active learning about the ecosystem and about ecosystem resilience (McFadden et al., 2011). McFadden et al. (2011) cite adaptive management examples such as the Everglades and the Glen Canyon Dam Adaptive Management Program as falling into the Resilience-Experimentalist school. These examples are indicative of large-scale approaches and thinking of the Resilience-Experimentalist school, which likely originates from the ecological and social complexity of these systems. The Resilience-Experimentalist approach is more in line with the origins of adaptive management from Holling, Walters, and Lee and has clearer linkages to collaboration and adaptive governance.

AM and Restoration at a Large Scale

Trends in ecological science mirror the systems-based theory of adaptive management. The whole-ecosystem approach dates to the foundations of ecology as a scientific discipline. Some of the very earliest scholars from which the science of ecology emerged focused on taking a large-scale approach, with Forbes (1887) writing of "the necessity for taking a comprehensive survey of the whole as a condition to a satisfactory understanding of any part". As an emerging field in the 1980s, conservation biology unified many fields including ecology, genetics, economics, sociology, and others to better understand "natural ecological systems" and respond to growing pressures on ecosystems and their diversity (Meffe and Carroll, 1994). Ecosystem management was defined in the mid-1990s as a field that "integrates scientific knowledge of ecological relationships within a complex sociopolitical and value framework toward the general goal of protecting native ecosystem integrity over the long-term" (Grumbine, 1994). At that time, Grumbine (1994) saw adaptive management as one of many "themes" of ecosystem management.

By 1995, researchers could identify and evaluate over 600 ecosystem management projects across the United States, most of which crossed geographic and political boundaries (Yaffee et al., 1995). In promoting whole-ecosystem experiments, Schindler (1998) argued experimenting at small scales can yield "erroneous conclusions," and emphasized the need to work at large scales. Much of the writing and evaluation of ecosystem management pointed to the dynamic and adaptive capacities of ecosystems as "essential constants" (Levin, 1999), thus providing a bridge between adaptive management and the large scale and resilience of ecosystems. Federal agencies like the U.S. Forest Service began to orient their management practices and policies toward the larger scales of ecosystem management (Thomas, 1994; Salwasser, 1999) and linked an ecosystem approach with adaptive management (Clark, 1999). Large scale management at the ecosystem level had generally become "a coordinating habitat conservation policy" for most federal agencies (Ruhl, 2004). As opposed to just a theme of ecosystem management, at least at the federal level adaptive management became the "methodological sibling" of ecosystem management (Ruhl, 2008). Now, adaptive management is cited as an approach to ecosystem management (Keith et al., 2011). Discussions about environmental policy and management tend to focus on developing alternative strategies that can respond to ecosystem dynamics, but to develop those strategies in the context of learning and being able to "operate in a realm where uncertainties dominate" (Schindler and Hilborn, 2015).

Application of adaptive management at small scales like forest harvest has certainly been tried (Gregory et al., 2006). In terms of river restoration projects, most of the over 37,000 projects identified in the National River Restoration Science Synthesis database were implemented on less than one kilometer length of stream (Bernhardt et al., 2005). However, as awareness of environmental degradation has increased along with knowledge of ecosystem form and function, the notion of tackling multiple problems simultaneously at an ecosystem level has become the norm in terms of scientific restoration advice to policy makers (Doyle and Drew, 2008). Greater understanding of the workings of systems like rivers (Poff et al., 1997) has pushed programs to build management approaches around larger actions like flow releases from large dams that have complex effects over large distances and over long time periods downstream (Wohl et al., 2015). The National Research Council concluded adaptive management is key for river restoration particularly in large systems experiencing “ecological decline and policy paralysis” (National Research Council, 2002).

The ideas of ecosystem restoration and adaptive management are often joined at the hip, and today the highest profile examples all point to large scales in geography and complexity. For example, the Platte River (Smith, 2011), Everglades (Gunderson et al., 1995), Kissimmee River (Whalen et al., 2002), Glen Canyon (Susskind et al., 2010), Columbia River (Lee, 1993), CALFED (Kallis et al., 2009), and waterfowl harvest management (Johnson et al., 2014) are all large-scale projects. No fewer than 14 major ecosystem restoration initiatives now underway in the United States claim adaptive management as their guiding scientific framework (Congressional Research Service, 2011). These initiatives span a range from the Chesapeake Bay, to the Missouri River, and to the Louisiana Gulf Coast. The geographic scale of these efforts is enormous – consider the 2,400-mile Missouri River spanning seven states. Coupled with costs in the billions of dollars and the unfolding of events over several decades, these initiatives are on the leading edge of defining a restoration program as large-scale. Evaluations of large river restoration programs and projects routinely point to the use of adaptive management as the "optimal strategy" (DeBruyne and Roseman, 2015).

In most cases, the largest of these initiatives are controlled by the United States Army Corps of Engineers (Corps). As a leading water management agency, the Corps finds itself at the center of many large-scale programs where adaptive management is being attempted. For example, in the Everglades, the Corps is the lead agency working with the South Florida Water Management District as its major partner in implementing the Comprehensive Everglades Restoration Plan (CERP). In 2010, the Corps and the South Florida Water Management District jointly released an Adaptive Management Integration Guide intended to describe how to apply adaptive management in the Everglades (LoSchiavo et al. 2013; RECOVER, 2010). While not yet adopted in its most rigorous form, adaptive management is emphasized in policy and in field for restoration actions on the Upper Mississippi River (Theiling et al., 2015).

Given many ecosystems where the Corps is the lead federal agency are ultimately governed by Congressional directorate, authorized purposes such as navigation, flood control, and power production must be intertwined with restoration goals and tend to establish a framework where typical command and control management is the easy first choice for a governance structure. Command and control management has long been noted as an approach leading to short-term gains but invariably results in unintended consequences and an inability to respond to surprises or change (Holling and Meffe, 1996). Holling and Meffe (1996) term command and control a "pathology" and counter it with a logical move toward ecosystem management. If successful implementation of true adaptive management is the goal and true adaptive management requires a rigorous process of learning through experimentation and management action changes due to this learning, there is seemingly inherent conflict between adaptive management and the more rigid controlled governance structure in these large restoration programs led by the Corps of Engineers. Some recent efforts by the Corps to attempt adaptive management involve structured decision making in a more Decision Theoretic approach (Gemeinhardt et al., 2015), while other efforts involving Corps attempts to deviate from its typical management structure and expand into more flexible governance models are still works in progress. One example is the advisory body for the Corps' Missouri River Recovery Program, the Missouri River Recovery Implementation Committee.

At the same time, another large federal agency involved in major water management in the western United States has also become a primary purveyor of adaptive management on a large scale. In 2011, the Bureau of Reclamation (Reclamation) convened a conference at the University of New Mexico to discuss 16 Reclamation river restoration programs in the western United States (Bureau of Reclamation, 2011). Some of these clearly fit with the large scale programs. For example, the San Joaquin River Restoration Program in California is considered one of the largest river restoration projects in the country, focusing on flow and habitat management actions along a 153-mile stretch of river to the tune of roughly $900 million by the year 2026. While not all the Reclamation programs are as ambitious, they are considered large-scale and there are two common themes among most of them: the use of adaptive management and the presence of several unique governance structures.

Challenges to AM Implementation and Success

Large-scale systems are challenging in and of themselves, particularly when related to rivers and aquatic systems. It is often hard to get usual experimental tenets of alternative hypotheses, documentation of initial conditions, sufficient observations, and randomized assignment of replicated treatments and controls (Konrad et al., 2011). Large-scale flow experiments are seen today as not being separate from their social context as experiments and responses span many time scales, rivers are heavily influenced by factors such as valley confinement and tributary inputs, and you should evaluate diverse species' response (Konrad et al., 2011). The result thus far has primarily been that attempts at large flow events implemented as management experiments have only led to the testing of a small set of discrete events (Olden et al., 2014). Large-scale management is filled with examples of the inability to deal with uncertainty gridlock and inertia that tend to keep current management practices in place even in the face of failure (Gunderson et al., 2002).

Challenges to implementing adaptive management on a large scale are numerous and several authors have evaluated the roots of those challenges. In an initial assessment of adaptive management case studies, Walters (1997) wrote of many reasons leading to a lack of successful examples of adaptive management including: an inability to build, validate, and use predictive models; high costs of monitoring and the costs, real or perceived, of implementing management experiments like flow manipulations; length of time for species to respond and the response be detected; self-interest and lack of leadership among scientists and agencies; political inaction; and conflicting ecological values. Ten years later, Walters (2007) revisited the issue and concluded adaptive management had been “radically less successful” than anticipated. In response, Walters narrowed his list of key challenges to not understanding the need for management experiments, inadequate funding of the monitoring needed to collect the right data, and an overall lack of leadership in helping guide programs through the process of implementation.

Scales of time and space, the magnitude of uncertainty, and clearly identifying the problem at hand all bound the potential effectiveness of adaptive management as a framework for applying science (Gregory et al., 2006). Policies favoring reactive management, shifting objectives, and the lack of solid success stories at a large scale further inhibit the successful implementation of adaptive management (Allen et al., 2011b). The notion of implementing actions as experiments is often viewed in a negative manner by policy-makers and the public as managers fear unanticipated outcomes and a loss of control (Chapin III et al., 2009). Additionally, it is difficult to build the common experimental design aspects of randomness, control, and replication into management actions on singular linear systems such as rivers. Allen and Gunderson (2011) built on this list of “pathologies” related to active adaptive management by noting: a lack of a robust process of engaging stakeholders; not being flexible enough to address surprises; focusing on planning and following known prescriptive processes instead of focusing on action; decision makers being too risk averse; and a failure to transmit learning in a useful way to decision makers and the decision-making process. Thus, in many major aquatic ecosystem restoration and species recovery programs across the United States, adaptive management is likely, at best, applied in a passive approach where, if developed and negotiated properly, one or a small number of agreed-upon management actions can be implemented and the adaptive management process can work through the learning of those bounded actions.

Adaptive management remains widely cited as the management approach of choice and is routinely cited throughout the formative documents of most large river recovery and ecosystem restoration programs in the United States. Adaptive management is so pervasive now in national environmental policy documents that Ruhl and Fischman (2010) refer to it as the "tonic of natural resources policy". Yet, there remain few examples at large scales of successful adaptive management implementation. Ruhl (2008) claims adaptive management is "inevitable *and* impossible". This disconnect is curious, given adaptive management grew out of complex system thinking and was formed as a concept to assist managers with making decisions in the face of uncertainty at large scales of geography and time. There is a growing body of scholarly work on the concept of social-ecological systems and how governance of these systems should account for dynamics that traditional environmental governance structures are not capable of handling (Garmestani and Allen, 2014). This dissertation research aims to probe that governance structure-adaptive management relationship.

AG and AM

When Lee (1999) concluded adaptive management has thus far been more successful as an idea rather than an actual approach to management, he also made the following important observation:

> Efficient, effective social learning, of the kind facilitated by adaptive management, is likely to be of strategic importance in governing ecosystems as humanity searches for a sustainable economy.

This linking of adaptive management, social learning, and governance traces back early in the thinking about and implementation of adaptive management. Holling and Chambers (1973) wrote about gaps between disciplines and the need to smooth information flow as knowledge is gained about large-scale ecological problems to help develop policy, test hypotheses, and implement management actions. Walters (1986) noted management policies should be "actively adaptive, probing, and deliberately experimental" but in addition to these principles adaptive management is about management being done "*by* people". He notes his book "Adaptive Management of Renewable Resources", considered one of the pillars of adaptive management, was written with a "preoccupation with communication" presumably to make the concept of adaptive management more amenable to a broader array of managers and decision-makers. Gunderson et al. (1995) discuss institutions that must have the flexibility to learn and can adjust policy and management based on learning.

These are all allusions to the idea adaptive management fits within a policy-making realm requiring an embrace of complexity, flexibility, and the need to act in the face of uncertainty. Over the last three decades, much of the change in water policy and water governance focused on decentralization and an increase in a participatory approach (Pahl-Wostl and Knieper, 2014). This change built on work dating back to the 1950s by Elinor and Vincent Ostrom and others to describe polycentric governance, first in terms of municipalities and then in terms of common pool natural resources (Ostrom et al., 1961; Ostrom, 2010; Pahl-Wostl and Knieper, 2014). Polycentric governance structures rely on coordination, self-organization, many centers of decision-making, and an ability to respond to new information and new challenges (Pahl-Wostl, 2009; Pahl-Wostl and Knieper, 2014). Karkkainen (2004) referred to these as “polyarchic” structures being developed in an age of “post-sovereign environmental governance”.

While adaptive management was developed in response to a changing reality in resource management, adaptive governance grew out of need to utilize nimbler and inclusive governing structures to handle more complex problems. Folke et al. (2005) wrote about the social dimension of adaptive management and the emerging governance structures that were looser and emerged spontaneously when traditional government structures proved too rigid to be responsive. This “new governance” is a form of democratic social coordination where decision making is shared, structures are self-organizing, and the actors in the process self-enforce rules and progress (Lee, 2003).

Dietz et al. (2003) were early adopters of the phrase adaptive governance in describing the application of new governance structure to natural resource problems. Even at this early stage, adaptive governance and adaptive management became in many ways interchangeable terms because of the recognition of the difficulty of dealing with diverse groups of people involved in large-scale environmental problems, the high degree of uncertainty about which actions to take and what responses might be predicted, and the fundamental notion that there needs to be an equal understanding of the ecological system and its related human-environment interactions (Dietz, 2003). In other words, applying adaptive management was deemed equivalent to adaptively governing social-ecological systems (Chaffin et al., 2014).

Folke et al. (2005) identified four key principles of adaptive governance: (1) knowledge of the ecosystem; (2) adaptive management; (3) flexible and multilevel governance; and (4) an ability to confront uncertainty and surprise. These principles reveal an obvious nexus between adaptive governance and adaptive management as a widening platform for ecosystem management and probing uncertainty promotes new and more flexible governance regimes that can respond to surprise and better serve multilevel social networks (Hughes et al., 2007). If ecosystems are multilevel and transition between configurations is explained by resilience theory, then governance structures need to match that complexity (Berkes, 2012).

Gunderson and Light (2006) summarize the work of Brunner et al. (2005) to describe adaptive governance as "operating in a situation where the science is contextual, knowledge is incomplete, multiple ways of knowing and understanding are present, policy is implemented to deal with modest steps and unintended consequences, and decision making is both top-down and bottom-up". This is the science and policy nexus at which adaptive management operates but adapting governance structures to operate at this nexus can be difficult. Olsson et al. (2006) describe it as "shooting the rapids", meaning working through the rough waters of building networks, negotiating goals and objectives, and creating the kind of polycentric institutions that allow for experimentation and adjustment in the face of knowledge. The challenges of developing leadership, communication pathways, and social networks in often adversarial conditions make adaptive governance difficult to create and requires "social will" (Chaffin et al., 2014; Allen et al., 2013).

The importance of governance structure and the need to develop more dynamic control mechanisms are often noted as potential keys to enabling more successful adaptive management, particularly at large scales. Hilborn (1992) in discussing adaptive management and fisheries decision making concluded an “institution must realistically assess if it can change its behavior once it has learned”. The idea of enabling a learning organization to foster successful adaptive management has been confirmed in subsequent reviews of adaptive management trials (Greig et al., 2013). Allan and Curtis (2005) note the “poor fit” between adaptive management and the frameworks currently employed to manage natural resources. In assessing progress, or lack thereof, in the Everglades, Gunderson and Light (2006) postulated transitioning to adaptive governance would move that large adaptive management program out of a perennial planning loop into experimentation and greater responsiveness to new information. Critics of adaptive management as it has been implemented on the Colorado River below Glen Canyon Dam point to a need to build institutional capacity and an organizational infrastructure more suited to problem-solving (Susskind et al., 2010). The same authors point to a failure in the “initial design of the collaborative process” in the Glen Canyon’s Adaptive Management Plan as a key reason why adaptive management has not lived up to its potential (Susskind et al., 2012). The 1964 treaty serving as the governing mechanism on the Columbia River is cited as one reason why early attempts at adaptive management failed, and re-imagining governance on the Columbia is likely necessary to make adaptive management work in the future (Cosens and Williams, 2012).

Carpenter and Folke (2006) provide the strongest statement regarding the link between adaptive management and adaptive governance – “Its [adaptive management] success or failure appears to depend on the institutional and political processes that govern the project". But, while the general trend in the United States is to match a large-scale ecosystem approach with more collaborative, shared governance (Gerlak, 2008) there remain gaps between more traditional, rigid legal and policy frameworks and the growing understanding of ecological resilience, the frequency of change, and the need to respond to surprise (Cosens et al., 2014). Collaboration and its associated partnerships and coordination are often promoted as a requirement to increased complexity in natural resources management (Margerum and Robinson, 2015).

Collaboration and AM

Adaptive governance and its breaks from natural resource management norms clearly holds potential as an enabler of successful adaptive management at a large scale. A common addition to this line of thinking is collaboration. Collaboration is common in natural resources today because contentious issues involving water or endangered species tend to cross political and social, not just geographic, boundaries (Heikkila and Gerlak, 2014). Like adaptive management and adaptive governance sometimes being used interchangeably, so too are collaborative governance and adaptive governance, or at least the terms are used together. Numerous recent articles related to adaptive management and adaptive governance bring collaboration to the table as an important feature. Gerlak and Heikkila (2006) examined four "large-scale collaborative resource governance institutions" (Chesapeake Bay, Columbia River, Everglades, and CALFED Bay-Delta) to assess levels of collaboration and how it impacts decision making. Gerlak (2008) also evaluated "collaborative institutional arrangements" and how they engage participants in adaptive management. Susskind et al. (2010) referred to the implementation of adaptive management related to operation of Glen Canyon Dam as "collaborative adaptive management" or CAM. Scarlett (2013) noted linking adaptive management and collaboration is one important tool to help address conflicts inherent in many large-scale systems. Williams and Brown (2014) linked adaptive management and collaborative, objective-driven decision making with "better management".

Armitage et al. (2007) noted the "logical development" of adaptive co-management from the user participation theme of collaboration or co-management and the "learning by doing" theme of adaptive management. Olsson et al. (2004) saw adaptive co-management as a unifying term and approach combining the learning of adaptive management, the connections of collaborative management, and serving to "operationalize" adaptive governance as described by Dietz et al (2003). Armitage et al. (2009) argued the need for merging co-management and adaptive management as the best way to describe the kind of collaborative process necessary to operate within social-ecological systems. In all cases, the emphasis was on collaboration and the ability to revise not only ecological knowledge but also institutional structures (Olsson et al., 2004). Adaptive co-management was seen as being the mechanism to best link scientists, managers, and stakeholders to facilitate collaborative learning and decision making.

Collaborative adaptive management, as a term, may seem redundant given the previous discussion of the development of adaptive management and adaptive governance. Galat and Berkley (2014) note the use of the term collaborative adaptive management by Susskind et al. (2012) is in the same context as the use of term adaptive co-management by Olsson et al. (2004) and Armitage et al. (2007). Other authors use the terms adaptive co-management and collaborative adaptive management interchangeably

(Monroe et al., 2013). As another way to link scientific learning to stakeholder values in a social-ecological system, collaborative adaptive management fits squarely in the Resilience-Experimentalist paradigm of adaptive management (Galat and Berkley, 2014). The Collaborative Adaptive Management Network (CAMNet) is a loosely-organized group of adaptive management practitioners that define collaborative adaptive management as an approach that "incorporates and links knowledge and credible science with the experience and values of stakeholders and managers for more effective management decision-making" (CAMNet, 2015). Many of these individuals work in systems where the science of adaptive management interfaces with multiple stakeholders and unique decision making structures. As such, they tend to act as "honest brokers" when it comes to delivering scientific and technical information in a way useful to decision makers (Huitema et al., 2009; Pielke, 2007). The work of CAMNet members, and many others in the field of adaptive management, occurs largely in the realm of "collaborative, adaptive governance" (Kallis et al., 2009) where experimentation, learning, and adjustment are expected and rewarded. In this sense, collaboration and adaptive governance do function as one and are integral to the implementation of true adaptive management. There are clearly links between adaptive co-management and adaptive management, though the terms and the applications are distinct. The focus of my dissertation research is the intersection between AG and AM.

Conclusion

A review of the extensive body of literature on AM reveals the concept grew out of fisheries management and a need to address ever-more complex challenges at a large system scale. AM as a concept and approach was purposefully built to tackle the “wicked problems” inherent in ecosystems that are inherently complex and that do not necessarily reveal the scale-dependent consequences of management interventions (DeFries and Nagendra, 2017). In parallel, AG grew out of a need to address more complex problems in the context of social-ecological systems (SESs). AG and AM were linked from the beginning, with several scholars suggesting AG being the structural framework required to promote successful implementation of AM. Collaboration is also a unifying theme between AG and AM, including themes of polycentrism and shared decision-making. In writing about the Glen Canyon Adaptive Management Program, the authors of Melis et al. (2015), including Carl Walters, one of the grandfathers of AM, make the following statement:

> “…we believe it is important for scientists involved in adaptive management programs to recognize that these projects are not inherently science endeavors, but are often quite complex societal collaborations…”

AM is widely cited and applied in numerous contexts in North American natural resources management, with multiple nuanced definitions of AM cited based on the context of each management situation. This is particularly true for the largest of restoration programs on river system and other ecosystems across the country. However, a review of literature reveals few reported examples of AM being successfully implemented in these programs. Why? This literature review revealed the scholarly linkages between AG and AM, the practical implications of AG and AM implementation, and the need to better understand this intersecting relationship.

My literature review was not conducted as a more formal systematic review which is typically undertaken as a more formal and methodological means to synthesize published literature for the purposes of drawing evidence-based conclusions (Haddaway et al., 2020; Grant and Booth, 2009). Systematic reviews originated from the social science and healthcare fields and continue to be applied across disciplines where a more rigorous methodology less susceptible to bias is necessary to inform policy-relevant questions (Haddaway et al., 2020). More traditional literature reviews, as I conducted, are less formal and more prone to bias in the selection and application of literature (Haddaway et al., 2020). For the purposes of my dissertation, a more traditional integrative critical review of a wide breadth of relevant literature was more applicable to critically evaluating existing literature and theory, identifying key terms and themes, and further refining areas of investigation (Grant and Booth, 2009). I was attempting to learn more about most critical aspects of the current knowledge of the topics as defined by my research objective and did not intend to synthesize information for policy-relevant questions or to provide evidence for decision-making (Haddaway et al., 2020). A systematic review would have resulted in a more formal database of publications and involved coding, statistical analysis, and possibly a peer review of both the methodology and results. However, a more traditional narrative review was a useful tool for my purpose of appraising current knowledge and suggesting a rationale for further dissertation research (Ferrari, 2015).

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CHAPTER 3:

PROBING PANARCHY, RESILIENCE, ADAPTIVE GOVERNANCE, AND ADAPTIVE MANAGEMENT IN CASE STUDY PROGRAMS FROM THE BUREAU OF RECLAMATION

Introduction

Chapter 2 summarizes scholarship on and the relationship between AG and AM. But panarchy and resilience are also concepts that are intertwined with AG and AM and have the potential to reveal insight into how restoration programs came to be, the challenges they face, and additional insight into why components of AG and AM are or are not working. Instead of a traditional literature review, this chapter presents a review of key concepts in panarchy and resilience theory by using the Platte River Recovery Implementation Program (PRRIP) as an example. I conduct a panarchy assessment of the PRRIP followed by evaluating ecological resilience through the lens of a specific Platte River example. Both are followed by an initial review of key components of AG and AM in both the PRRIP and the Trinity River Restoration Program (TRRP). This initial review sets the stage for using the PRRIP and the TRRP as case studies for field trial application of my conceptual model restoration program evaluation framework described in detail in Chapter 4.

Rationale for Review of Bureau of Reclamation Restoration Programs

The PRRIP and TRRP are both restoration programs that find their home in the Bureau of Reclamation, part of the U.S. Department of the Interior. Most large-scale

Bureau of Reclamation restoration programs, and most restoration programs across the country, are implemented as a management tool to improve conditions for endangered species, and most of the ecosystems where these programs originate are aquatic. The negative effects of activities like flow regulation, overgrazing, and urbanization have all been part of altering hydrology and increasing restoration activity particularly in the West (Shah et al., 2007). The Endangered Species Act serves as the "primary driver" of many restoration efforts (Benson, 2012). Therefore, AM is often implemented in these large-scale restoration programs to reduce uncertainty regarding the response of one to a handful of species to specific management actions often constrained by specific recovery plans and Biological Opinions from the United States Fish and Wildlife Service or National Marine Fisheries Service. For example, the federal listing of at least 11 native Southwest species and increased interest in ecosystem management let to the development of an initial set of five large-scale adaptive management programs within Reclamation on the Glen Canyon Dam, Lower Colorado River, Middle Rio Grande, San Juan River, and Upper Colorado River (Shah et al., 2007).

Many of the major and most recent endangered species-related water controversies like the Klamath Basin involve Reclamation water projects (Chaffin et al., 2016), but the agency is also employing unique tools like Recovery Implementation Programs (RIPs) to cooperate and collaborate with stakeholders and work through difficult water management challenges (Benson, 2013). These RIPs grew out of contentious water management issues on rivers like the Platte, Upper Colorado, and most recently the Middle Rio Grande. RIPs generally place stakeholders at the decision-making table in some form and rely on AM "principles" to assist with decision making

(Benson, 2013). These RIPs currently relate to water use and management in western United States. The RIPs are complemented by other governance structures and adaptive management approaches like the Glen Canyon Dam Adaptive Management Program on the Colorado River which has been deemed “an experiment in adaptive governance” (Zellmer and Gunderson, 2009). Table 3.1 provides a sample of AG and AM data I recently compiled on several of the Bureau of Reclamation programs for use in comparing and contrasting various attributes between the programs.

Table 3.1. Sample attribute table from review of several Bureau of Reclamation restoration programs, Chad Smith (2020).

Attribute	Trinity River Restoration Program (TRRP)	San Joaquin River Restoration Program (SJRRP)	Columbia River Basin Fish & Wildlife Program (Columbia River Program)	Upper Colorado Endangered Fish Recovery Program (Upper Colorado Program)	San Juan River Basin Recovery Implementation Program (San Juan Program)	Glen Canyon Dam Adaptive Management Program (GCDAMP)	Lower Colorado River Multi-Species Conservation Program (LCR MSCP)	Platte River Recovery Implementation Program (PRRIP)
Executive Authority for the Program	Program start – 2000 2000 Record of Decision (ROD) 2000 Final EIS/EIR (includes Appendix C – Implementation Plan) Both are formal implementation documents for the 1999 Flow Evaluation Study developed by Service and Hoopa Valley Tribe Cong. authorization – P.L. 98-541 (October 24, 1984)	Program start – 2009 Stipulation Agreement (NRDC et al v. Rodgers et. al and Orange Cove Irrigation District et. al, September 2006) Cong. authorization – P.L. 111-11 (March 30, 2009), Title X, Subtitle A (San Joaquin River Restoration Settlement Act) Subsequent MOUs	Program start – 1982 Cong. authorization – P.L. 96-501 (December 5, 1980); Northwest Power Act; ID, MT, OR, and WA form the Northwest Power and Conservation Council (NPCC) Northwest Power Act directs Council to develop and manage program to mitigate adverse effects of Columbia River hydrosystem on fish and wildlife Last updated as 2014 Columbia River Basin Fish and Wildlife Program; update underway to add a 2020 Addendum. A significant piece of the addendum are a set of objectives and indicators for the Program. We intend final adoption in August. Latest draft of the objectives and indicators: https://www.nwcouncil.org/reports/2020-4	Program start – 1988 1988 Cooperative Agreement, extended through 2023 Cong. authorization – P.L. 106-392 (October 30, 2000); cost-sharing for UCR and SRB RIPs P.L. 109-183 (March 20, 2006); authorized additional federal funds for capital construction projects and extended construction period through 2010. P.L. 111-11 (March 30, 2009), capital funding authorized through 2023 P.L. 112-270 (January 14, 2013), annual funding authorized and extended through FY2019 PL 116-9, Section 8101 (March 12, 2019) annual funding through FY23.	Program start – 1992 1992 Cooperative Agreement, extended through 2023 Cong. authorization – P.L. 106-392 (October 30, 2000); cost-sharing for UCR and SRB RIPs P.L. 109-183 (March 20, 2006); authorized additional federal funds for capital construction projects and extended construction period through 2010. P.L. 111-11 (March 30, 2009), capital funding authorized through 2023 P.L. 112-270 (January 14, 2013), annual funding authorized and extended through FY2019 PL 116-9, Section 8101 (March 12, 2019) annual funding through FY23.	Program start – 1997 Cong. authorization – P.L. 102-575, the Grand Canyon Protection Act of 1992 1995 FEIS for operation of the Glen Canyon Program 1996 Record of Decision (ROD) 2016 Long Term Experimental Management Plan (LTEMP) ROD	Program start – 2005 2005 Record of Decision (ROD) 2005 Implementing Agreement 2005 Funding and Management Agreement 2005 Steering Committee By-laws 2018 Amended Incidental Take Authorization 2005 Final EIS/EIR Cong. authorization – P.L. 111-11, Section 9401 (March 30, 2009)	Program start – 2007 2006 Final Program Document – negotiated from 1997 Cooperative Agreement Cong. authorization – P.L. 110-229, Section 515 (May 08, 2008) Cong. authorization for Extension (2020-2032) – H.R. 1865 (P.L. 116-94), Section 2, Division P, Title I (December 20, 2019)

These programs are examples of why the mission and tools of the Bureau of Reclamation have been updated, to some degree, to help Reclamation deal with water and environmental challenges of the "new West" (Benson, 2011). The current mission of Reclamation reads:

> "The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public." (Bureau of Reclamation, 2015).

Once a major dam builder in the United States, Reclamation and its new mission now reflect a more modern approach to water management that more commonly attempts to balance water use and economic development with environmental concerns (Benson, 2011). This change in Reclamation focus happening in the western United States is occurring in a region marked by its aridity at a time when droughts in the Southwest and central Plains are expected to increase in severity in the latter half of the 21st century (Cook et al., 2015). While Congress has not yet provided Reclamation a new "organic act" or more comprehensive legislative framework for addressing environmental challenges (Benson, 2011), more than other federal water management agencies it is employing adaptive management in a variety of governance structures to deal with limited water, increasing demand, and endangered species' needs. Doremus and Tarlock (2008) concluded Reclamation functions not as a traditional builder of dams and water reclamation projects, but more as a manager of water and "ecosystem restorer."

In a 2009 review of water governance literature, Huitema and several other authors found little available literature analyzing experiments in water governance. The authors suggested the use of an empirical research agenda with case studies and other analyses to evaluate the effectiveness of different types of water governance structures.

This included looking at large-scale approaches to water management and how those structures and programs used adaptive management to help work across ecological and social boundaries (Huitema et al., 2009). In reviewing literature since Huitema et al. 2009, I found no literature and am not aware of any ongoing research directly evaluating the role of governance structure as a key factor in leading to successful implementation of true adaptive management in large-scale ecosystem restoration and species recovery programs, either within Bureau of Reclamation programs or other agencies.

A 2011 Reclamation report on 16 restoration programs and the related workshop discussion session at the University of New Mexico explored important challenges to these programs such as governance arrangements, scale, long-term investment, and the role of science (Bureau of Reclamation, 2011). Particularly within the Bureau of Reclamation, a variety of governance structures are currently being employed to coordinate restoration efforts (Bureau of Reclamation et al., 2011). This variety of institutional arrangements now being utilized in large-scale Reclamation restoration efforts serves as an important data set for exploring research questions related to governance and adaptive management. An early assessment of these 16 programs revealed a variety of governance structures, a mixed use of adaptive management ("stout" vs. "lite"), and a stark contrast between success and failure.

Methods

I conducted an integrative narrative review of historical and current literature to explore and better understand relevant theories, concepts, and experiences related to panarchy, resilience, adaptive governance (AG), and adaptive management (AM), building on the review conducted for Chapter 2. I used the results of this critical review of literature in these fields to assist in my evaluation of a large previous body of work and to aid in further refinement of my central research question and the conceptual model framework described in Chapter 4 (Grant and Booth, 2009). This more traditional review of qualitative evidence is consistent with my intent to explore relevant literature in a configurative attempt to further understand the origins, challenges, and adaptations of the case study programs details below through the lenses of panarchy and resilience.

I focused the literature review on a defined set of topical areas of most interest to me in further scoping my research question and through experience working with colleagues across the U.S. and Canada on implementation of AM and AG. Reviewed literature included original and older documents through current-day publications as the body of scholarly work on AM and AG continues to grow. I organized the logical structure (Pautasso, 2013) of my review according the following conceptual themes:

- Panarchy
- Ecological resilience
- Adaptive governance
- Adaptive management

Multiple collections of scholarly and practical work were used to build a database of articles, books, official restoration program documents, grey literature, and other sources of information for my narrative review: Google Scholar searches with the terms “panarchy,” “resilience,” “adaptive management,” and “adaptive governance”; seminal works of literature recommended by my doctoral committee during my program of study;

references from my doctoral program coursework in AM, ecology, resilience, and water policy and management; references recommended by colleagues in AM and large-scale restoration; extensive documents and literature from the Platte River Recovery Implementation Program (PRRIP), Trinity River Restoration Program (TRRP), and multiple other restoration programs around the country; government literature sources on restoration program budgets and technical guidance on AM in federal programs; literature compilations from AM experts and panel discussions; documents from members of the PRRIP Independent Scientific Advisory Panel; AM literature compiled from personal work with AM in large-scale programs across the country including the PRRIP, TRRP, Middle Rio Grande Endangered Species Collaborative Program (MRGESCP), the Comprehensive Everglades Restoration Program (CERP), the Missouri River Recovery Program (MRRP), and restoration programs in the Gulf of Mexico and coastal Louisiana; and a general compilation of additional AM and AG literature acquired through two decades of my own work in large-scale restoration programs.

Nearly all of these documents are in my possession as both printed and downloaded PDF files, with some articles, program documents, and books remaining in hard copy only. The electronic documents are stored both in a large, comprehensive Google Drive folder and then further broken down in folders of several topical areas. I reviewed each document for themes of interest related to panarchy, resilience, AG, and AM, made notations to highlight key points in printed copies of literature, kept electronic notes by topical area, and used this review process to narrow the set of literature into the most informative and explanatory set of documents based on the areas of interest identified above. I used this more focused set of literature to summarize key points of interest and suggest direction for exploration with my dissertation research.

I collected 491 references during the course of my narrative literature review. This includes 470 literature references from refereed journals, restoration program documents, and gray literature and 21 published books on the topics of AG, AM, panarchy, and resilience. Nearly all of these documents are in my possession as both printed and downloaded PDF files, with some articles, program documents, and books remaining in hard copy only. The electronic documents are stored both in a large, comprehensive Google Drive folder and then further broken down in folders of several topical areas. I reviewed each document for themes of interest related to AG, AM, panarchy, and resilience; made notations to highlight key points in printed copies of literature; kept electronic notes by topical area; and used this review process to narrow the set of literature into the most informative and explanatory set of documents based on the areas of interest identified above.

I used the PRRIP and the TRRP as Bureau of Reclamation-based case studies in this chapter and in the field trial application of my conceptual model restoration program evaluation framework in Chapters 4-6 to help eliminate variation between government entities at least in terms of controlling guidance or legislation. Because these programs operate in the western United States, they operate within uniform water administration under the prior appropriation doctrine of “first in time, first in right”. Geographic uniformity in the western United States also ensures more socio-hydrologic uniformity in terms of water availability, use, and management. This should allow for greater intra-evaluation between the PRRIP and the TRRP as compared to evaluating Reclamation programs versus programs operated by the U.S. Army Corps of Engineers or other agencies.

For the PRRIP and TRRP as case studies, I conducted an integrative narrative review of foundational documents, archival records, and program-specific literature and obtained a more complete understanding of both restoration programs through direct and participant observation. Review of documents and archival records and direct and participant observation are four main methods for collecting case study research data (Yin, 2014). I also began informal collection of data in both programs by probative discussions with decision-makers, technical staff, stakeholders, and independent scientists in the PRRIP and TRRP. This experiential knowledge is critical to better understanding adaptive management and the importance of collaboration to enabling its successful implementation (Beratan, 2014).

Results

I filtered my set of 491 references into a categorical set of 153 of the most relevant literature in the four topical areas of AM (87 references), AG (47 references), panarchy (4 references), and resilience (15 references). I used this more focused set of literature to summarize key points of interest and suggest direction for exploration with my dissertation research. The results of this narrative review are provided below, organized according to the logical structure of conceptual themes related to the central proposition of my dissertation and potential areas of emphasis in evaluating AG and AM in large-scale restoration programs.

Exploring Panarchy Through the Platte River SES

Gunderson and Holling (2002) describe a panarchy as a nested set of adaptive cycles within social-ecological systems (SESs) that operate at a discrete but linked set of scales. Adaptive cycles are represented by an infinity loop starting with the r phase of exploitation, pioneer species, and rapid development. Over time, growth slows, and important resources are conserved in the K phase (conservation). At this time, the system begins to become more brittle, overconnected, and vulnerable to disturbance and rapid collapse. A disturbance such as a fire, drought, or flood can then more easily push the system past a threshold at which time the system collapses and releases capital as stored potential (omega phase, Ω). Connections are broken but is at this time the system is most prone to innovation, novelty, and renewal (alpha phase, α) (Gunderson and Holling, 2002). The use of the infinity loop is suggestive of ongoing and repeated movement through this adaptive cycle on the part of the system, thus linking it to resilience (the capacity of a SES to absorb disturbance and even reorganize while maintaining key structure and function = ecological resilience; Holling, 1973) and the presence of multiple equilibria, multiple stability domains, and constant change.

Within a panarchy of cross-linked scales, the influence of large, slow variables at higher scales allows the small, fast variables at lower scales to move through iterations of adaptive cycles more quickly without disrupting the entire cross-linked system (Allen et al., 2014). But as the higher scales move through the conservation phase of the adaptive cycle and become brittle, overconnected, and prone to disturbance, the activity of the fast, small variables and lower scales can reverberate up through the system and trigger collapse and regime shift (Gunderson and Holling, 2002). This process is called “revolt.”

As the higher scales move through the release phase, accumulated resources and memory from moving through previous iterations of the adaptive cycle move downward through the system to the smaller scales (Gunderson and Holling, 2002). This process is called "remember" and can help the system move through renewal and reorganization yet keep critical structure and processes if resilience is high.

Berkes and Folke (1998) use the term social-ecological system (SES) to describe coupled ecological and human systems ("humans-in-nature") that comprise complex bioregional landscapes like river systems. Understanding aspects of panarchical scale within a SES is critical to understanding the emergence and institutionalization of adaptive governance (AG), which in turn can provide the social capital and context for adaptive management (AM) to work (Chaffin et al., 2014). AG can emerge when a system is moving from the release phase into the renewal phase and the potential is high for building new connections, novel approaches to management and governance, and the social capital of trust, leadership, and participation can emerge and help transform governance (Folke, 2006). The development of AG at this stage can provide the context for AM to emerge as well, and if AM is properly linked to the AG structure then the fit of AM should correspond to the ecological scale of the problem best linked to management intervention and the ability of the AG structure to implement AM, learn, and adapt accordingly.

The complex SES of the Platte River basin can be characterized by its biophysical and social settings. As shown in Figure 3.1, the Platte River begins in the Rocky Mountains of Colorado, with snowmelt running through the North Platte River in Wyoming and the South Platte River in Colorado to join as the Platte River at North Platte, Nebraska. The river flows eastward across Nebraska to its confluence with the Missouri River and drains an area of roughly 90,000 square miles (Birge et al., 2014).

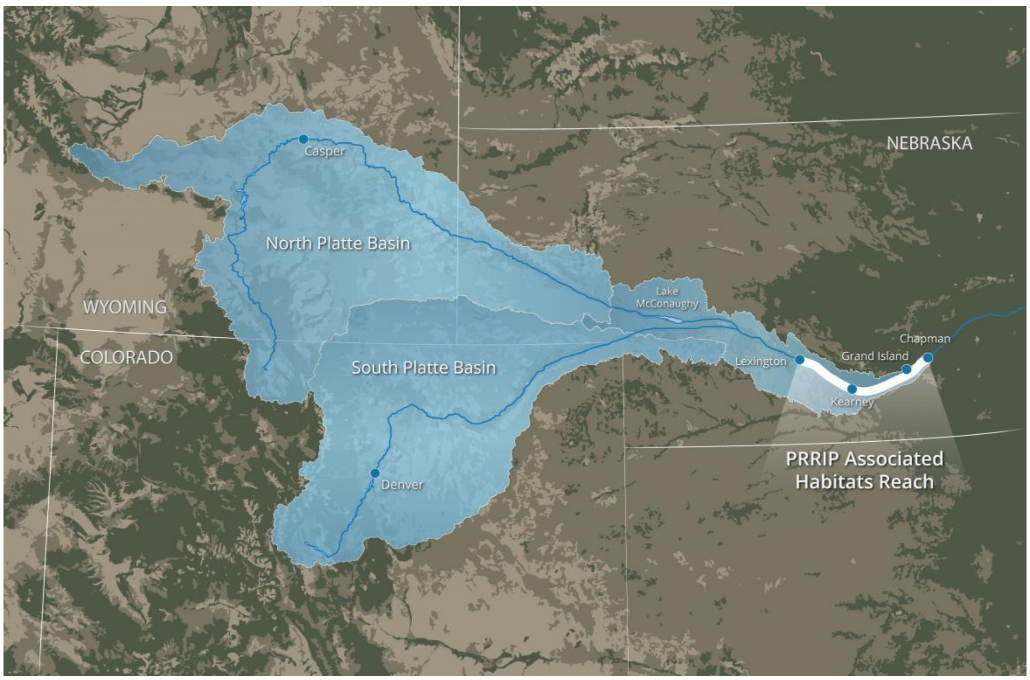

Figure 3.1. Platte River Recovery Implementation Program project area (reproduced from the Platte River Recovery Implementation Program website accessed 08/01/2020).

The Platte flows through substantial urban development on the Front Range of Colorado, a series of large federal (Bureau of Reclamation) dams in Wyoming, and intensive agricultural operations in eastern Colorado and across Nebraska. River flows are heavily influenced by urban and agricultural water withdrawals, precipitation in the form of snowfall and rain, and patterns of local, regional, and global weather and climate. The social system of the Platte is thus characterized by both rural/agricultural and urban communities with a complex mix of municipal, state, and federal governance with unique management entities like Natural Resource Districts in Nebraska and irrigation districts in Wyoming interspersed.

Recent resilience assessments of the Platte River basin have identified cycles of change in settlement, water use, and policy (Birge et al., 2014; Nemec et al., 2014). In evaluating the Platte River SES using Panarchy theory, it is informative to focus on the most recent changes in the SES and the results of recent movements through adaptive cycles and cross-linked scales. Figure 3.2, adapted from Chaffin and Gunderson (2016), is used evaluate key processes and attributes of the Platte River system panarchy.

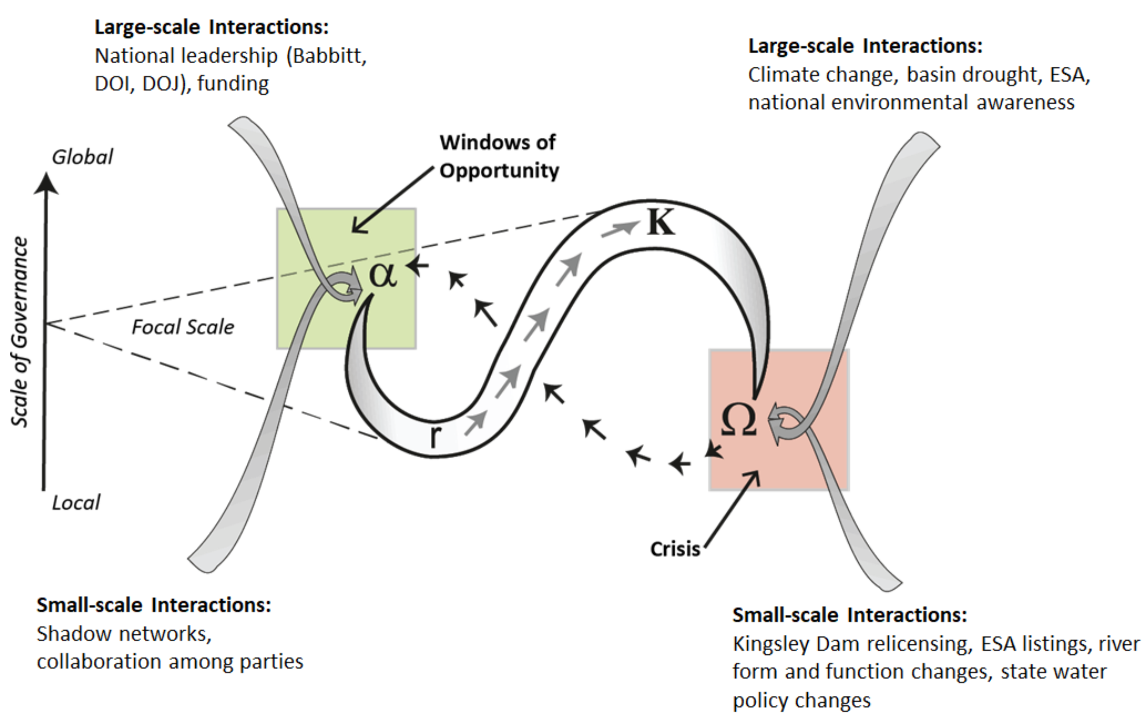

Figure 3.2. Panarchy theory model as applied to the Platte River basin and PRRIP (adapted from Chaffin and Gunderson, 2016).

r phase (exploitation) and K phase (conservation)

These two phases together represent the "front loop" of the adaptive cycle (Gunderson and Holling, 2002). This period occurred during most of the 20th century and was marked by rapid development of vast water infrastructure, construction of dams, and numerous water compacts between basin states (Birge et., 2014). This time period was paired with substantial increases in agricultural and municipal water use as well as other landscape alterations. As this development and use continued to grow, it led to substantial changes in river flows and ecological processes related to geomorphology, vegetation germination and growth, and patterns of use by species including cranes (Sandhill and whooping), interior least terns, and piping plovers. As water use continued, the presence of major dams like Kingsley Dam and a water "plumbing" system in Nebraska led to a slowing of growth and an accumulation of resources. Management became bureaucratic and focused heavily on water use and control of water and sediment through engineered solutions. The system became overconnected and thus more vulnerable to disturbance and regime shifts (Allen et al., 2014).

Ω *phase (release) and α phase (renewal)*

These two phases together represent the "back loop" of the adaptive cycle (Gunderson and Holling, 2002). This period began occurring during the 1980s. The listing of several species as threatened and endangered (whooping crane, tern, plover) and changes in the form and function of the central Platte River became significant concerns. As discussed below, the process of relicensing Kingsley Dam pushed the system into crises and began a process of renewal that in some ways continues to this day.

Crisis/Large-scale and Small-scale interactions

In the 1980s, 1990s, and early 2000s, a series of jeopardy biological opinions from the United States Fish and Wildlife Service (Service) on water projects raised concerns over water use and habitat decline on the central Platte River. During the relicensing process Kingsley Dam, the Service called for a return of 417,000 acre-feet of water annually to the central Platte River. Relicensing deliberations centered on use of the central Platte River by certain endangered and threatened species and habitat alterations over time associated with water diversions and land-use changes. Smaller variables related to vegetation, sand movement, and local environmental concerns were starting to reverberate up to cross-linked scales in the panarchy. Larger-scale variables like system-wide drought and a growing national environmental movement, along with national policy changes, were starting to reverberate down to cross-linked scales in the panarchy.

Window of Opportunity/Large-scale and Small-scale interactions

This cross-scale pressure at scales both above and below the overall Platte River basin created a “window of opportunity” (Chaffin and Gunderson, 2016) for AG to emerge essentially twice in the 1990s and 2000s. At first parties worked under a Cooperative Agreement that was an experimental but accountable governance arrangement to see if basin parties could build a stable governance structure for the long term. AG emerged again with the beginning of the formal Platte River Recovery Implementation Program (PRRIP) with fuller institutional authority and accountability. The PRRIP is using adaptive management (AM) under the construct of AG to reduce uncertainty about what is going on at smaller scales and what can be done to manage it so "revolt" up can be tempered with "remember" down. Though not yet fully embraced by the PRRIP as a whole in terms of understanding, PRRIP actions are an attempt to build more resilience into system so cross-scale interactions do not have deleterious effects and possible cause a regime shift. The PRRIP appears to be an example of AG that is structured at a correct focal scale where the bioregional ecosystem and institutional arrangements match and can be effective (Huitema et al., 2009).

A final summary explanation of the Platte River basin panarchy can be compared to that identified by Gunderson, Holling, and Peterson for the Everglades SES (Gunderson and Holling, 2002). In short summary, the Everglades panarchy consists of crisis in the ecosystem; revolt up to the Everglades policy level for the SES; resultant media pressure and political pressure in the context of new understanding about the Everglades ecosystem and the linked human and ecological systems; and finally, "revolt" up to the federal scale from which resources trickle down ("remember") to help manage the ecosystem (Gunderson and Holling, 2002).

This pattern has generally repeated itself on the Platte River. Smaller cycles of vegetation sediment, and other riverine processes were working fast, while at the same time regional climate, climate change, federal policy, and large-scale water use and development were pushing down on the SES. This made the overall system vulnerable to disturbance, so smaller-scale variables revolted up when larger-scale variables were nearing the end of K phase. Those reverberations up caused reverberations down and release and renewal began. With a system not working well, federal resources and leadership trickled down to smaller scales to allow the emergence of adaptive governance and adaptive management and ultimately a purpose of rebuilding system resilience.

Ecological Resilience on the Platte River – An Example

The notions of ecosystems having multiple scales and multiple stability domains or regimes with nonlinear and discontinuous interactions are foundations of resilience theory (Holling, 1973). Folke (2016) describes resilience being like "steering a vessel in troubled waters" which fits well in the Anthropocene where the ecosystems in many SESs face tipping points into alternative regimes that may not be desirable and that may be difficult to emerge from (Gunderson et al., 2010). Holling (1996) identified two types of resilience that operate differently and pose different challenges for managers. Engineering resilience is defined as the rate or speed of recovery exhibited by a system after a disturbance and is grounded more on stability and conceptions of a return to some equilibrium (Holling, 1996). Alternatively, ecological resilience is the amount of disturbance that can be absorbed by a system while undergoing change yet retaining key structure and process and is grounded in variability, multiple stability domains, and a focus on persistence of relationships (Holling, 1973; 1996).

An example of ecological resilience in the Platte River system relates to the interaction between the river's geomorphology and vegetation. The Platte River is a mobile, sand-bed river. River flows push sub-surface sand dunes through the Platte's channel formations and also deposit sand at points of lower flow velocity, around bar and island edges, along the banks, and, where the river remains connected to its floodplain, in side channels and other depositional zones. The mobility of the Platte's bed and its bar material is a function of flow volume, velocity, frequency, and other flow-related factors, but also of the presence or absence of emergent vegetation. At one scale, river flows and mobile sediment scour young (1-2 growing seasons) vegetation such as cottonwood seedlings, reed canarygrass, and willows to keep that vegetation from maturing and beginning to stabilize bed, bar, and bank material (sand). At this scale, under a pre-dammed condition, the relatively fast and small variables of daily, monthly, and annual flow and seed germination and early plant growth cycle quickly (annual basis) through an adaptive cycle, particularly if a large disturbance such as a flood releases system capital and renewal and reorganization begin.

At another scale, the interaction between river morphology and vegetation historically maintains a fairly wide, braided, vegetation-free channel that over time has provided roosting habitat for whooping cranes and staging and roosting habitat for Sandhill cranes. This higher ecological scale functions on an annual basis due to migratory patterns but those effects linger over a longer time period because of the long history of annual stopovers on the Platte by cranes. The positive feedback loop between river morphology (sand) and vegetation is linked cross-scale to the patterns of animal use and behavior on the Platte through crane migration and use.

Construction of dams, withdrawal of water, and clear (devoid of sediment), cold-water returns due to creation of a large irrigation "plumbing" system fundamentally changed the movement of sand through the Platte River system over time as well as the forces of sand mobility and the formation of dunes, bars, and islands. Coupled with large-scale system drought and intense water use, the feedback loop of sand movement and mobility and the effects of germination suppression and young plant scouring was reduced allowing more woody vegetation to establish on river bars and banks, trapping what sediment was mobile and creating large, wooded islands no longer subjected to large water pulses or floods. This changed the dynamic nature of the Platte River and also reduced available channel habitat and roosting/stopover sightlines for cranes, changing bird behavior by pushing cranes to remaining wide channels further to the east and/or channel areas subjected to intensive mechanical management. This represents a type of regime shift or transition in the ecosystem accompanied by myopic policies focused on water use and development created a kind of "perverse" engineering resilience that locked the system in a stability domain that slowly grew more vulnerable to disturbance (Cosens and Fremier, 2014). This led to a pathology of management with strong engineering resilience, low ecological resilience, and movement closer toward a potentially irreversible stability domain (Holling, 1996). Gunderson et al. (2010) term this a "rigidity trap". Development of the PRRIP and its emergent adaptive governance structure and use of adaptive management was part of the adaptive cycle renewal process aimed at breaking this rigidity trap.

In the mid-2000s, this condition was exacerbated further by the surprise advancement of an invasive species (Phragmites) that further solidified bars, islands, and banks and tightened water flow further away from the historical condition of wide, shallow, braided channels. The entirety of this change is often referred to as the "vegetation ratchet effect" and what was once a positive reinforcement transitioned to a strong set of negative feedback loops. One of the key management challenges on the Platte today is restoring the positive feedback loop in a way that is sensitive to cross-scale interactions and that allows system memory in the Platte panarchy ("remember") to assist with restoring critical structure and processes that might increase the river's resilience. Learning to live with surprise, change, and uncertainty is a key feature of resilience and the Platte River basin is still working on incorporating this ability to learn at a multi-scale level (Folke, 2016).

AG and AM in the PRRIP and the TRRP

The panarchy theory model in Figure 3.2 above has also been adapted to reflect the AG cycle (DeCaro et al., 2017). This suggests AG systems move through cycles of growth, entrenchment, collapse, and renewal (Chaffin and Gunderson, 2016) and have the capacity to integrate the environmental and social complexity of SESs into functional governance and management (Chaffin et al., 2014). If AM failures are explained at least in part by governance failures (Cosens et al., 2014) then AG may be the type of governance that allows sufficient flexibility for AM to be successful (Cosens and Williams, 2012). After an initial review of documents, direct and participant observation, and informal discussion with participants, below I begin to formulate an understanding of key themes and components of AG and AM in the two case study restoration program (the PRRIP and the TRRP) and lay the foundation for further exploration of these processes through field trial application of my conceptual model restoration program evaluation framework described in Chapters 4-6.

PRRIP and TRRP AG

AG Similarities

The PRRIP and the TRRP both emerged in the late 1990s during the Clinton Administration when Bruce Babbitt was Secretary of the Interior. Secretary Babbitt and several high-level staffers in the Interior Department and at the Department of Justice (including David Hayes and Janice Schneider) worked together to allow several unique AG approaches to emerge in large-scale water management systems where crises (ESA listing, lawsuits, decadal droughts, water overuse) were threatening to push these SESs into regime change. The Platte River system and Trinity River system were two of these examples.

Key individuals are often cited as an important element of the development of AG (Folke et al., 2005). This high-level leadership in Washington, DC provided the legitimacy and accountability for leaders and shadow networks at smaller scales in both the Platte and Trinity basins to explore novel approaches to answering questions about ecological resilience and building governance structures in these SESs (Gunderson and Light, 2006). In the Platte River, teams of scientists and a broad mix of policy interests began to coalesce under the leadership of regional administrators for the Service and the Bureau of Reclamation and directors of state water management agencies. In the Trinity River, the network of scientists working on the Flow Evaluation Study searched for structural options that might work as an implementation device for their flow, gravel, and habitat restoration recommendations.

Both the PRRIP and TRRP emerged from this time period (their "window of opportunity" in their respective panarchies; Chaffin and Gunderson, 2016) with similar patterns of purpose and need and both fall under a broad network of large-scale restoration programs housed in the Bureau of Reclamation. Both programs have governance structures born out of legal and legislative necessity and operate under a stated charge to employ adaptive management (AM for the PRRIP, AEAM for the TRRP) as their scientific organizing principle. Folke et al. (2005) suggest that the emergence of viable governance structures often depend on the development of large multistakeholder organizations. Generally, in both the Platte and the Trinity this occurred. In the Platte basin, the Governance Committee (GC) of the PRRIP is comprised of federal and state agency representatives as well as stakeholders representing water users and environmental entities (PRRIP, 2006). All of these entities vote by consensus on all PRRIP decisions. In the Trinity basin, the Trinity Management Council (TMC) of the TRRP is comprised of federal, state, and Tribal entities. Stakeholders are involved, but only in an advisory role to the TMC.

There is a degree of polycentricity in each of these SESs. Polycentricity represents a nested set of governance systems at several levels that allows a SES more adaptive capacity to deal with external drivers and disturbances (Folke et al., 2005). The focal scale of the Platte River SES panarchy is the PRRIP and its bioregional context. Below that scale are multiple governance systems including state coordination, Natural Resource Districts, irrigation districts, and other more local systems. Above the focal scale, regional coordination among the states and national policy provide accountability and legitimacy. In the Trinity River SES panarchy, the TRRP is the focal scale though it is not necessarily bioregional in scale. Figure 3.3 shows the geographic area of the TRRP;

activities of the program are focused just in the State of California. However, like the Platte, the TRRP is connected at a scale above it to regional coordination within the Bureau of Reclamation and to national policy, with smaller scales of Tribal coordination, the state, and local power districts functioning below the focal scale.

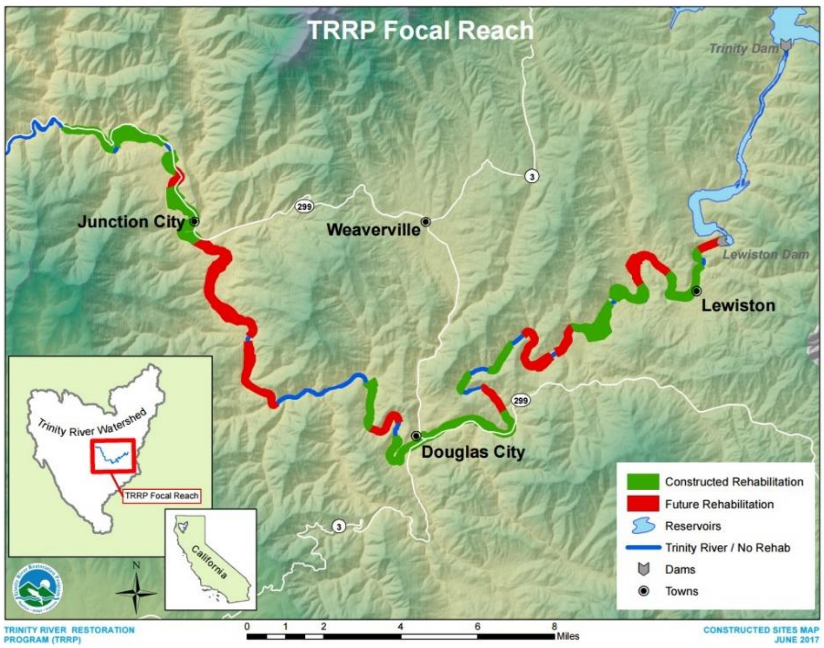

Figure 3.3. Trinity River Restoration Program project area (reproduced from the Trinity River Restoration Program website, accessed 08/01/2020).

AG Differences

Institutionalization

As a new system of AG emerges in a SES, it has to build accountability and legitimacy to solidify and retain adaptive capacity to function as the SES moves through its adaptive cycle (Cosens et al., 2014). This occurred in the Platte, in that the version of the GC that negotiated during the Cooperative Agreement and formed the PRRIP was allowed to remain as the decision-making body when the PRRIP formally began in 2007 (PRRIP, 2006). The GC was successful during the ten years of Cooperative Agreement negotiations and gained the stability, functionality, and accountability to continue forward as a successful decision-making body. In the Platte River SES panarchy, the focal scale of governance (the PRRIP) can continue to conduct AM and adapt while relying on higher scales of governance for resources and stability (Cosens et al., 2014). This also ensured the collaborative structure for AG was in place before AM was attempted. Lee (1993) notes that this may be a primary reason why there have been few examples of successful AM, with experimentation being adopted and proceeding without the required social conditions of AG (Chaffin et al., 2014).

That appears to be an overarching issue with the TRRP. Once the ROD was signed, the leadership in Washington, DC that allowed the TRRP to form left office and the higher-scale leadership, accountability, and social memory ("remember") left with them. The emergent AG structure in the basin, the TRRP and its TMC, immediately fell apart in terms of mission and direction from beginning with no leadership. TRRP participants describe this as the TRRP being "kicked down" in terms of authority into lower levels of Reclamation. The TRRP has slowly contracted inward and remains focused on a small set of management actions with unclear cross-scale linkages above or below the focal scale.

Social Capital

Trust and social networks provide the bonding agents of social capital as AG emerges (Folke et al., 2005). On the Platte, trust-building occurred for years during the Cooperative Agreement through meeting year after year to negotiate what became the Final Program Document. Negotiation meetings were specifically designed to start in the afternoon and end the following morning to allow for social networking and relationship building over time, which smoothed negotiations and allows parties with disparate views to successfully make decisions in a collaborative body. The building of social capital has never occurred in the Trinity SES and strong positive feedbacks of a constant flow of federal funding and intense conflict, particularly between the Tribes and other parties, have worked to stabilize the rigidity trap on the Trinity (Gunderson and Light, 2006).

Scale

Huitema et al. (2009) argue that emergent AG has to match the bioregional scale where the components of the SES (the ecosystem and the institutional arrangements) are compatible. This seems to be true on the Platte. In the Platte River SES panarchy, the PRRIP falls at a focal scale about midway through a range of governance options between local actors and the highest level national policy. Given its cross-linked structure with three states and a management set of jurisdictions, the PRRIP has an ability to work through land and water management challenges that can have an impact on habitat and species in the area of PRRIP work while being linked to water management and policy at the level of the states and also the support of policy and resources at the national scale.

The TRRP is focused on a small stretch of the Trinity River below Lewiston Dam that is contained entirely in northern California (see Figure X). Additionally, the TRRP focuses on anadromous fisheries that migrate into and out of both the Klamath River and the ocean. The enormous cross-scale effects of this bioregional scale are in no way manageable by the TRRP and a lack of sensitivity to those cross-scale effects is not only confounding any results the TRRP is able to obtain from monitoring but also is likely a root cause of the TRRP's inability to coalesce around a common set of goals, objectives, and experimental management actions.

Decision-Making

Horizontal and vertical transfer of information is critical to decision-making within an emergent AG structure (Cosens, 2010). Folke et al. (2005) describe the need for individuals needing to play the roles of mavens (information brokers), connectors (can connect a large number of people together), and entrepreneurial leaders (deal brokers) to help AG emerge. Linking back to AM, Walters (2007) identifies the need for someone in the form of a "compleat emmanuensis" to invest a large amount of time and energy over the course of a career to making an AM program successful. This is a connection to the 1973 work of Holling and Chambers identifying common characters acting in a workshop setting related to environmental assessment.

The PRRIP's approach to governance is much different from other adaptive management programs where federal agencies are in the lead in terms of both staffing and decision-making. In those systems, federal employees staff the programs but are also ultimately in charge of making policy decisions. In the PRRIP, all stakeholders including water users and conservation groups are voting members of the policy body and are represented along with state and federal agency representatives. This is a major difference from other programs where stakeholders may be involved in the process at various levels but do not make management or policy decisions. On the Platte River, the executive director and staff are independent of the U.S. Department of the Interior, the states, the water users, and the conservation groups. This builds in a considerable level of independence and lack of bias. The governance structure of the Platte is very much in line with a social learning process that is inherent in adaptive management implementation and engages stakeholders at a decision-making level to build trust and provide a broader context for experimental management actions (Lee, 1993). The TRRP reflects the typical arrangement identified above with federal agency staffing and a decision-making body (the TMC) that does not directly involved stakeholders in decision-making. Over time, this has disaffected many stakeholders from the TRRP and its work and created tension at the local scale that could lead to cross-scale reverberations ("revolt") up the Trinity River SES panarchy in the form of political protest and pressure.

AM and Uncertainties

PRRIP

The science framework for the Platte River Recovery Implementation Program (PRRIP) is adaptive management (AM). The PRRIP operates under an Adaptive Management Plan (AMP) that provides guidance for Program science and offers a systematic process to test priority hypotheses and apply the information learned to improve management on the ground (PRRIP, 2006). The AMP includes conceptual models and priority hypotheses developed jointly by Program partners to use the best available science implement action as experiments, learn, and revise management actions to provide benefits for four target species: the endangered whooping crane (*Grus americana*), interior least tern (*Sternula antillarum*), and pallid sturgeon (*Scaphirhynchus albus);* and the threatened piping plover (*Charadrius melodus*).

During negotiations under the Cooperative Agreement (CA), PRRIP parties were at odds over two value-laden views of the world – river restoration through mechanical means, or river restoration through application of water via dam releases. Given the structure of the negotiations under the CA, state and federal agency partners were joined at the table by waters users and environmental entities thus engaging stakeholders directly in the negotiations that formed the PRRIP as well as its AMP (this is an aspect of emergent adaptive governance on the Platte). As Melis et al. (2015) conclude, AM is not just a scientific endeavor of experimentation and learning but a “complex societal collaboration” between scientists, managers, and decision-makers. The PRRIP brought in advisors from several other large, ongoing AM programs in the U.S., including the Glen Canyon Dam Adaptive Management Program, to learn from their successes and failures and attempt to build an AM program for the Platte River that could more readily be seen as treating management as an adaptive learning process (Walters, 1986).

As a result, the PRRIP AMP is fundamentally structured around key uncertainties in the Platte River ecosystem. The AMP consists of conceptual models, priority hypotheses, management objectives, management strategies, management actions, and integrated monitoring and research to investigate the linkages between management actions and both river response and species response (Smith, 2011; PRRIP, 2006). Hypotheses related to the formation and maintenance of in-channel sandbars by water and mechanical means; maintenance of channel width by water and mechanical means; the ability to scour and remove vegetation with flow; and responsive use of these habitats by whooping cranes, terns, and plovers have been the focus of AM implementation during the PRRIP’s 13-year First Increment. So, the “compass” of AM was coupled with the “gyroscope” of negotiating through conflict and disagreement about the best course of action for learning to generate an AM approach that is still being implemented (Lee, 1993).

Walters and Holling (1990) identify AM as being applied as trial and error, passively, or actively. Platte River AM is likely best identified as passive given the AMP identifies a small set of management actions, including one flow-related management action, to be implemented and evaluated during the First Increment as opposed to a range of flow releases for active experimentation (PRRP, 2006). However, within this context, there has been experimentation with various sizes of constructed nesting islands and the use of natural flood and drought events to learn more about flow-sediment-vegetation dynamics. And, as the PRRIP enters its 13-year Extension through the year 2032, the AMP will be revised and more active flow experimentation is being considered as the most likely path forward.

Learning has been key feature of Platte River AM and in at least one case, a full loop of AM has been completed with the governance body of the PRRIP, the Governance Committee (GC), deciding to alter management actions regarding flow and both in-channel and off-channel tern/plover nesting habitat in response to learning from implementation of AM (Compass Resource Management, 2016). Implementation of PRRIP AM has also been mindful of avoiding key failures of AM seen in many other program, including finding ways to do more experimentation on the ground, supporting continued implementation leadership, and supporting continued funding for monitoring (Walters, 2007).

TRRP

In contrast, the Trinity River Restoration Program (TRRP) can best be described as conducting trial and error. Initial evaluation suggests the TRRP departs from AM in several fundamental ways. Much of that departure relates to how adaptive governance (AG) emerged in the Trinity River SES and what has happened to that emergent AG over time.

Beginning in the 1980s, several efforts began to address both the flow degradation issues on the Trinity River and the resulting loss of the salmonid fishery. The Bureau of Reclamation built and owns both Trinity River dams so in 1981 a small flow increase to the river was initiated as was a more comprehensive Flow Evaluation Study. That study was completed by the U.S. Fish and Wildlife Service and Hoopa Valley Tribe in 1999 and recommended flow alterations, habitat restoration, and sediment augmentation under a framework of adaptive management to help restore the Trinity River fishery (USFWS and Hoopa Valley Tribe, 1999). These recommendations were adopted as the Preferred Alternative in the Final Environmental Impact Statement/Environmental Impact Report (EIS/EIR; USFWS et al., 2000), which led to a Record of Decision (ROD; DOI, 2000) from the Department of the Interior mandating flow changes on the Trinity River and creating the Trinity River Restoration Program (TRRP).

The authors of the Flow Evaluation Study modeled their recommended approach on the approach being utilized at the time through the Glen Canyon Dam Adaptive Management Program. The Glen Canyon AM program was seen as a form of Holling's (1978) Adaptive Environmental Assessment and Management (AEAM) approach and Trinity River scientists saw that as their best path forward. All uncertainties related to flow modification, gravel augmentation, and habitat to restore anadromous fisheries were developed by a small group of Trinity River scientists through the Flow Evaluation Study with no clear linkages back to any form of governance structure and with no format for developing a set of key questions and hypotheses to be addressed using AM (Lee, 1993).

The TRRP started in the year 2001 and this divergence between science priorities and the structure of the program continues to this day. There is no agreed-upon set of goals, objectives, or hypotheses. Uncertainties regarding anadromous fisheries and their responses to TRRP gravel augmentation and habitat restoration remain unanswered, and in many cases uninvestigated. The 2000 ROD does prescribe a set of flow releases based on water-year type, but those releases are implemented as passive management actions with no deliberate plan to apply flow in an active experimental manner. Melis et al. (2015) note that the original purpose of AM was not just to gain better understanding but to learn how to better manage complex SESs with that understanding. I term the process of gaining better understanding just for the sake of understanding as building a “science pile” that is not linked to a governance structure or any kind of real SES problem set. The TRRP is actively building a large science pile.

Conclusion

I conducted a probative review of panarchy, resilience, AG, and AM in two Bureau of Reclamation case study restoration programs, the PRRIP and the TRRP. This initial analysis of the case studies gave me insight into cycles of change in the PRRIP and TRRP SESs and how governance structures responded. Integrative narrative literature review, direct and participant observation, and informal discussions with program participants helped to expand my understanding of the history, purpose, and function of the PRRIP and the TRRP, challenges that led to reorganization and renewal within both systems, and early insight into a relative comparison of success of AG and AM between the two case studies. AG has been termed the solution to the failures of AM (Cosens et al., 2014). It may not be a panacea (Ostrom, 2009; Chaffin and Gunderson, 2016) but early analysis of the two case studies suggest a more thorough understanding of AG and AM components would be instructive as to the influence of AG on AM success. That insight provides a direct bridge to the conceptual model restoration program evaluation framework described in Chapter 4 and applied through a field trial in the PRRIP and TRRP (as described in Chapters 5 and 6).

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CHAPTER 4

A CONCEPTUAL MODEL RESTORATION PROGRAM EVALUATION FRAMEWORK

Introduction

The United States (U.S.) spends nearly a billion dollars annually on projects categorized as “ecosystem restoration,” “river restoration,” or “endangered species recovery” programs. Agency justifications related to the President’s budget reveal Bureau of Reclamation spending on endangered species recovery and other related programs is estimated at $428.1 million in Fiscal Year 2020, covering many large-scale programs on rivers in the western U.S. – Platte River, Trinity River, Middle Rio Grande, Upper and Lower Colorado River, San Joaquin River, and Klamath River (Bureau of Reclamation, 2019). U.S. Army Corps of Engineers spending on ecosystem restoration in Fiscal Year 2020 is estimated at $348.4 million, including some of the largest projects in the country – the Comprehensive Everglades Restoration Program, Upper Mississippi River, Missouri River, Chesapeake Bay, California Bay-Delta, and Columbia River (USACE, 2019). In nearly all cases, these programs operate under unique governance arrangements driven by specific legislation and incorporate in whole or in part adaptive management (AM) as a scientific framework and as a device to assist with program decision-making.

Yet still, few examples exist of these programs achieving incremental or complete success and AM is often seen as widely referenced and applied in these settings to little effect. A substantial amount of literature references attempts to implement AM in the context of large-scale restoration programs with little evidence of success (Lee, 1999;

Walters et al., 1992; Lee, 1993; Allan and Curtis, 2005; Zellmer and Gunderson, 2009; Allan and Garmestani, 2015; Murray et al., 2015). Recent literature on AM and law (Benson and Schultz, 2015), evaluating AM success (Chaffin and Gosnell, 2015), and the nature of collaboration and networks in implementing AM provides important guidance moving forward but does not easily reveal a practical mechanism for diagnosing what ails AM.

Emerging scholarship on governance identifies several overlapping themes with AM and adaptive governance has emerged as a possible approach to tackling the challenges of moving large-scale adaptive management programs forward (Gunderson and Light, 2006; Chaffin et al., 2014; Cosens et al., 2014). As noted by Chaffin et al. (2014), most of the recent research on adaptive governance has been theoretical in nature, building on the early work of Elinor Ostrom with polycentric forms of governance, finding a common definition in Dietz et al. (2003), and branching off into how governance structures take on complexities like resilience and climate change (Cosens et al., 2014; Chaffin and Gunderson, 2015). Addressing these challenges points to the need to focus on governance and its role in water planning and policy (Pahl-Wostl et al., 2012a; Heikkila, 2016), but there are few “analytical frameworks” that can be applied to evaluate governance performance and point to necessary reforms (Dale et al., 2013). Similarly, assessment frameworks for AM focus on improving the steps of the AM process but do not capture related linkages to the governance structure under which those AM processes are operated (Chaffin and Gosnell, 2015).

In this chapter I propose as a conceptual model a new evaluation framework for large-scale aquatic system adaptive management programs. Here, I present the structure of and justification for the framework as a conceptual model. Later chapters detail the methodology and results of applying the framework as practical tool to assess the governance structure and operation of a large-scale program, as well as the structure and operation of adaptive management within the program. While the framework and the associated methodology are new, they are adapted from multiple sources in the literature of adaptive management, governance, and risk analysis as well as my own personal experience over many years working with and evaluating AM in multiple large restoration programs around the country.

The central proposition of my dissertation is that governance of a large-scale aquatic system adaptive management program is determinative in successful implementation of adaptive management thus predicating program success. This chapter provides the structural support for a framework to evaluate this proposition through case study research described in Chapters 5 and 6.

Evaluating AM Success

Before describing a methodology to evaluate the interplay between adaptive management and governance, it is imperative to define AM and bound the methodology and related evaluation in the context of that definition. Identifying a common definition of AM is difficult. AM is referenced and applied broadly with significant nuance and the practice of AM continues to evolve (Fischenich et al., 2019). My own work implementing and evaluating AM as a practitioner in several programs around the U.S. continues to expose me to the complexities of AM concepts and its scope. But there are underlying commonalities and principles that focus my understanding of AM and that I applied in developing the AM evaluation framework as described in this chapter and applied in Chapters 5 and 6.

Murray et al. (2015) best summarize the notion of successfully implementing adaptive management at a large scale, and the challenge of finding that success:

> "The bottom line is: adaptive management is easier and more likely to be successful at smaller spatial scales where treatments can be more readily replicated and controlled, and if the time required to test hypotheses can be measured in years rather than decades. Adaptive management gets harder at larger spatial and temporal scales, and at the extremes becomes impossible."

The lack of good examples of successful adaptive management implementation may be due in part to differences in both regulatory and statutory definitions (Doremus et al., 2011) and subsequently differences in application (Allen et al., 2013). In my dissertation, I am not promoting a consensus definition of adaptive management or advocating for one definition over another. Practitioners work across a wide range of what can be considered adaptive management and debating different definitions does little to move the practice of adaptive management forward. I suggest a more productive approach to the differing definition problem is to instead think of a decision space cutting across all definitions of adaptive management (Murray et al., 2015).

The evaluation framework developed and described in this chapter and applied in Chapters 4 and 5 is best understood when a clear definition of adaptive management is stated reflecting my perspective on the use of adaptive management in the context of large-scale restoration programs. Thus, the working definition of adaptive management for the purposes of my dissertation is:

> "AM is a systematic, practical approach for improving resource management policies and practices. It provides a structured process for learning which management actions best meet management objectives, and for reducing resource management uncertainty. In its most effective form, an experimental approach is

> used to test clearly formulated hypotheses about important, but uncertain, components of a system. Effective AM requires considerable effort, planning and rigor. It is much more than simply monitoring and responding to observed outcomes (although these are important aspects of AM).” (Marmorek, 2020)

This definition best captures the scientific rigor of adaptive management as an exercise in science, but clearly represents adaptive management is also an exercise in management. My dissertation research explores the relationship between adaptive management and governance structures and whether that interaction is crucial to successfully implementing adaptive management at a large scale in a rigorous manner.

A methodology to evaluate an AM program can only be effectively used if applied against a metric of success or failure of that AM program. Like defining AM, identifying what it means to successfully implement AM in a restoration program is difficult but necessary. With increased pressure on scarce funding and with many large programs in the U.S. having been implemented for many years, specifying measures of AM success and a conducting a critical evaluation of effectiveness are timelier than ever (Chaffin and Gosnell, 2015).

To date, most evaluations of AM success have been tied to success or failure of the restoration and ecosystem rehabilitation projects in which AM is implemented (Chaffin and Gosnell, 2015; O’Donnell and Galat, 2008). This leads to reporting out habitat acres restored, number of birds or fish or trends in population, or other project-specific metrics that may tell a story about the restoration program but about the function of AM as a framework for science and learning within that program. This makes for difficult cross-comparisons of AM between programs because ecological indicators and goals and objectives are program-specific. Favorable outcomes are relative to the contexts in which AM is applied within a project or AM program (McFadden et al., 2011).

Williams et al. (2009) use the Department of Interior AM Technical Guide as a platform to begin looking at AM success through the lens of process. The Technical Guide defines AM success as making progress “toward achieving management goals through learning-based (adaptive) decision process (Williams et al., 2009). The focus on learning moves the success definition in the direction of proceeding through the steps of the AM cycle in a way that results in management changes because of learning. Williams et al. (2009) in the Technical Guide and Susskind et al. (2012) in an evaluation of the Glen Canyon Dam Adaptive Management Program each provide success indicators like “clear overarching goals”, “stakeholders are actively involved”, and results “used to adjust and improve management decisions”. This shifts thinking away from program-specific ecological indicators to more process-oriented factors (Chaffin and Gosnell, 2015).

For the purposes of my dissertation, I define AM success with a focus on process. Successful AM is implemented through a definable AM Plan and the restoration clearly moves through 6-step cycle of Assess, Design, Implement, Monitoring, Evaluate, and Adjust. The AM Plan should identify these six steps and provide a roadmap for completing iterations of the whole cycle as well as individual steps. In the end, I am looking for clear evidence that information and learning from AM are communicated to the decision-makers in a program, and that those decision-makers make documented decisions made to adjust actions or objectives if necessary using AM learning as an input. In a vague manner, I am looking for a culture of learning within a program. This makes the process of AM as important as any outputs that relate back to the specifics of a program's goals and objectives.

AM is not always the right prescription for a restoration program and implementation is often attempted in less than ideal situations (Allen and Gunderson, 2011). A focus on process for identifying AM success can help to identify if and when AM should be applied. If AM is implemented just because it is written into a management document or because it was identified as a panacea to a long-standing problem that may be more social than ecological in nature, then a program is most likely not doing AM in the first place and it is not necessary. I suggest that large restoration programs should only invest in the time and resources necessary for successful AM if learning and process are the focus.

Evaluating Governance Success

A brief history of time: Elinor Ostrom developed a framework for social-ecological systems (SESs) with a focus on community self-organization for sustainability (Ostrom, 2009; Cosens et al., 2014). While Ostrom was building out these issues of organization and governance, Holling and other researchers were developing and refining the concepts surrounding resilience and the nonlinear behavior of SESs (Holling, 1973; Cosens et al., 2014). From this jumping off point, AM was developed as the framework for managing these complex, nonlinear systems (Holling, 1978; Walters and Hilborn, 1978; Walters, 1986; Cosens et al., 2014b). As has been well-documented, AM has largely not been successfully applied and a good deal of literature ties this failure at least in part to issues of governance (Dietz et al., 2003; Brunner et al., 2005; Folke et al., 2005; Gunderson and Light, 2006; Cosens et al., 2014).

For these challenges of governance and AM, the solution was termed adaptive governance ((Dietz et al., 2003; Brunner et al., 2005; Folke et al., 2005; Gunderson and Light, 2006; Chaffin et al., 2014; Cosens et al., 2014). Chaffin et al. (2016) define governance generally as the way in which society, a program, or any group makes collective decisions, chooses collective goals, and takes action to achieve those agreed-upon goals. The transition from general environmental governance to a more adaptive framework began with thinking about addressing the challenges of environmental problems and expanding governance tools to address these challenges at the right scale (Dietz et al., 2003). In short, adaptive governance (AG) is the social condition that enables ecosystem management through AM (Chaffin et al., 2014). AG is a structure that allows adaptation processes to emerge and enables a decision-making body to operate the dynamic and multi-scalar nature of SESs (Cosens et al., 2014b).

AG is a direct extension of the realization that AM is really a "complex societal collaboration" (Melis et al., 2015). AG combines a host of concepts that bring into decision-making, governance, and the use of science learning the human nature of management such as participation and collective action. Folke et al. (2005) identify four aspects of AG important in SESs:

1) Build knowledge and understanding of ecosystem dynamics.
2) Feed that knowledge into AM as the learning environment.
3) Share management and power through flexible institutions and multilevel governance structures.
4) Be prepared for uncertainty and surprise.

When these aspects are combined with Ostrom's concepts of polycentrism and information sharing, AG forms the platform necessary to allow sufficient flexibility and decision space for AM (Cosens and Williams, 2012).

What is AM without AG? The chief proposition of my dissertation is failure. Gunderson and Light (2006) note that AG "deals with the complex human interactions that have been obstacles to implementation of " AM. To explore this proposition, the framework conceptual model detailed below is built around looking for an AG structure that incorporates functioning decision-making, aspects of polycentrism, clear processes for making decisions, and organization around agreed-upon goals and objectives. It should also be matched to the correct bioregional scale (Huitema et al., 2009) that ensures the ecosystem in question and related institutional arrangements are compatible. In this way, restoration programs will reveal whether there is a useful input point for learning from AM.

AM Program Evaluation Framework: A Conceptual Model

Evaluating the process of AM for success is the link to governance and decision-making. Learning and process are the focus of AM, but that learning should be in service to decision-making and what decision-makers need to know. What information would be helpful to them as an input in decision-making? Is AM structured around delivering this information? I postulate that if so, AM will work at large scale. If not, AM is just trial and error dressed up as a big science project. In that case, AM will not be successful because there is no grounding purpose to follow the six-step cycle and generate learning. If the learning has nowhere to go (e.g. if the learning is just housed in published papers or monitoring and research reports and is not instead shaped to fit the information needs of the decision-makers and the goals/objectives of the program) then AM will fail. Or, more likely, the restoration program was not really doing AM in the first place.

The conceptual model framework described in detail in this chapter is grounded on the premise that a restoration program must build a working governance and decision-making structure to create the right landing spot for AM information and learning. Then, the iterative six-step cycle can be applied, learning has a place to go, and procedurally a program can successfully implement AM. I developed the methodology described in this chapter to gain insight into what the right working governance structure is, whether AM is structured to correctly link to that governance structure, and subsequently try to predict AM success or failure.

The components of the framework arose most directly out of my experience with several large-scale restoration programs around the country working through challenges related to successful implementation of AM and achievement of goals and objectives. While AM is ubiquitous in these programs as the management framework of choice (or of aspiration), they affirm the oft-stated axiom that few, if any, examples of successful AM at a large scale exist. Given the amount of federal money spent annually on large restoration programs and the promise of AM, it remains curious that examples of success are in short supply. There has been a good deal of recent scholarship on the construct and components of AG and the construct and components of AM separtely, but no examples of assessment frameworks that capture the linkages between governance condition and AM. *This cross-disciplinary approach is unique and holds value for application to restoration programs across the country facing the headwinds of reduced budgets,* *questioning of success, and the need to show underlying progress toward meeting foundational goals and objectives.* The framework, both in concept and application, is generalized for the concepts of AG and AM but specific to the primary context of river and aquatic restoration programs in the U.S. that purport to utilize AM. This conceptual model, and the associated application, are attempts to identify the aspects of governance that are most closely associated with the potential for solutions like AM to emerge, to facilitate social and scientific learning, and for governance (or AG) to adapt and adjust (Cosens et al., 2018; Pahl-Wostl et al., 2007). Figure 4.1 and the remainder of this chapter present the evaluation framework as a conceptual model. The methods for and results of an initial field trial of the framework as a practical tool to assess the governance structure and operation of a large-scale program, as well as the structure and operation of AM within the program, are presented in Chapters 5 and 6.

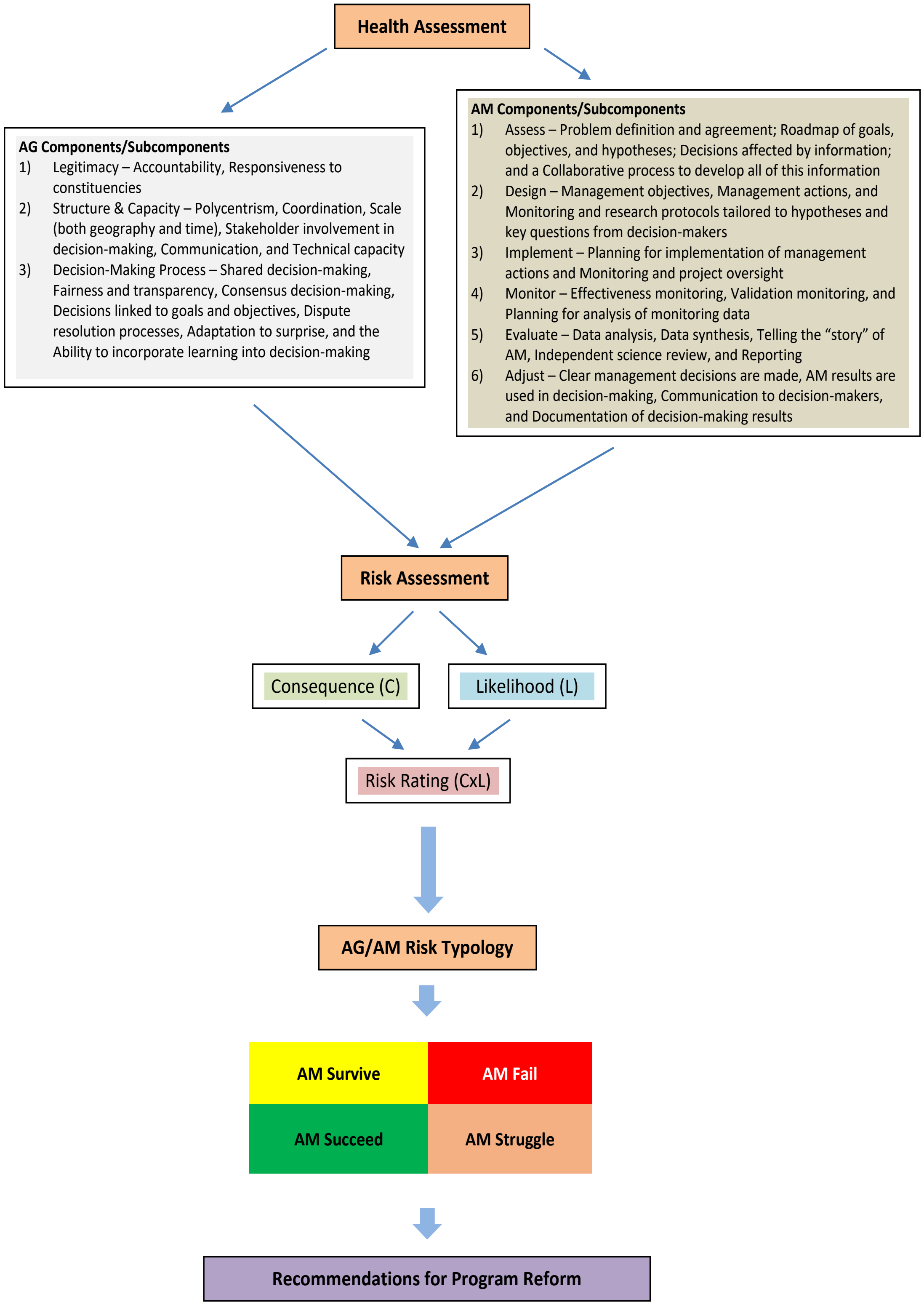

Figure 4.1. Schematic of conceptual model restoration program evaluation framework.

Conceptual Model Evaluation Framework Element – Performance Assessment

AG Components

Recent attempts at governance analysis have widened the identification and treatment of attributes of "good governance." Building off Ostrom's (1961) early work on polycentricity and coining of the term "adaptive governance" by Dietz et al. (2003), Lebel et al. (2006) identify six attributes of governance as it pertains to managing resilience in natural resource systems. Lockwood et al. (2010) propose a set of eight good governance principles as general guidance for natural resources management. Rijke et al. (2012) discuss the fit of a governance structure to its purpose and identify important properties of governance networks and processes. A large body of work by Pahl-Wostl and Knieper, with other partners (Pahl-Wostl et al., 2012; Pahl-Wostl and Knieper, 2014; and Knieper and Pahl-Wostl, 2016) digs deeply into water governance and management and encompasses important advances in ideal governance typologies and suggests further exploration of resource governance systems, particularly in U.S. river basins. Cosens et al. (2014) and the Adaptive Water Governance Project focus on the critical governance aspects of structure, capacity, and process particularly in relationship to the law in and management of social ecological systems.

Table 4.1 describes three governance components that regularly stand out as imperative in matching "good governance" with AM. While substantial recent scholarship on AG provides different models of what constitute the key components of AG, the three components of legitimacy, structure and capacity, and decision-making process consistently appear as critical features (Cosens et al., 2017; Brunner et al., 2005; Dietz et al., 2003; Folke et al., 2005; Lebel et al., 2006; Gunderson and Light, 2006;

Chaffin et al., 2014; Chaffin et al., 2016). The components are further adapted from legislative and implementation reviews of several large restoration programs across the U.S., discussions with governance and adaptive management experts from many of these programs, and from personal experience implementing AM and working on AM and AG issues in several systems. Key indicators are identified in Table 3 that would be expected for a restoration program to be successful in establishing and maintaining a functioning AG structure. Refinements in these components and indicators may happen over time as the evaluation methodology is improved through more in-depth and continued use.

Table 4.1. Conceptual model evaluation framework AG components, with definitions and key indicators.

AG Component	Definition/Subcomponents of Interest	Key Indicators
Legitimacy	Accountable and enabled with decision responsibility; responsive to constituencies above and below	• Negotiated or legislated context for decision-making • Foundational (program) document or some other kind of legislative authority • Authority for program and management actions extends for a minimum of 5-7 years with options for extension
Structure & Capacity	Polycentric structure with centralized decision-making body but with explicit support from committees and levels of authority; clear coordination among governance levels; scale of program represents manageable geography on the ground but also tied to relevance of key decision-makers; stakeholders directly involved in decision-making; clear and regular communication; technical capacity within program to deliver information useful to decision-makers	• Decision-making body described in foundational document that includes stakeholders making decisions • All program information is public and available electronically via a central database and web site • Geographic scale clearly defined • Program scale can result in measured benefits for species or resources in question • Program scale includes all relevant parties to decision-making • Constant and consistent communication within program, with authorities, and with the public • Interdisciplinary committees/teams • Stable source of funding tied to program goals and objectives
Decision-Making Process	Shared decision-making; fair and transparent process for making decisions by consensus; decisions tied to process described in foundational document and linked to program goals and objectives; means for resolving disputes and decisions that do not reach consensus; ability to respond to change and surprise (uncertainty) and to incorporate learning into decision-making	• Program goals and objectives clearly spelled out in foundational document and agreed upon by all parties • Understanding of methods for measuring these and reporting progress • Decision-makers agree on and understand questions to be addressed • Group votes recorded, record of consensus and/or successfully dealing with issues that do not result in consensus • Means for adjusting management based on program learning • Clear communication of useful technical information to decision-makers

The key AG components built into the conceptual model evaluation framework include:

Legitimacy – Adapted in part from Cosens et al. (2017), this component reflects a restoration program's authority to exist and make science-based decisions within a sphere of public support. Though Cosens et al. (2014b) argue legitimacy is not a defining feature of AG but rather a necessary element, aspects of legitimacy are centered in much of the most recent scholarship on the emergence of AG in environmental systems and Cosens et al. (2014a) note it is one of the most overlooked aspects of AM. This includes features of legitimacy such as accountability, transparency, stability over time but flexibility to respond to change, authority, integrity, an encompassing legal framework that is legally binding, legal sunsets, and clear support (Cosens et al., 2017; Lebel et al., 2006; Cosens et al., 2014a; Cosens et al., 2014b; Lockwood et al., 2010; Chaffin et al., 2014; Craig et al., 2017; Pahl-Wostl et al., 2012; DeCaro et al., 2017; Chaffin et al., 2016; Dietz et al., 2003). To bound this AG component for evaluation and to aid in developing a risk rating, key *subcomponents* for evaluation include accountability and responsiveness to constituencies.

Structure and Capacity – Adapted in part from Cosens et al. (2017), these combined components reflect the underlying structure of the AG framework in a restoration program and the capacity of that framework to function and support decision-making. This includes features of structure and capacity such as polycentrism with multiple levels of authority, subsidiarity with decision-making at the lowest scale closest to the resource, collaboration, promotion of learning, fit to the bioregional scale, adaptive capacity to deal with surprise, participatory capacity to engage stakeholders, context-dependent, promotion of cross-linkages, and well-defined boundaries for the dilemma faced by the SES in question and for the jurisdiction of the governance structure (Emerson and Gerlak, 2014; Cosens et al., 2017; Cosens et al., 2014a; Cosens et al.; 2014b; Lebel et al., 2006; Lockwood et al., 2010; Chaffin et al., 2014; Brunner et al., 2005; Huitema et al., 2009; Craig et al., 2017; Pahl-Wostl and Knieper, 2014; Pahl-Wostl et al., 2012; DeCaro et al., 2017; Cosens et al., 2018; Gerlak et al., 2020; Folke et al., 2005; Gunderson and Light, 2006; Chaffin et al., 2016; Dietz et al., 2003; Cosens 2010). To bound this AG component for evaluation and to aid in developing a risk rating, key *subcomponents* for evaluation include polycentrism, coordination, scale (both geography and time), stakeholder involvement in decision-making, communication, and technical capacity.

Decision-Making Process – This process-based component is adapted in part from Cosens et al. (2017) and Cosens et al. (2014a) and is focused on the ability of a restoration program's decision-making body (as a representation of AG) to implement actions, respond to learning, and make decisions. This includes features of decision-making such as problem solving, dispute resolution, seeking consensus, and supporting shared and participatory decision-making (Emerson and Gerlak, 2014; Cosens et al., 2017; Lebel et al., 2006; Cosens et al., 2014b; Lockwood et al., 2010; Craig et al., 2017; DeCaro et al., 2017; Gunderson and Light, 2006). To bound this AG component for evaluation and to aid in developing a risk rating, key *subcomponents* for evaluation include shared decision-making, fairness and transparency, consensus decision-making, decisions linked to goals and objectives, dispute resolution processes, adaptation to surprise, and the ability to incorporate learning into decision-making.

Assessment of these AG components and subcomponents through application of the conceptual framework will consist of a set of questions identified in Table 4.2. These questions are a tool to provide insight into the structure and function of AG in a restoration program from decision-makers, staff, independent scientists, and other program participants. The questions are adapted in part from governance component assessment questions developed by Cosens et al. (2014a) and expanded to fit the conceptual model's key components based on a review of substantial AG literature and my prior experience with implementing and assessing governance in several large restoration programs. These questions will form the foundation of initial applications of the conceptual model but may be adjusted based on situational context and particular issues facing successful implementation of AG.

Table 4.2. Assessment questions for conceptual model evaluation framework AG components.

AG Component	Questions
Legitimacy	1) Was the program formed by negotiation, legislation, or another mandate? 2) Were stakeholders involved in development of the program? How? 3) Is there a foundational program document that describes goals, objectives, and hypotheses? 4) Is there an Adaptive Management Plan? 5) How long is the program currently authorized to operate? 6) Is there a process in place for extending the program if more time is needed? 7) How is the program funded? 8) What are annual appropriations? 9) Who makes decisions about developing and spending the annual budget? 10) Is the budget tied to program goals and objectives? 11) What is the overall program budget? 12) To whom are decision-makers accountable above them (governors, agency heads, federal administration, etc.)? 13) To whom are decision-makers accountable below them (constituencies)? 14) Does the program involve endangered/threatened species? 15) If the program is engaged in species recovery, is there a clear statement of what recovery means and how it will be measured?
Structure & Capacity	16) Is the decision-making body described in the foundational document? 17) Is there a process for filling spots on the decision-making body specified in the foundational document? 18) Are stakeholders explicitly part of the decision-making body or do they just serve an advisory role? 19) Is there a committee structure specified in the foundational document to assist the decision-making body with policy matters, technical matters, and program operation? 20) How are the different levels of the program coordinated and by whom? 21) What is the geographic scale of the program? 22) What is the approved time scale of the program? 23) Are all the relevant entities to the program encompassed by these scales of time and space? 24) Can measurable gains for the system and the species involved be achieved in the time and space defined? 25) Does the program include the technical capacity to deliver useful information to decision-makers? 26) Are technical teams/committees interdisciplinary, and do those disciplines cover the important technical topical areas for the program? 27) How is communication handled within the program? 28) How is communication handled with authorities? 29) How is communication handled with the public? 30) What is the level of trust among the decision-makers?
Decision-Making Process	31) Who makes the decisions? 32) Is decision-making shared with stakeholders or are decisions ultimately made unilaterally by a single agency? 33) Are program goals and objectives clearly detailed in the foundational document? 34) Do all decision-makers agree on the goals and objectives? 35) Is there agreement to utilize adaptive management? 36) What do the key questions decision-makers have that relate to program scientific information and adaptive management? 37) Do all decision-makers agree on these key questions? 38) Is there a clear understanding of the data collection methods relevant to these questions and reporting progress? 39) Does the decision-making body operate by consensus? 40) Does the program have a history of successfully reaching consensus? 41) If consensus is not reached, what is process for resolution? 42) Does the program have a history of using this resolution method? 43) Are group votes recorded?

	44) Is there a process spelled out for adjusting management based in part on program learning? 45) Is there regular clear communication of scientific and technical information to decision-makers? 46) Is the program prepared to respond to changing conditions or surprises? 47) Have any surprises occurred, and if so, how did the program deal with them? 48) Does the program have a record of incorporating learning into decision-making?

AM Components

The second category of components in the conceptual model is built around the structure of AM itself. The AM components center on a hybrid approach of evaluating AM against implementation of each of the six key steps, followed later by categorizing a program's AM prospects within a proposed ideal typology. Table 4.3 describes the six steps or components of AM that if present are considered to constitute successful AM. Key indicators are also identified that would be expected in any adaptive management program to be successful in implementing a full cycle of AM through the Adjust component with a clear indication of the learning from AM being utilized in the decision-making process.

The approach of assessing AM against the six steps as "components" is adapted from Chaffin and Gosnell (2015) with insight on the indicators from Murray et al. (2011), additional literature review, and personal experience implementing and assessing AM in several large restoration programs across the country. This approach keeps the focus on the process and learning of AM rather than trying to assess AM against context-specific goals. Previous AM assessment methodologies have tended to focus on reviewing AM through a lens of particular areas of interest or study. Gregory et al. (2006) pose AM topical considerations and related questions. Thom et al. (2016) evaluate several large aquatic ecosystem recovery programs by focusing on the AM approach (passive or active), presence or absence of decision triggers, and the level of stakeholder engagement. Beratan and Berkeley (2020, in process) are attempting to evaluate the effectiveness of Collaborative Adaptive Management (CAM) against the challenges of process planning and the institutions in which it operates.

Table 4.3 describes six AM components that regularly stand out as imperative in successful AM. *The conceptual model framework presented here is intended to be applied more broadly across a range of AM programs to provide a more consistent measure of success*. These six components reflect the basic construct of AM as a six-step process and are grounded in much of the scholarship on AM dating back to its origins. While different models of the AM process have been proposed (Murray and Marmorek, 2003; Stankey et al., 2003; Williams et al., 2009) there is general consistency among these models on the inclusion of the six main steps. *These steps provide a consistent set of metrics for assessing AM across a range of restoration programs and build on the theoretical underpinnings of AM found in a range of scholarship and literature*. Key indicators are identified in Table 4 that would be expected for a restoration program to successfully implement AM. Refinements in these components and indicators may happen over time as the evaluation methodology is improved through more in-depth and continued use.

Table 4.3. Conceptual model evaluation framework AM components, with definitions and key indicators.

AM Component	Definition/Subcomponents of Interest	Key Indicators
Assess	Problem definition and agreement; decisions will be affected by information so a roadmap of goals, and objectives, hypotheses is established accordingly; collaborative process for development and agreement; these are the building blocks of AM	• Agreed-upon goals and objectives • Definition of AM written down • Identify critical uncertainties – what don't we know but want to learn? • Conceptual Ecological Models (CEM) and/or conceptual management models • Alternative management actions • Identify indicators/triggers, spatial and temporal bounds • State assumptions • Clear indication of how what is learned will be used for decisions • Collaborative process to develop this information, not mandated from top-down or only science teams
Design	Explicit management objectives, management actions, and monitoring/research protocols designed to deliver information relative to priority hypotheses and questions from decision-makers	• Decide on active or passive AM • Statement of measurable objectives/management actions • Contrasting treatments if possible (with replication and control) • Modeling to predict outcomes • Data management plan • Monitoring plan • Design is linked to time and budget authority for program
Implement	The machinery of AM on the ground; implementation of management actions and monitoring, with project oversight	• Management actions and monitoring implemented • Explicit project oversight with staff dedicated to AM program
Monitor	Conduct monitoring and research necessary to provide the correct data to answer AM program hypotheses and decision-maker questions	• Monitoring protocols developed that provide data to answer key questions and link to decisions • Baseline monitoring, or agreement on the starting condition of the system in question • Effectiveness (achieve project objectives?) monitoring and validation (species response and progress toward objectives) monitoring
Evaluate	Critical element – the path from data to management decision-making; statements of what was learned and what it means for goals, objectives, hypotheses, and decision-making	• Compare monitoring results against objectives, hypotheses, uncertainties, and decision-maker questions • Compare results against model predictions • Use of peer review or other independent science review • Annual data synthesis reporting
Adjust	Clear management decisions are made, with AM results used to help guide those decisions	• Clear and regular communication of synthesis to decision-makers • Record of decision-makers using information to help make decisions • Documentation of decisions and how AM information was used in the decision-making process • Documentation of changes to management actions at least in part because of program learning • Information updated regularly and made public

The key AM components built into the conceptual model evaluation framework include:

Assess – This component captures the beginning of the AM cycle and starts with a clear definition of the problem and an agreement of how to proceed with addressing the problem. This process will provide a roadmap for next steps and set the stage for collaborative development of an approach for assessing hypotheses and contributing learning to the decision-making process. The "assess" component includes features such as defining and bounding the problem; establishing clear goals; defining management objectives, management actions, indicators, uncertainties, and hypotheses; exploring alernative management actions; spatial and temporal bounds, fit to the right bioregional scale; anticipated learning; embracing uncertainty; and treating learning as central to the process (Marmorek, 2020; Marmorek et al., 2019, Murray and Marmorek, 2003; Susskind et al., 2012; Holling 1978; Walters, 1986; Lee, 1993; Walters and Holling, 1990; Melis et al., 2015; Williams et al., 2009). To bound this AM component for evaluation and to aid in developing a risk rating, key *subcomponents* for evaluation include problem definition and agreement; a roadmap of goals, objectives, and hypotheses; decisions affected by information; and a collaborative process to develop all of this information.

Design – This component captures the technical aspects of developing an AM Plan and how to design management experiments to achieve objectives while testing hypotheses regarding critical uncertainties. The "design" component includes features such as designing management experiments with contrast; developing an implementation plan and monitoring plan; specifying a plan for data management and analyses; identifying a range of possible outcomes; and focusing on large experiments and crude monitoring instead of small experiments and precise monitoring (Marmorek, 2020; Marmorek et al., 2019, Murray and Marmorek, 2003; 2012; Holling 1978; Walters, 1986; Lee, 1993; Walters and Holling, 1990). To bound this AM component for evaluation and to aid in developing a risk rating, key *subcomponents* for evaluation include management objectives, management actions, and monitoring and research protocols tailored to hypotheses and key questions from decision-makers.

Implement – This component captures the implementation of AM on the ground. The "implement" component includes features such as implementing management actions as designed; conducting monitoring according to established protocols; documenting changes; and showing interim results (Marmorek, 2020; Marmorek et al., 2019; Murray and Marmorek, 2003; Walters and Holling, 1990). To bound this AM component for evaluation and to aid in developing a risk rating, key *subcomponents* for evaluation include planning for implementation of management actions and monitoring and project oversight.

Monitor – This component captures the methods of monitoring and research needed to provide the right data to answer AM Plan hypotheses and decision-maker questions. The "monitor" component includes features such as conducucting implementation, effectiveness, and validation monitoring; summarizing interime results and outcomes; and beginning to asses progress toward management objectives and testing hypotheses (Marmorek, 2020; Marmorek et al., 2019; Murray and Marmorek, 2003; Walters and Holling, 1990). To bound this AM component for evaluation and to aid in developing a risk rating, key *subcomponents* for evaluation include effectiveness monitoring, validation monitoring, and planning for analysis of monitoring data.

Evaluate – This component captures the process of analyzing and synthesizing raw data from AM monitoring and research and stitching that data in the "story" of AM. The "evaluate" component includes features such as comparing predicted and actual outcomes; assessing alternative hypotheses; beginning to link multiple lines of evidence; completing synthesis reporting; obtaining independent science review; and developing bottom-line conclusions for decision-makers (Marmorek, 2020; Marmorek et al., 2019; Murray and Marmorek, 2003; Walters and Holling, 1990). To bound this AM component for evaluation and to aid in developing a risk rating, key *subcomponents* for evaluation include data analysis, data synthesis, telling the "story" of AM, independent science review, and reporting.

Adjust – This component captures the movement of data synthesis from previous steps of AM into the decision-making realm. Is AM learning used to change management actions or affect other decisions? The "adjust" component includes features such as documenting what learning occurred; communcating learning to decision-makers; and using tools such as Structured Decision Making (SDM) as a way to manage better (Marmorek, 2020; Marmorek et al., 2019; Murray and Marmorek, 2003; Walters and

Holling, 1990; Melis et al., 2015; Williams et al., 2009). To bound this AM component for evaluation and to aid in developing a risk rating, key *subcomponents* for evaluation include clear management decisions are made, AM results are used in decision-making, communication to decision-makers, and documentation of decision-making results.

Assessment of these AM components through application of the conceptual framework will consist of a set of questions identified in Table 4.4. These questions are a tool to provide insight into the structure and function of AM in a restoration program from decision-makers, staff, independent scientists, and other program participants. The questions are adapted in part from AM component assessment questions developed by Chaffin and Gosnell (2015) and expanded to fit the conceptual model's key components based on a review of substantial AM literature and my prior experience with implementing and assessing AM in several large restoration programs. These questions will form the foundation of initial applications of the conceptual model but may be adjusted based on situational context and particular issues facing successful implementation of AM.

Table 4.4. Assessment questions for conceptual model evaluation framework AM components.

AM Component	Questions
Assess	1) What are the key questions important to decision-makers? 2) Do all decision-makers know what those questions are and agree those are the right questions? 3) What information do decision-makers need? 4) What are the program's goals and objectives? 5) What is the program's definition of AM? 6) Is the AM definition written down and does everyone know it? 7) Are objectives measurable? Are hypotheses testable? 8) Does the program have CEMs and/or conceptual management models? 9) Are alternative management actions/treatments defined? 10) Are decision triggers/indicators defined for the appropriate geographic scale and time? 11) Is there a clear statement of assumptions for program hypotheses and management actions? 12) Is a process specified for communicating learning to decision-makers and how that learning will be used to help make decisions? 13) Were stakeholders involved in development of the Adaptive Management Plan, including specifying objective, hypotheses, and management actions? 14) Was the Adaptive Management Plan developed through a collaborative process?
Design	15) Does the program utilize passive or active AM, and do the decision-makers understand the difference? 16) What are the proposed management actions? 17) Is there contrast in the management actions, how they are implemented, and expected results? 18) Does the program conduct modeling to predict the possible outcomes of management actions? 19) If used, how are models developed and refined? 20) Who conducts modeling for the program? 21) Is there a Data Management Plan? 22) Does the program have specific monitoring protocols for data collection? 23) How were these protocols developed, and who developed them? 24) Is there a process for changing these monitoring protocols? 25) Is the design of AM linked to the program's time and budget authority?
Implement	26) Who leads the implementation effort? 27) Are staff employees of any of the program's decision-making entities? 28) Are there staff assigned to the program that work on the program full time? 29) How are management actions implemented? 30) How are the results of implementation monitored and reported to the decision-makers? 31) Are there sufficient time and budget resources available for full program implementation?
Monitor	32) Is monitoring and research tailored to decision-maker questions and information needs? 33) Do program staff direct monitoring? 34) Is monitoring conducted by staff, by other parties, or a combination? 35) Is there baseline monitoring data? 36) Is there agreement in the program on baseline conditions? 37) Does the program conduct effectiveness monitoring (how did aquatic system respond)? 38) Please describe the program's effectiveness monitoring. 39) Does the program conduct validation monitoring (species response to management actions)? 40) Please describe the program's validation monitoring.

Evaluate	41) Are monitoring results compared against objectives, hypotheses, and uncertainties? 42) Are monitoring results compared against model predictions? 43) How is this information reported, by whom, and how often? 44) Does the program use independent peer review? 45) If so, what documents or items are peer reviewed? 46) Does the foundational program document include details of the program's peer review process? 47) Does the program use an independent science review panel? 48) If so, what are the science panel's responsibilities? 49) Does the foundational program document detail how science review panel members are appointed? 50) Does the program conduct data synthesis? 51) How is data synthesis reported? 52) Who is responsible for developing and reporting program data synthesis? 53) Does the program generate an annual data synthesis report? 54) Does the program host an annual adaptive management/data synthesis workshop?
Adjust	55) Is there regular communication of relevant scientific and technical information to decision-makers? 56) How is AM information communicated to decision-makers and used to adjust management actions? 57) Has your program successfully adjusted using AM information as part of the decision-making process? 58) How are decisions documented? 59) How are changes to management based on program learning documented? 60) Is program information updated regularly and made public? 61) Is all program information available electronically?

Conceptual Model Evaluation Framework Element – Risk Assessment

The foundation of my conceptual model evaluation framework draws heavily from recent scholarship on AG and AM analysis and also recent efforts to apply risk analysis to governance systems and AM. Strong links between governance structure and AM point to the overlap between organizational processes and risk management (Loftin, 2014). For any risk management project, risk analysis is a first step in evaluating threats and helping decision-makers prioritize and make more informed choices (Dale et al., 2013). In an AM program, this approach is important in helping determine what it means to sufficiently resolve an uncertainty (Loftin, 2014). This raises the concepts of the probability of failure and the consequences of that failure for program success (Loftin, 2014).

Risk is often invoked in AG and AM literature relative to uncertainty, reducing that uncertainty, and how governance structures can be adapted to help overcome the risk aversion of decision-makers. If AM is intended as an exercise in embracing uncertainty and taking risks (Walters, 1986; Walters and Holling, 1990; Murray and Marmorek, 2003; Doremus et al., 2011; Melis et al., 2015), and if AG emerged as an adaptation to enable AM in SESs (Folke et al., 2005; Chaffin et al., 2014; Chaffin et al., 2016; Cosens et al., 2014), then the presence of risk, risk assessment, and overcoming risk aversion are inhernet to the successful practice of AG and AM. Risk-taking can promote innovation in thinking that can lead to more creative applications of AG and AM (Kofinas et al., 2007) Uncertainty gives rise to interest in AM but that same uncertainty can slow or cripple the implementation of AM due to high risk-aversion in many of the governing institutions in environmental systems (Bormann and Stankey, 2009). Risk aversion is routinely cited as a key stumbling block in AG and AM leadership and decision-making (Peat et al., 2017; Williams and Brown, 2014) as well as navigating between assessments of resilience and application of law in attempts develop functional AG and AM and improve outcomes in environmental systems (Walker and Salt, 2012). Some perceptions of risk are specific to threatened and endangered species and a misconstured reluctance on the part of managers to embrace experimental policies for fear of negative impacts on those imperiled species (Runge, 2011; Allen and Gunderson, 2011). These types of risk aversion, including a lack of understanding true risks and their implications, can be so high that it results in programs being stuck in a perpetual planning mode (Gunderson and Light, 2006; Zellmer and Gunderson, 2009).

Calls to acknowledge and specify the uncertainties and risks related to AM implementation and overcome risk aversion suggest a need to provide some basic yet consistent means of assessing and communicating risk through an AG structure. Dietz (2013) highlights adaptive risk management, or adaptive risk governance, as a response to the challenges of uncertainty in environmental systems. Another way to name or define AG, adaptive risk management affirms the idea that "decisions should take explicit account of uncertainty, facilitate social learning, maintain some flexibility, and revisit the decision periodically" (Dietz, 2013). In essence, the combined key concepts of AG and AM. In discussing adaptive co-management, Armitage et al. (2008) point to risk sharing through collaboration for management experiments and to promote adaptation and sustainability. In all cases, decision-makers dealing with uncertainty and the risks of taking action "do need to know those uncertainties that really matter to the magnitude of the risk and its management " (Kasperson, 2014).

The typical model of risk analysis is comprised of risk assessment, risk management, and risk communication (Klink and Renn, 2012). Risk assessment is the process of evaluating consequences and their likelihood of occurring (Lane and Stephenson, 1998). Risk management means decision-makers using the results of a risk assessment to compare and contrast decision alternatives. Risk communication is part of risk management in an organizational setting, focusing on communicative goals and linking risk analysis results to key aspects of organizational learning (Boholm, 2019). For effective risk communication, Kasperson (2014) recommeds four principles: 1) an understanding that risk communication takes time and persistence; 2) the need to address conflicting values and issues of concern; 3) communication of uncertainties; and 4) the redesign of information sharing processes in situation of high distrust.

For the purposes of my dissertation and the conceptual model evaluation framework, I focus on using the first step of risk analysis, risk assessment, as an aid in identifying weaknesses in AG and AM structure and function in a restoration program. Risk assessment approaches are common in many fields, including defense, engineering, and medicine. Ecological risk assessment has been in use for decades (Lackey, 1994). Fisheries management has adopted wide use of risk assessment (Francis and Shotten, 1997; Lane and Stephenson, 1998; Fletcher, 2005). More complex and robust quantitative risk assessments are used in stock assessment analyses with rich datasets to help meet a set level of performance (Francis and Shotten, 1997; Fletcher, 2010; Fletcher, 2005). However, these quantitative analyses only work in a small number of situations where significant amounts of quantitative information is available (Fletcher, 2005).

An alternative risk assessment approach is less complex qualitative risk assessment (Fletcher, 2005; Fletcher, 2009; Scandol, 2009). Qualitative assessments use word form or descriptive scales to describe the magnitude of potential consequences and likelihood those consequences will occur (Scandol, 2009). Qualitative assessments apply descriptive scales for consequence and likelihood in table form and then combine those into a colored risk matrix (or "risk fever chart") where risks are given a priority (Scandol, 2009; Lough et al., 2006). This produces a general indication of the level of risk and is often the only option available when numerical data is inadequate or not present (Scandol, 2009). The purpose of these formal qualitative risk assessments is to assess risks of components in question (in the case of my dissertation and the conceptual model evaluation framework, the components of AG and AM identified and detailed above) and determine their priority for action (in the case of dissertation and the conceptual model evaluation framework, action by the restoration program in question to improve the performance and outcomes of AG and AM).

All risk analysis is subjective, requiring judgment and open to human bias (Redmill, 2002). Quantitative risk analysis that involves numerical modeling also involves subjectivity in choices of model structure and parameter values that can result in precise but meaningless risk metrics (Scandol, 2009). Qualitative risk analysis may result in less precision but results that are more real and general and that focus on important relationships, especially important when dealing with the uncertainties inherent in ecosystems and SESs (Scandol, 2009). As a result, qualitative risk assessment is used regularly in many aspects of environmental and fisheries management (Food and

Agriculture Organization of the United Nations, 2020; Perseus, 2020; Mimeault et al., 2017; Fisheries and Oceans Canada, 2019; Mandrak et al., 2012).

Formal qualitative risk assessments begin with a qualitative rating of consequence (a measure of impact) and a qualitative rating of the likelihood that specific consequence will happen (a measure of probability) (Food and Agriculture Organization of the United Nations, 2020; Fletcher, 2010). Scores or ratings for consequence and likelihood should be based on literature reviews, expert knowledge, and data obtained from the system or program in question, with careful attention paid to the collective wisdom about a system and components of interest (Food and Agriculture Organization of the United Nations, 2020; Fletcher, 2010; Fisheries and Oceans Canada, 2019). But, if the risk assessment will be used to benchmark a particular system or program over time, or used to compare across systems or programs, stanadardized criteria for rating consequence and likelihood (and subsequent risk ratings in the next step) should be developed and applied (Dale et al., 2013). A standardized approach can be repeated over time within or between governance systems, though the quality and depth of data used in each assessment will drive the quality of the risk analysis.

The second step in a formal qualitative risk assessment is to calculate a risk rating for components of interest (Food and Agriculture Organization of the United Nations, 2020; Fletcher, 2010). The simple calculation for risk rating is multiplying the consequence rating (C) and likelihood rating (L) to produce a single risk score (CxL = Risk Rating). These values are plotted against a risk matrix colored to visually represent varying degrees of risk. Justifications should be recorded for the logic and assumptions inherent in assinging ratings for consequence, likelihood, and risk (Food and Agriculture Organization of the United Nations, 2020; Fletcher, 2010).

Conducting this kind of risk analysis is not common for AG structures in river restoration programs or in large-scale AM programs (Loftin, 2014). However, given that AM is largely an exercise in embracing uncertainty it seems logical that risk assessment holds promise as an investigative tool for the prospect of predicting AM success. Loftin (2014) notes that AM can only be successful "if applied under and supported by a governance structure that understands AM". The conceptual model evaluation framework presented here is an attempt to provide decision-makers and managers in existing or proposed large-scale programs with a tool to explore that AG-AM relationship in their own programs.

Using a formal qualitative risk assessment (CxL = Risk Rating) provides an analytical tool for assessing the structural and functional performance of important AG and AM components and suggests a means for at least initial insight into the potential for program success and recommendations to avoid program failure. A thorough review of AG and AM literature reveals very few examples of qualitative risk assessment used to evaluate governance systems generally (with the exception of extensive use in fisheries management) and has not been previously applied in the U.S. on environmental governance structures or on river restoration programs. The application of qualitative risk assessment to AM programs presented in my dissertation is unique, as is the combination of a risk assessment for both AG and AM in one model The most applicable and insightful examples comes from Dale et al. (2013 and 2016). In both examples, the authors conducted a risk analysis for governance systems using the Great Barrier Reef as a case study. The risk analysis framework developed in Dale et al. (2013) details normative criteria for consequence, likelihood, and risk and describes a trial application of this risk assessment methodology to a set of governance themes, domains, and subdomains. Dale et al. (2016) applies this formal qualitative risk assessment framework across 40 structural and functional subdomains of Great Barrier Reef governance and incorporates the establishment of risk ratings for these subdomains as represented in a color-coded risk matrix. Both Dale et al. (2013) and Dale et a. (2016) conclude that a risk-oriented analysis of governance was analytically powerful and valuable for identifying areas of potential high risk for decision-makers to consider as reform potential. Both articles also note that this kind of qualitative risk assessment is the exception, not the norm, and that broader application of the practical risk assessment tool would contribute to the consistency of the approach and add to the potential of creating a blueprint for decision-making and reform.

In this context, success or failure of AG and AM components (and their underlying subcomponents) fit the definition of risk as the product of the probability of failure and the magnitude of the consequence of that failure (Loftin, 2014). For the purposes of my dissertation and development of the conceptual model evaluation framework, I adpated the following definitions for likelihood and consequence from Dale et al. (2013), Dale et al. (2016), and Loftin (2014):

> *Likelihood* – The idea that something is likely to happen or have happened. For my conceptual model, a failure of AG or AM with a low likelihood of occurring would present a low risk to a restoration program manager or

decision-maker.

Consequence – The importance of a result of something that occurred earlier. For my conceptual model, an AG or AM component with a high likelihood of failure could have significant negative consequences on the overall success of a restoration program.

In consideration of applying the conceptual model evaluation framework across more than one restoration program, I adapted standardized criteria for consequence and likelihood ratings from Dale et al. (2013) that could be applied to components of AG and AM. Tables 4.5 and 4.6 detail the standardized criteria utilized to develop the likelihood and consequence ratings. A decision rule is described for each possible rating score and each score and decision rule is also color-coded to provide easy visual reference and to translate more directly to the overall risk matrix in the next step. The result of application of these criteria for consequence and likelihood for components of AG and AM will be a 5x5 risk matrix. This is a first step in a formal qualitative risk assessment for AG and AM component failures that are likely to occur.

Table 4.5. Rating scale for consequences of AG or AM component failure.

Consequence Rating	Decision Rule
(1)	Failure of the AG or AM component/subcomponent will have no consequences for intended program outcomes.
(2)	Failure of the AG or AM component/subcomponent will have limited consequences for intended program outcomes.
(3)	Failure of the AG or AM component/subcomponent will have consequences of concern for intended outcomes.
(4)	Failure of the AG or AM component/subcomponent will have significant consequences for intended outcomes.
(5)	Failure of the AG or AM component/subcomponent will have severe consequences for intended outcomes.

Dark Green = no risk **Light Green** = low risk **Yellow** = moderate risk
Orange = moderately high risk **Red** = high risk

Table 4.6. Rating scale for likelihood of AG or AM component failure.

Likelihood Rating	Decision Rule
(1)	The performance (structure/function) of the AG or AM component/subcomponent is excellent overall and will not fail to deliver its intended restoration program outcomes.
(2)	The performance (structure/function) of the AG or AM component/subcomponent is good overall and is not likely to fail to deliver its intended restoration program outcomes.
(3)	The performance (structure/function) of the AG or AM component/subcomponent is marginal overall and could fail to deliver its intended restoration program outcomes.
(4)	The performance (structure/function) of the AG or AM component/subcomponent is poor overall and is likely to fail to deliver its intended restoration program outcomes.
(5)	The performance (structure/function) of the AG or AM component/subcomponent is dysfunctional overall and will fail to deliver its intended restoration program outcomes.

Dark Green = no risk **Light Green** = low risk **Yellow** = moderate risk
Orange = moderately high risk **Red** = high risk

The next step in the formal qualitative risk assessment is to combine consequence and likelihood ratings into an overall risk matrix. The risk rating or value for each AG or AM component (or subcomponent) is the mathematical product of the consequence (C) and likelihood (L) ratings from the previous step. Deriving a risk rating or risk value by multiplying C x L is common methodology in risk assessments and is standard practice as applied to fisheries (Fletcher, 2005; Fisheries and Oceans Canada, 2019; Fletcher, 2010 and 2019; Food and Agriculture Organization of the United Nations, 2020; Francis and Shotton, 1997; Lane and Stephenson, 1998; Lough et al., 2006; Mandrak et al., 2012; Mimeault et al., 2017; Perseus, 2020; Scandol et al., 2009). The C x L risk rating methodology was also applied to multiple domains and subdomains of AG at a large scale in the Great Barrier reef (Dale et al., 2013 and 2016) which served as a foundational example for the use of C x L risk ratings in my conceptual model evaluation framework. As detailed in Figure 4.2, calculating a C X L risk rating for each AG and AM subcomponent and component of interest will result in a 5x5 risk matrix with possible values between 1 and 25. This method allows for more accurate ranking and clustering of AG and AM component risk to reveal more significant areas for program reform (Dale et al., 2016). This matrix also employs a color scale as a quick-reference visual guide to the degree of severity of risk as explained in Table 4.7.

Likelihood Rating

AG/AM component performance dysfunctional and will fail to deliver intended restoration outcomes. (5)	5	10	15	20	25
AG/AM component performance poor and will likely to fail to deliver intended restoration program outcomes. (4)	4	8	12	16	20
AG/AM component performance marginal and could fail to deliver intended restoration program outcomes. (3)	3	6	9	12	15
AG/AM component performance good and will not fail to deliver intended restoration program outcomes. (2)	2	4	6	8	10
AG/AM component performance excellent and will not fail to deliver intended restoration program outcomes. (1)	1	2	3	4	5
Risk Rating	Failure of AG/AM component will have no consequences for intended restoration program outcomes. (1)	Failure of AG/AM component will have limited consequences for intended restoration program outcomes. (2)	Failure of AG/AM component will have consequences of concern for intended restoration program outcomes. (3)	Failure of AG/AM component will have significant consequences for intended restoration program outcomes. (4)	Failure of AG/AM component will have severe consequences for intended restoration program outcomes. (5)

Consequence Rating

Figure 4.2. 5x5 risk matrix (CxL = Risk Rating) for AG and AM components, adapted from Date el al. (2016).

Table 4.7. Color-coded risk rating descriptions for risk matrix (Figure 4.2), adapted from Fisheries and Oceans Canada (2019).

Risk Rating (from Risk Matrix)	Risk Description	Management Recommendation
1-5 **No Risk**	A risk where: • No impact to the successful function of AG or AM or to successful outcomes of the restoration program.	No adjustments in AG, AM, or management necessary.
6-10 **Low Risk**	A risk where: • A negligible or non-detectable impact to the successful function of AG or AM and to successful outcomes of the restoration program could occur. • A detectable but minimal impact could occur but is not likely.	Generally, no adjustments in AG, AM, or management necessary.
11-15 **Moderate Risk**	A risk where: • It is likely that a detectable but minimal impact to the successful function of AG or AM and to successful outcomes of the restoration program will occur. • A detectable moderate impact could occur but is not likely.	Based on the nature of the risk, additional adjustments in AG, AM, or management may or may not be necessary.
16-20 **Moderately High Risk**	A risk where: • It is likely that a detectable moderate impact to the successful function of AG or AM and to successful outcomes of the restoration program will occur. • A significant or severe long-term impact could occur but is not likely.	Reform or refinement of AG, AM, and/or management should be considered to support successful restoration program function.
21-25 **High Risk**	A risk where: • There is potential, even unlikely, for a severe long-term impact to the successful function of AG or AM and to successful outcomes of the restoration program to occur. • It is likely that a significant or detectable moderate impact will occur.	Reform or refinement of AG, AM, and/or management necessary to support successful restoration program function.

Conceptual Model Evaluation Framework Element – AG/AM Risk Typology

As a means of linking the AG and AM component performance assessment and risk assessment, I suggest a unique categorization of risk ratings into a repeatable typology. As detailed in Figure 4.3, the two-dimensional classification organizes degrees of AG component failure risk and AM component failure risk into a configuration of four quadrants. The configuration is intended to serve as a predictive tool for the success or failure of AM within a restoration program. The AG/AM risk typology is adapted from the coordination and polycentricity characteristics of a proposed ideal typology of governance regimes developed by Pahl-Wostl and Knieper (2014). The Pahl-Wostl and Knieper (2014) authors constructed a Weberian ideal type noting four possible quadrants for categorizing governance regimes related to climate change adaptation. Weber's ideal type was developed through sociological research and can be a useful tool for assigning meaning and a categorization structure to data beyond sociology (Swedberg, 2018).

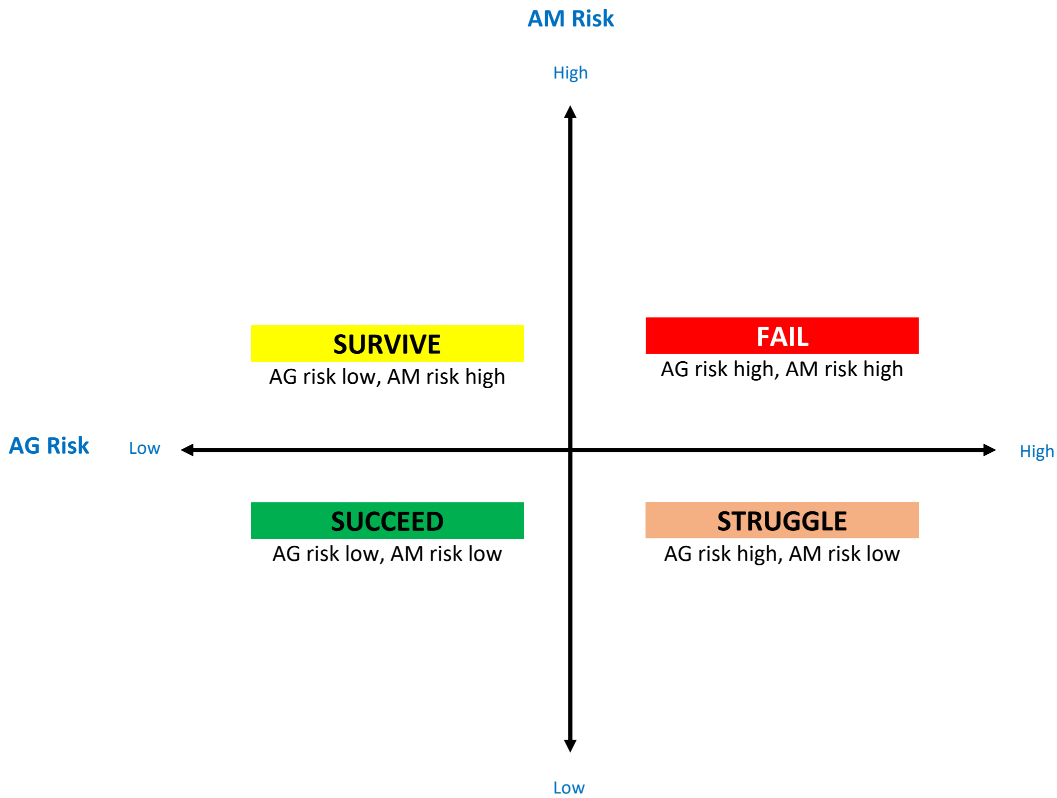

Figure 4.3. Proposed AG/AM risk typology.

AG/AM Risk Typology Quadrants

As with the risk assessment, my underlying assumption for application of the risk typology is that the restoration program in question intends to remain functional over time, is making management decisions, and is (or believes it is) or wants to start implementing AM successfully. With this as the definition of success for a restoration program for the purposes of this typology, the risk of success or failure of a restoration program overall and AM in particular is categorized into four possible quadrants:

Succeed – There is low risk of AG failure and low risk of AM failure. This means the restoration program will succeed because of a strong and functional AG structure with all key components present and functioning, and that AM is likely to succeed within this structure with a functional AM process attentive to all six steps of the AM cycle.

Survive – There is low risk of AG failure but high risk of AM failure. This means the restoration program will likely survive as a program generally because some or all of the key AG components are present and functioning, but because of some weaknesses in AG structure and function and also weaknesses in the AM process, AM will not succeed within the program.

Struggle – There is high risk of AG failure and low risk of AM failure. This means the restoration program may continue to exist and function at some level but will struggle to be successful. The AG structure is weak and not functioning well enough to support the process of AM. Several of the six AM steps may be in place but will be operating without connection to the AG structure. In this case, a program will merely be building a “science pile” of information through application of AM but not enabling use of that information in decision-making.

Fail – There is high risk of AG failure and high risk of AM failure. This means that the restoration program is likely to fail overall without significant intervention. An AG structure is not present or functional and thus there is no social capital or inertia to successfully implement AM. In this case, the AM process is not functional and any activity being conducted prescribed to AM is simply trial and error in this condition.

AG/AM Risk Typology Dataset and Scores

Data for characterizing risk as a means to categorize AG and AM for placement in the typology will be drawn from the risk assessment of AG and AM components and subcomponents. A brief summary:

AG component risk – The risk rating for each AG subcomponent will be used to calculate an average risk rating for the overall component. An overall average AG risk rating for the restoration program will be calculated from the individual component risk rating averages.

AM component risk – The risk rating for each AM subcomponent will be used to calculate an average risk rating for the overall component. An overall average AM risk rating for the restoration program will be calculated from the individual component risk rating averages.

Scores plotted in the typology – For each restoration program, three scores will be plotted in the typology: Score #1 is the overall average AG risk rating; Score #2 is the overall average AM risk rating; and Score #3 is the overall average risk rating for the restoration program (overall average AG risk rating + overall average AM risk rating divided by 2).

Conceptual Model Evaluation Framework Element – Recommendations for Restoration Program Reform

Based on results of the AG and AM component performance assessment, the AG and AM component/subcomponent risk assessment, and application of the AG/AM risk typology, identified weaknesses in the structure and function of AG and AM in a restoration program will be the focus of recommendations for restoration program reform and refinement. Suggested reforms will be a starting point of preliminary priorities for strategic reform and overall improvements to the structural integrity of both AG and AM within a restoration program. Proposed reforms can serve as a benchmark to monitor and see how successfully a restoration program adjusts and adapts over time in an effort to improve outcomes.

Conclusion

Scholarship on governance identifies several overlapping themes with AM and identifies AG as the emergent structure necessary to tackle the challenges of moving large-scale AM programs forward (Gunderson and Light, 2006; Chaffin et al., 2014; Cosens et al., 2014). As noted by Chaffin et al. (2014), most of the recent research on adaptive governance has been theoretical in nature, building on the early work of Elinor Ostrom with polycentric forms of governance, finding a common definition in Dietz et al. (2003), and branching off into how governance structures take on complexities like resilience and climate change (Cosens et al., 2014; Chaffin and Gunderson, 2015). Addressing these challenges points to the need to focus on governance and its role in water planning and policy (Pahl-Wostl et al., 2012a; Heikkila, 2016), but there are few analytical frameworks that can be applied to evaluate governance performance and point to necessary reforms (Dale et al., 2013). Similarly, assessment frameworks for AM focus on improving the steps of the AM process but do not capture related linkages to the governance structure under which those AM processes are operated (Chaffin and Gosnell, 2015).

This chapter presents a unique coneptual model evaluation framework for large-scale restoration and AM programs. The conceptual model uses risk assessment as a fundamental methodology to assess key components of AG and AM in restoration programs and uses risk ratings for those components to identify areas of weakness in the structure and function of AG and AM. Through case study application as described in the next chapter, my intent is to move this conceptual model evaluation framework beyond a heuristic device and successfully test its utility as a repeatable tool for benchmarking the structural/functional performance of the AG and AM structures within a restoration program now and over time to aid decision-makers in considering changes to their program. This will serve as the exploratory methodology for my proposition that, as suggested in the literature of AG and AM, AM can only be successfully implemented within the bounds of a strong and functional AG structure. By extension, it is also my intent to provide an example of using this tool to compare AG and AM structure and function between restoration programs to provide a larger comparative dataset for decision-makers to consider as they navigate the process of reforming their program to achieve better outcomes.

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CHAPTER 5

FIELD TRIAL APPLICATION OF THE CONCEPTUAL MODEL RESTORATION PROGRAM EVALUATION FRAMEWORK: METHODS

Introduction

This chapter provides a description of methodological rationale and approach employed in my field trial application of the conceptual model AM program evaluation framework described in detail in Chapter 4. This trial application involved a dual case study approach with the Trinity River Restoration Program (TRRP) and the Platte River Recovery Implementation Program (PRRIP) to test the validity of the conceptual model evaluation framework as a tool to explore the central proposition of my dissertation that large-scale AM can only succeed within a functioning AG structure. In this chapter, I provide the rationale for the case study approach, a description of the two case studies, and the methodology used to collect and analyze data through application of the conceptual model evaluation framework.

Research Approach

To implement a field trial application of the conceptual model AM program evaluation framework, I utilized a case study research methodology. Case study research involves the study of a bounded contemporary system or multiple bounded systems (the cases) in a real-world setting (Yin, 2014). Case study is a form of qualitative research implemented through detailed and in-depth data collection from multiple sources of information and then reporting out case descriptions and themes (Creswell, 2013). The unit of analysis in my research is two cases (the TRRP and the PRRIP) which is considered a multisite study (Creswell, 2013).

The foundation of my conceptual model AM program evaluation framework is a formal qualitative risk assessment. That assessment requires in-depth knowledge and analysis of the structure and function of AG and AM within a specific restoration program. Creswell (2013) notes that case study research is best suited for the type of problem requiring in-depth knowledge and understanding of one case or multiple cases. That differentiates case study research from other methods of qualitative research considered for my research including narrative research (best for stories of individual experiences), phenomenology (best for describing the essence of a lived phenomenon), grounded theory (best for grounding a theory in the views of participants), and ethnography (best for describing the shared patterns of culture of a group) (Creswell, 2013).

My methodology followed the defining characteristics of case study research as described by Creswell (2013):

Identification of specific cases – Real-life cases should be concrete and bounded within parameters of interest and in place and time. Identification of multiple cases allows for cross-case comparison. For my research, I selected the TRRP and PRRIP as ongoing river restoration programs with clear components of AG and AM. Both programs exist in specific geographic locations, have been operating for a number of years, are authorized and funded to continue operating, and provide an opportunity for in-depth learning about components of AG and AM and comparing results of risk assessment across the two programs.

Intent – Case study research can be intrinsic (focused on a case or cases of unique interest) or instrumental (focused on understanding specific issues or problems of concern). For my research, a conducted a collective instrumental case study looking at the issues of AG and AM in multiple cases (in this case, two river restoration programs).

In-depth understanding – Case study research should present in-depth understanding of the case or cases that comprise the research accomplished through collection of multiple forms of data. For my research, in-depth understanding was obtained through document review, observation of both the TRRP and the PRRIP, semi-structured electronic interviews, follow-up in-person interviews (for the TRRP), and extensive prior knowledge of both program through prior work (for the TRRP, multiple discussions with the program about AG, AM, and the structure and function of both; for the PRRIP, 13 years as a staff member in the program's Executive Director's Office).

Data analysis – Requires specific methodology for analyzing collected data. For my research, this includes analyzing and comparing data from multiple cases (the TRRP and the PRRIP), coding interview responses for general sentiment and themes, and the application of formal qualitative risk assessment for each program.

Case description – Requires a clear description of each case and the themes and issues that will be studies. This chapter includes a concise description of both cases studied (TRRP and PRRIP) and Chapter 4 provides a detailed rationale for the conceptual model AM program evaluation framework risk assessment and the assignment of consequence risk, likelihood risk, overall risk (CxL), and placement of the two cases in the proposed AG/AM risk typology.

Themes analyzed across cases – Multiple cases can be analyzed for similarities and differences. For my research, I compare and contrast the results of the application of the conceptual model AM program evaluation framework for key components of AG and AM.

Lessons learned from cases – Case study research concludes with conclusions from the researcher derived from evaluation of each case. Chapter 7 provides a summary set of conclusions and discussion.

Research Case Studies

The TRRP and PRRIP share similar patterns of purpose and need and both fall under a broad network of large-scale restoration programs housed in the Bureau of Reclamation. Both programs have governance structures born out of legal and legislative necessity and employ AM as their scientific organizing principle. However, the two programs differ in the fundamental operation and structure of their decision-making bodies, their staffing, and in successful employment of full AM cycles. These differences bear exploration and provide an instructive data set for the initial application of the conceptual model AM program evaluation framework and the associated risk assessment.

Case Study #1 – Trinity River Restoration Program (TRRP)

Dam building on California's Trinity River, the largest tributary to the Klamath River, led to reduced flows and subsequent declines in anadromous fish populations (DOI, 2000). Construction of Trinity Dam and Lewiston Dam as part of the Central Valley Project eliminated 109 miles of salmonid habitat above Lewiston, California and Trinity River flow below Lewiston was reduced by up to 90 percent for export to the Sacramento River (USFWS and Hoopa Valley Tribe, 1999). Stocks of chinook salmon and steelhead declined dramatically, damaging an important fishery relied upon by the Hoopa Valley and Yurok Tribes since the late-1800s (DOI, 2000).

Beginning in the 1980s, several efforts began to address both the flow degradation issues on the Trinity River and the resulting loss of the salmonid fishery. The Bureau of Reclamation built and owns both Trinity River dams so in 1981 a small flow increase to the river was initiated as was a more comprehensive Flow Evaluation Study. That study was completed by the U.S. Fish and Wildlife Service and Hoopa Valley Tribe in 1999 and recommended flow alterations, habitat restoration, and sediment augmentation under a framework of adaptive management to help restore the Trinity River fishery (USFWS and Hoopa Valley Tribe, 1999). These recommendations were adopted as the Preferred Alternative in the Final Environmental Impact Statement/Environmental Impact Report (EIS/EIR; USFWS et al., 2000), which led to a Record of Decision (ROD) from the Department of the Interior mandating flow changes on the Trinity River and creating the Trinity River Restoration Program (TRRP). Figure 5.1 the project area of the TRRP.

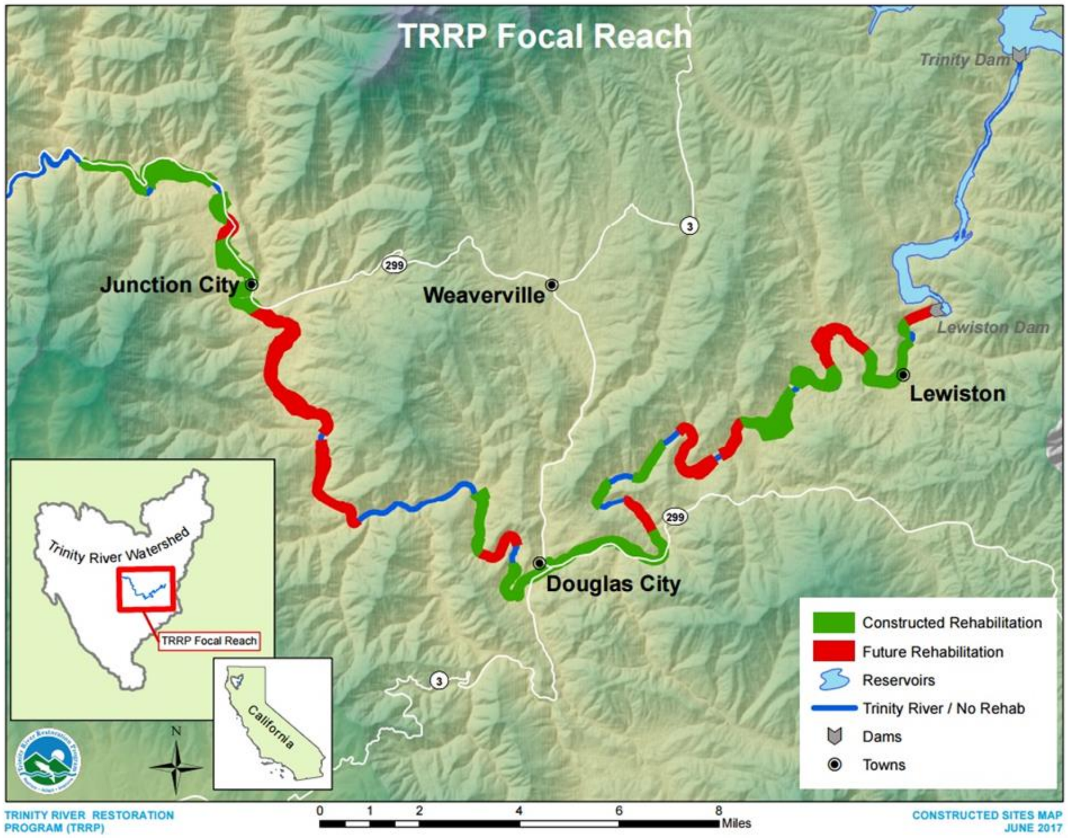

Figure 5.1. Trinity River Restoration Program (TRRP) project area (from the TRRP website, accessed 08/01/2020).

The TRRP began in 2000 as an innovative means to implement the Preferred Alternative from the EIS/EIR as outlined in the ROD (DOI, 2000). Specific management actions under the TRRP include variable flow releases from the Trinity River Dam, augmentation of coarse gravel substrate for salmonid spawning, channel rehabilitation, watershed restoration, and infrastructure improvements. The ROD designated a Trinity Management Council (TMC) as the decision-making body for the TRRP, comprised of tribal, federal, state, and local agency representatives (DOI, 2000). Figure 5.2 from the EIS/EIR details the intended structure of the TRRP.

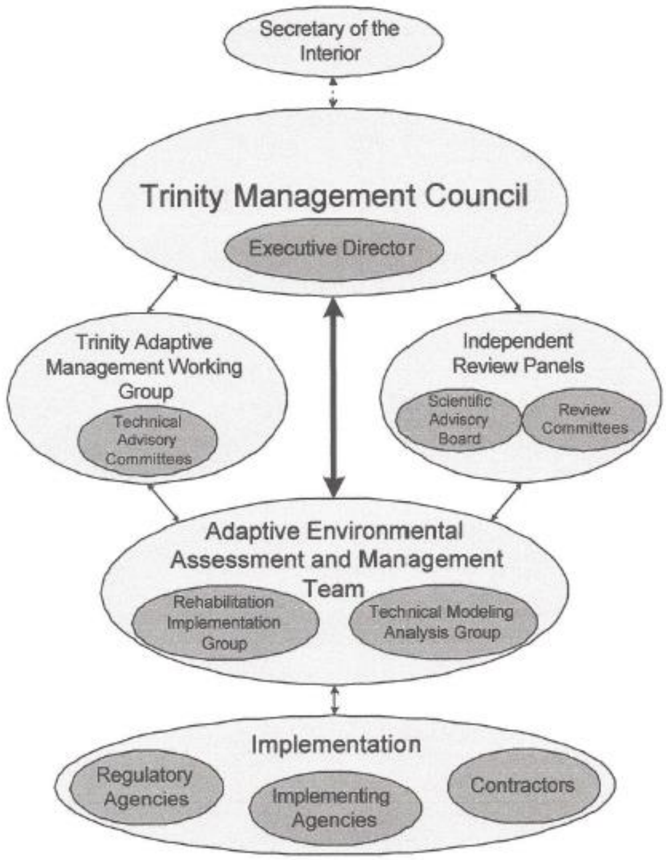

Figure 5.2. TRRP organizational structure (from USFWS et al., 2000).

The TRRP operates under an Adaptive Environmental Assessment and Management (AEAM) Program, as AM was initially coined in the late 1970s (Holling, 1978). The Trinity River AEAM Program is guided by the TMC, which enlists the help of agency and stakeholder personnel that form the Trinity Adaptive Management Working Group (TAMWG). The AEAM Program directs monitoring and research for the TRRP and provides a means to explore hypotheses and ideally recommend adjustments to management actions like the annual Trinity River flow schedule (DOI, 2000). Like most large-scale restoration program in the U.S., day-to-day work of the TRRP is managed by federal Reclamation staff and staff of the USFWS manage the work of the TAMWG.

Case Study #2 – Platte River Recovery Implementation Program (PRRIP)

On the Platte River in the 1980s, 1990s, and early 2000s, a series of jeopardy biological opinions from the United States Fish and Wildlife Service (USFWS) on water projects raised concerns over water use and habitat decline on the central Platte River. During the relicensing process for the Kingsley Dam hydroelectric project on the North Platte River in western Nebraska, the USFWS called for a return of 417,000 acre-feet (51,300 hectare-meters) of water annually to the central Platte River. Relicensing deliberations centered on use of the central Platte River by certain endangered and threatened species and habitat alterations over time associated with water diversions and land-use changes.

Beginning in 1997, the states of Colorado, Wyoming, and Nebraska; the U.S. Department of the Interior; waters users; and conservation groups spent nearly 10 years debating the components of a long-term plan to address endangered species needs while protecting water users. During negotiations, the participants committed to working toward two primary objectives: 1) reduce the shortage of flows in the central Platte River by 130,000 to 150,000 acre-feet (16,000 to 18,500 hectare-meters) per year on average, and 2) protect or restore 10,000 acres (4,100 hectares) of habitat in the central Platte River basin (PRRIP, 2006b). Agreement on these two objectives led to the development of the Platte River Recovery Implementation Program (PRRIP). The PRRIP is authorized for a 13-year First Increment from 2007 through 2019 and is estimated to cost roughly

$325 million (in 2005 dollars). Figure 5.3 details the focus area of the PRRIP called the Associated Habitat Reach (AHR) in central Nebraska, a ninety-mile reach extending from Lexington, NE downstream to Chapman, NE and including the Platte River channel and off-channel habitats within three and one half miles of the river.

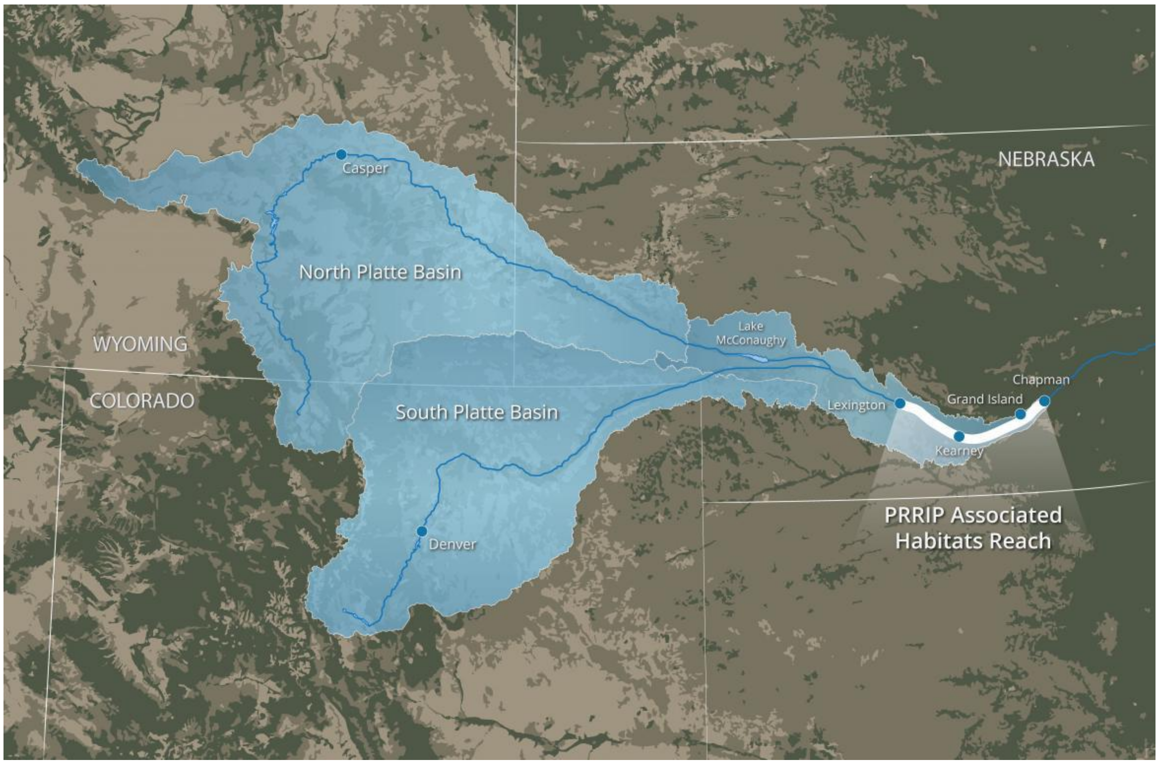

Figure 5.3. Platte River basin, detailing the Associated Habitat Reach of the Platte River Recovery Implementation Program (PRRIP) (from the PRRIP website, accessed 08/01/2020).

The science framework for the PRRIP is adaptive management (AM). The PRRIP operates under an Adaptive Management Plan (AMP) that provides guidance for Program science and offers a systematic process to test priority hypotheses and apply the information learned to improve management on the ground (PRRIP, 2006a). The AMP includes conceptual models and priority hypotheses developed jointly by Program partners to use the best available science implement action as experiments, learn, and revise management actions to provide benefits for four target species: the endangered whooping crane (*Grus americana*), interior least tern (*Sternula antillarum*), and pallid sturgeon (*Scaphirhynchus albus)*; and the threatened piping plover (*Charadrius melodus*).

One of the unique aspects of the Program is its governance and management structure, as detailed in Figure 5.4. Decisions are the ultimate responsibility of the Governance Committee (GC), which consists of representatives from the Bureau of Reclamation; the U.S. Fish and Wildlife Service; the states of Colorado, Wyoming, and Nebraska; upstream and downstream water users; and conservation groups. The GC is assisted by several standing advisory committees made up of technical representatives of Program agencies and institutions. The GC hired an independent executive director not affiliated with any of its entities. Day-to-day operations of the Program are the responsibility of the executive director and staff. Staff members also operate independently from the partner agencies.

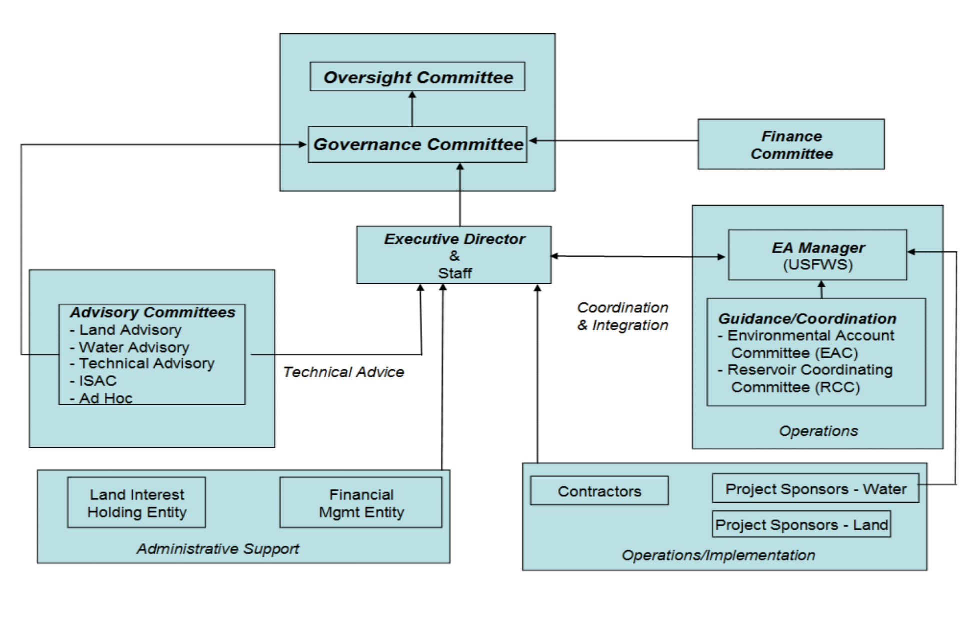

Figure 5.4. Decision-making structure for the PRRIP (from PRRIP, 2006b).

The Program's approach to governance is much different from other adaptive management programs where federal agencies are in the lead in terms of both staffing and decision-making. In those systems, federal employees staff the programs but are also ultimately in charge of making policy decisions. In the PRRIP, all stakeholders including water users and conservation groups are voting members of the policy body and are represented along with state and federal agency representatives. This is a major difference from other programs where stakeholders may be involved in the process at various levels but do not make management or policy decisions. On the Platte River, the executive director and staff are independent of the U.S. Department of the Interior, the states, the water users, and the conservation groups. This builds in a considerable level of independence and lack of bias. The governance structure of the Platte is very much in line with a social learning process that is inherent in adaptive management implementation and engages stakeholders at a decision-making level to build trust and provide a broader context for experimental management actions (Lee, 1993).

In 2016, the PRRIP achieved a milestone by documenting successful completion of one full iteration of the six-step adaptive management cycle (Compass Resource Management, 2016). Based on knowledge and review of most other large-scale adaptive management programs in the U.S., that achievement has not been replicated. This dissertation began in part as an exploration of possible reasons why other large adaptive management programs in the U.S. have not achieved similar success. In 2019, the PRRIP was authorized to enter into an Extension of the First Increment, keeping the PRRIP operating through the year 2032.

Data Collection

In the conceptual model AM program risk evaluation framework, I identify and describe three components and 15 subcomponents of interest for adaptive governance (AG) and six components and 15 subcomponents of interest for adaptive management (AM). Data for these aspects of the risk assessment framework was collected from two case studies, the TRRP and the PRRIP. Yin (2014) identifies six sources of evidence commonly utilized in case study research. For my research, I used five of these sources to conduct a structural/functional performance assessment of both case studies (the TRRP and the PRRIP), a risk assessment of both case studies, placing both case studies in the AG/AM risky typology, and suggesting recommendations for reform of both restoration programs. This ensured I used multiple sources of evidence to strengthen my case study data and triangulate that data leading to more convincing and accurate conclusions (Yin, 2014).

Documentation and archival records – This type of data is both broad in terms of time, events, and setting but also specific in terms of exact references and events. I conducted a detailed review of all foundational documents, legislation, planning documents, reports, and published and grey literature for both the TRRP and the PRRIP. Appendix A provides an example template used to organize and catalogue observations from TRRP documents. Review of TRRP and PRRIP documents provided context and evidential detail important for conducting the performance assessment and risk assessment for both programs (Dale et al., 2013).

Direct and participant observation – Direct observation data covers events in real time and provides additional context. Participant observation provides more insight into interpersonal behavior and motives. I observed the function of both governance and decision-making in the TRRP and PRRIP as well as the structure and functions of AM in both programs and was also a participant in some program functions. I observed and in some cases participated in several meetings of the TMC for the TRRP over the course of 12 years both for work purposes and for the purposes of conducting research for my dissertation. This included simply observing TMC activity, giving presentations to the TMC on issues related to AG and AM, and participating in TRRP workshops on decision-making and the application of science. For the PRRIP, I observed and participated in multiple meetings of the GC, advisory committees, and work groups over the course of 13 years as a staff member in the program's Executive Director's Office. This included direct responsibility for implementation of the PRRIP AMP and communication with the GC regarding learning from AM and its use in decision-making.

Interviews – This type of data provides a more targeted focus on topics of interest for case study research and can result in explanations of meaning, attitude, and direction. Interviews are widely used in conservation research and can be an important data collection tool for small sample sizes, for further investigation into the views of participants, and for a better understanding of concepts and processes such as decision-making (Young et al., 2018). Case study research interviews can take the form of shorter (about one hour) or prolonged (two or more hours) interviews usually conducted in-person, or survey interviews using a structured questionnaire that can be conducted online (Yin, 2014).

For my dissertation research, I generally followed the methodological guide developed by Young et al. (2018) for conducting and reporting on interviews. Young et al. (2018) provide a set of basic stages in the interview process for conducting conservation-related research. These stages track with guidance from Yin (2014) and Creswell (2013) for conducting case study research and using interviews and surveys as a data collection tool.

Where and why? – The purpose of my dissertation research is to explore the proposition that AM can only be successful in large-scale restoration programs in the presence of a strong and functional AG structure. To test this proposition, in Chapter 4 I developed a conceptual model AM program evaluation framework to assess the structural/functional performance of several components and subcomponents of AG and AM, conduct a risk assessment of AG and AM in a restoration program, place the restoration program in a proposal AG/AM risk typology, and suggest recommendations for program reform based on that analysis. As discussed in this chapter, I used case study research to collect and analyze data in a field trial application of the conceptual model evaluation framework. I used two cases as my source of data, the TRRP in California and the PRRIP in Colorado, Wyoming, and Nebraska. Data collection through interviews occurred both online and in-person for the TRRP and online only for the PRRIP.

Initial project design – I used interviews for my research because of the sample size of potential respondents for both case studies (the TRRP and the PRRIP) and the need to explore attitudes, practices, and processes in both case studies to better understand the structure and function of AG and AM. As discussed previously in this chapter, interview data was paired with review of documents and archival records and both direct and participant observation to provide a full dataset for analysis. For the TRRP, I chose to implement two forms of interviews. A structured interview via a survey questionnaire delivered online with identification data (name, role in program) was followed by a semi-structured follow-up interview generally delivered in-person with some conducted over the phone due to geographic and travel constraints. The structured interviews were based on a set of pre-determined questions answered by each respondent to provide consistency among respondents. The semi-structured follow-up interviews were based on responses to the online survey and were used to allow respondents to clarify and expand upon responses to the online survey. For the PRRIP, I only utilized structured interviews via a survey questionnaire delivered online that included the respondent's role in the program as the only form of identification data. This kept survey responses anonymous which was necessary out of concern about answer bias and to ensure honest and open responses to the survey questions. While collecting my dissertation research data for the PRRIP, I was also an active staff member in the program's Executive Director's Office. As a researcher, I was concerned that my concurrent role as a member of the PRRIP staff would not allow for open and honest discussion of structural and functional issues with the PRRIP if I conducted in-person interviews.

For both the TRRP and PRRIP, questions for the structured online surveys were developed based on the sample question set for AG and AM components developed as part of the conceptual model AM program evaluation framework. For AG, the initial set of questions was developed based on the discussion of AG principles in Lockwood et al. (2010), AG attributes in Lebel et al. (2006), AG components and aspects in Cosens et al. (2014 and 2017), and questions used in the Great Barrier Reef risk analysis conducted by Dale et al. (2013 and 2016) on multiple domains and subdomains of governance. For AM, the initial set of questions was developed based on the AM program evaluation question set developed by Chaffin and Gosnell (2015) that were trialed in the Glen Canyon Dam Adaptive Management Program; the set of ideal elements of the six steps of the AM cycle identified by Murray et al. (2011) and trialed in the Middle Rio Grande Endangered Species Program; and the interview question set from Thom et al. (2016) used to interview AM practitioners in several large aquatic ecosystem recovery programs in the U.S. Both initial question sets for AG and AM were refined and adapted for use in the TRRP and the PRRIP based on review of documents and archival records for both case studies, as well as my direct and participant observation of both case studies. For both case studies, the question sets were categorized in blocks pertaining to the three AG components of interest and the six AM components of interests. Additional questions regarding respondent identification, restoration program goals and objectives, and open-ended summary questions were added as well to capture more wide-ranging responses that could apply across AG and AM components of interest. Table 5.1 shows the online survey question set for the TRRP. The follow-up interviews conducted in person and via phone with TRRP survey respondents were semi-structured in that some of the same questions asked via the online survey we re-asked to provide clarification for online survey responses, and additional questions were posed based on my review of the online survey responses and new questions that arose during the in-person and phone follow-up interviews. This open-ended approach was used to capture respondents' understanding of complex topics related to AG and AM as well as insight into risk assessment and communication (Boholm, 2019). Table 5.2 shows the online survey question set for the PRRIP.

Table 5.1. Online survey questionnaire for the TRRP case study.

TRRP Survey Questions
Identification
Q1 First Name
Q2 Last Name
Q3 Organization
Q4 Role in the TRRP
End of Block
Goals and Objectives
Q5 What is your interpretation of the goal of the TRRP? Is progress toward this goal being tracked, and if so, how?
Q6 What are the objectives of the TRRP?
End of Block
Governance Component – Legitimacy
Q7 Why is there not a single foundational Program document?
End of Block
Governance Component - Structure and Capacity
Q8 Is the TMC empowered to make all Program decisions? Does it operate by consensus?
Q9 Describe the relationship as you understand it between the TMC, TAMWG, Program operations staff, Program science staff, and SAB.
Q10 Are any key stakeholders currently not at the "TRRP table"? Why are they not engaged fully now?
End of Block
Governance Component - Decision-Making Process
Q11 Is there agreement among the TMC on the goal and objectives? Why or why not?
Q12 How do you define success for the TRRP? How is that success measured?
Q13 Is there regular, clear communication of scientific and technical information to the TMC? Does it pertain to Program decisions?
End of Block
Adaptive Management Component – Assess
Q14 How does the TRRP define adaptive management (AM)?
Q15 What critical decisions does the TMC need to make in the next 5-10 years? What key questions (uncertainties) do you have related to these decisions? What information do you need to help you answer those questions and make those decisions?
Q16 Is there a common understanding of key Program hypotheses – what you do not know but want to learn?
Q17 Has the Integrated Assessment Plan been officially adopted within the TRRP? How does it relate to the Program's foundational documents?
End of Block
Adaptive Management Component – Design & Implement
Q18 How do the fish population numbers identified in the EIS/EIR, and the flow and sediment augmentation volumes in the ROD and Implementation Plan relate to Program decision-making? What flexibility is there in terms of implementing management actions related to these metrics?

End of Block
Adaptive Management Component – Monitor
Q19 Is Program monitoring structured to provide information on the key decision-maker questions?
End of Block
Adaptive Management Component – Evaluate
Q20 Does the TRRP engage in data synthesis – essentially, telling the “story” of AM?
End of Block
Adaptive Management Component – Adjust
Q21 Is there a specific process for using TRRP science information to help make decisions?
End of Block
Overall
Q22 What are your biggest concerns about the TRRP, and what do you think can be done about them?
Q23 What else do you think we need to know, or that you want to tell us, that we did not cover?

Table 5.2. Online survey questionnaire for the PRRIP case study.

PRRIP Survey Questions
Identification
Q1 Role in the PRRIP (i.e. GC, TAC, WAC, LAC, ISAC, Program staff)
End of Block
Goals and Objectives
Q2 What is the goal of the PRRIP? Is progress toward this goal being tracked, and if so, how?
Q3 What are the objectives of the PRRIP?
End of Block
Governance Component – Legitimacy
Q4 Do you think the PRRIP budget is tied to the Program goal and objectives?
Q5 What does the word “recovery” mean for the PRRIP?
End of Block
Governance Component - Structure and Capacity
Q6 Why does the PRRIP utilize shared decision-making (i.e. federal/state agencies and stakeholders part of decision-making body)? What are the pros and cons of this approach?
Q7 How would you describe the level of trust among PRRIP decision-makers?
Q8 Describe the relationship as you understand it between the GC, Advisory Committees, Program staff, and ISAC.
Q9 Are any key stakeholders currently not at the "PRRIP table"? Why are they not engaged fully now?
End of Block
Governance Component - Decision-Making Process
Q10 Is the GC empowered to make all Program decisions by consensus?
Q11 Is there agreement among the GC on the goal and objectives? Why or why not?
Q12 How do you define success for the PRRIP? How is that success measured?
Q13 Is there regular, clear communication of scientific and technical information to the GC? Does it pertain to Program decisions?
End of Block
Adaptive Management Component – Assess
Q14 How does the PRRIP define adaptive management (AM)?
Q15 What critical decisions does the GC need to make in the next 5-10 years? What key questions (uncertainties) do you have related to these decisions? What information do you need to help you answer those questions and make those decisions?
Q16 Is there a common understanding of key Program hypotheses – what you do not know but want to learn?
End of Block
Adaptive Management Component – Design
Q17 Why does the PRRIP not have specific numerical recovery goals for the target species?
Q18 What flexibility is there in terms of implementing management actions related to the Program’s goal, objectives, and management objectives?
End of Block
Adaptive Management Component – Implement

Q19 Why does the PRRIP utilize independent implementation (i.e. Executive Director and staff are not employees of PRRIP entities)? What are the pros and cons of this approach?
End of Block
Adaptive Management Component – Monitor
Q20 Is Program monitoring structured to provide information on the key decision-maker questions?
End of Block
Adaptive Management Component – Evaluate
Q21 Does the PRRIP engage in data synthesis – essentially, telling the "story" of AM?
Q22 Describe how the PRRIP utilizes independent science review (both the ISAC and peer review)?
End of Block
Adaptive Management Component – Adjust
Q23 What is the process for using PRRIP science information and learning to help make decisions?
End of Block
Overall
Q24 What are your biggest concerns about the PRRIP, and what do you think can be done about them?
Q25 What else do you think we need to know, or that you want to tell us, that we did not cover?

Data gathering – For my research, I used key informant sampling of both the TRRP and the PRRIP which allowed me to target people in both programs most knowledgeable about programmatic structure and function (Young et al., 2018). Since both case studies are built around public restoration programs, I was able to access the current members of the decision-making body for each program, the current members of advisory committees, technical staff of the program and of participant entities, and all current members of relevant independent science review panels. A small number of stakeholders involved with the TRRP were included in the sample set as well. In the PRRIP, stakeholders are included in decision-making so were interviewed but identified as “decision-makers” instead of in a separate “stakeholder” category. The University of Nebraska-Lincoln Institutional Review Board (IRB) classified my interview research as exempt from Protection of Human Subjects provisions and was allowed to proceed for the PRRIP based on that exemption (see Appendix B for the IRB approval letter). The IRB required additional permission for data use from the TRRP which was granted by the Bureau of Reclamation (see Appendix C for the TRRP data use permission email).

For both the TRRP and the PRRIP, the online survey questionnaire was delivered using Qualtrics software (July 2020). For the TRRP, one group of 56 individuals was surveyed. This single survey group was comprised of distinct interviewee categories including decision-makers, technical staff, independent scientists, and stakeholders. I received 46 unique responses to the survey, with 42 online responses and an additional four unique in-person interviews with individuals that did not complete the online survey, for a response rate of 82%. Follow-up interviews were conducted with 36 people that responded to the online survey questionnaire. In-person interviews were conducted in

Weaverville, Arcata, and Sacramento, California with 32 respondents and an additional four follow-up interviews were conducted over the phone. Follow-up interviews took an average of one to two hours to complete. For the PRRIP, one group of 37 individuals was surveyed. This single survey group was comprised of distinct interviewee categories including decision-makers, technical staff, independent scientists, and stakeholders. I received 30 unique responses to the survey for a response rate of 81%.

Analysis and write-up – Online survey data for both case studies was stored electronically via Qualtrics and accessed via web browser. Follow-up interviews were recorded electronically in Microsoft Word (July 2020) during the course of the interviews. All online survey responses from the TRRP and the PRRIP were exported to a Microsoft Excel spreadsheet (July 2020). All text transcription from the in-person and phone follow-up interviews for the TRRP were matched to the online survey respondent and added to the response block for the final online survey question, resulting in a single complete electronic data file for each TRRP respondent that included both the online survey data and the follow-up survey data.

All data for the TRRP and PRRIP contained in the Microsoft Excel spreadsheets was imported into the NVivo software program (March 2020). NVivo (March 2020) was used as a computer-assisted qualitative data analysis tool to identify themes, frequent word use, word hierarchies, and sentiment references as an initial evaluation of the survey and interview data. Software programs such as NVivo can be useful in identifying meaningful patterns and concepts in large qualitative data sets early in case study research (Yin, 2014).

I used NVivo as a discovery tool with the following step-wise process to conduct an efficient broad-brush review of a large data set from the TRRP and PRRIP online surveys and in-person interviews based on common application procedures (QSR International, 2020):

1) All TRRP and PRRIP survey and interview data was broken into blocks of according to the three AG components of interest and the six AM components of interest. The summary questions at the end of each question set was added to each set of component data to capture any open-ended commentary that might pertain to the AG or AM component being analyzed.

2) All data was processed automatically to identify broad theme codes in the online survey and in-person interview responses.

3) All data was processed automatically to conduct a word frequency query and generate hierarchy charts to identify the most frequent words captured in the survey and interview responses for each AG and AM component in relation to the broad theme codes.

4) All data was processed automatically to analyze the general expressions of positive or negative sentiment references for each AG and AM component.

The use of NVivo to conduct autocoding of broad theme codes, word frequency and hierarchy, and sentiment allowed for clustering of key issues in the data before my own review of the data to show general themes and avoid any bias in developing my own coding structure (Young et al., 2018). The coding process assisted my research as an initial step in filtering a tremendous amount of open-ended text data submitted in the online surveys and, for the TRRP, augmented through extensive dialogue in the follow-up interviews. Summary results of the NVivo (March 2020) autocoding process is included in the write-up of results in Chapter 6.

Data Analysis – AG and AM Performance Assessment

I used multiple sources of data to conduct the first step of implementing the conceptual model AM program evaluation framework, a structural/functional performance assessment of AG and AM components and subcomponents of interest. Data from review of documents and archival records; direct and participant observation of both cases studies (the TRRP and the PRRIP); online surveys and follow-up interviews; initial autocoding of themes, word frequency, and sentiment from interviews and surveys; and thorough review of all interview data resulted in an assessment of 15 AG subcomponents and 15 AM subcomponents for both the TRRP and PRRIP. To better illustrate the combined results of this process, Table 5.3 shows a summary data output table of the depth of analysis applied within each AG and AM subcomponent for the TRRP. Table 5.4 shows a similar summary data output table for the PRRIP. Full set of data output tables for both case studies are provided in Appendices D and E.

Table 5.3. Sample data output table for the TRRP case study.

AG Component Legitimacy **AG Subcomponent** Accountability	**Subcomponent Description:** • *Definition* – Program is accountable and enabled with decision responsibility. • The TRRP is an official federal river restoration program that is legitimate and accountable as directed by three key foundational documents (Trinity River Flow Evaluation Study, Implementation Plan, Record of Decision) and several legislative authorities (P.L. 98-541, P.L. 104-143, P.L. 102-575). The TRRP is enabled with decision responsibility through the foundational documents and related legislation.
Performance Assessment	Structural: • The ROD is the ultimate statement of TRRP authority, but it was not negotiated by Program partners. • Authority for the TRRP is not currently bound by a specified timeline for making decisions or achieving goals or objectives. • Funding has been relatively stable over the years but the linkages between funding and milestones are weak. Functional: • The TRRP is being implemented, has a Program staff, and has a decision-making body in the TMC. • Decisions at the TMC level focus on annual budget line items, generally not on making management decisions/adjustments that are clearly tied back to the foundational documents.
Consequences of Failure	• The TRRP can only move forward with purpose if there is clarity in overall goals and objectives that come from foundational documents.
Consequence Rating (C)	**4**
Likelihood of Failure	• The three foundational documents provide guidance on the structure and function of the TRRP but differences between those three documents has led to Program drift over time. • Despite the presence of these documents and prior reviews of the TRRP, there remains a feeling that the Program is stuck and needs refinements to move forward.
Likelihood Rating (L)	**3**
Risk Rating (CxL)	**12**
AG/AM Risk Typology "Fit"	• AM is hard-wired into the TRRP though it is based on the original model of Adaptive Environmental Assessment and Management (AEAM). • There is clear direction to implement some version of AM and route information back to decision-makers, but actual implementation of true AM has been slowed in large part due to a lack of clarity in Program goals and objectives, and explicit development of an agreed-upon AM Plan linked back to those goals and objectives.
Recommendations for Reform	• Negotiate a single, unified TRRP Program Document that clearly spells out goals and objectives and provides clear guidance on how program implementation will be evaluated against these goals and objectives.

Table 5.4. Sample data output table for the PRRIP case study.

<table>
<tr><td>AG Component
Legitimacy</td><td colspan="2" rowspan="2">Subcomponent Description:
• Definition – Program is accountable and enabled with decision responsibility.
• The PRRIP is an official federal river restoration program that is legitimate and accountable as directed by the negotiated Final Program Document (with the Extension Addendum); Program Agreement signed by the Secretary of the Interior and the Governors of Colorado, Wyoming, and Nebraska; and Congressional legislation. The PRRIP is enabled with decision responsibility through the Program Document and related legislation.</td></tr>
<tr><td>AG Subcomponent
Accountability</td></tr>
<tr><td>Performance Assessment</td><td>Structural:
• The Final Program Document is the ultimate statement of PRRIP authority and was negotiated by the Program partners.
• PRRIP is implemented in 13-year increments. The First Increment is complete (2007-2019) and Congress approved a 13-year Extension of the First Increment in late 2019 keeping the PRRIP functional through 2032.
• Funding has been relatively stable over the years and tightly linked to the Program goal, First Increment Objectives, and management objectives in the AMP.</td><td>Functional:
• The PRRIP is being implemented, has a full independent Program staff, and has a decision-making body in the GC.
• Decisions at the GC level are made regarding budget priorities, management actions, land and water acquisition, direction of Program activities, and other priorities.
• Some lack of clarity on what “recovery” means. The PRRIP is an official endangered species Recovery Implementation Program (RIP), similar in nature to several other Bureau of Reclamation RIPs. But there is disagreement among GC members about the extent to which the Program is responsible for species recovery and what that means.</td></tr>
<tr><td>Consequences of Failure</td><td colspan="2">• Generally, very low because of the existence of the negotiated and agreed-to Program Document, Extension Addendum, and support of Program partners, Governors, the Secretary of the Interior, legislators, and the public.
• The issue of defining recovery</td></tr>
<tr><td>Consequence Rating (C)</td><td colspan="2">2</td></tr>
<tr><td>Likelihood of Failure</td><td colspan="2">• Very low. The PRRIP has clearly-established goals and objectives, a single, unifying foundational document (Final Program Document), and fully-functional decision-making body (GC), a fully-functional independent Executive Director’s Office, and a history of demonstrated success.
• While the issue of differing definitions of recovery is still present among GC members, it has not impeded program progress or success thus far and did not stop successful adoption of the 13-year Extension.</td></tr>
<tr><td>Likelihood Rating (L)</td><td colspan="2">1</td></tr>
<tr><td>Risk Rating (CxL)</td><td colspan="2">2</td></tr>
<tr><td>AG/AM Risk Typology “Fit”</td><td colspan="2">• Very low risk for this AG subcomponent. Given the clear legislative and administrative history of the PRRIP and support for the PRRIP, the presence of a single Program Document negotiated by the Program partners, and a fully-functioning decision-making body, independent staff, technical advisory committees, independent science review, and other functional and structural components of a strong restoration program, the PRRIP is an example of governance adaptation to the situational context that has enabled decision-making and AM to succeed.</td></tr>
<tr><td>Recommendations for Reform</td><td colspan="2">• Continue to implement the Program Document and Extension Addendum. A model program for consideration by other restoration programs in linking AG and AM.
• Some attention should be paid to the issue of what “recovery” means for the Program, whether the Program will be held accountable for meeting certain metrics of species recovery, and if so how to set those metrics.</td></tr>
</table>

Data Analysis – AG and AM Risk Assessment

The second step of implementing the conceptual model AM program evaluation framework in both case studies was to conduct a risk assessment of AG and AM components and subcomponents. This involved the application of standardized criteria for rating the risks and consequences of possible failure of 30 subcomponents of AG and AM in both the TRRP and the PRRIP and by multiplying the consequence of subcomponent failure (C) by the likelihood of subcomponent failure (L) to establish an overall risk rating (CxL) for each subcomponent. Subcomponent risk ratings were then averaged to develop a risk rating for each of three AG components of interest and each of six AM components of interest. Risk ratings were used to rank and cluster the AG and AM subdomains according to a standardized rating scale to point to areas of needed reform within each case study. The standardized criteria for consequence rating, likelihood rating, and overall risk rating are provided in Chapter 4 as part of the discussion of the development of the conceptual model AM program evaluation framework. Results of the risk assessment for each AG and AM subcomponent are included in the data output tables summarized above in Tables 5.5 and 5.6 and provided in their entirety for both case studies in Appendices D and E.

Data Analysis – AG/AM Risk Typology

The third step in applying the conceptual model AM program evaluating framework is to place the restoration program (or in this case, programs because of the use of two case studies) in the proposed AG/AM risk typology. An overall AG risk rating was calculated by averaging the risk rating for each of three AG components of concern.

That overall risk rating was used to place each case study restoration program into one of four quadrants in the typology according to the AG risk on the X-axis of the typology. An overall AM risk rating was calculated by averaging the risk rating for each of six AM components of concern. That overall risk rating was used to place each case study restoration program into one of four quadrants in the typology according to the AM risk on Y-axis of the typology. A final overall program risk rating was calculated by averaging the AG risk rating and the AM risk rating described above giving each case study a final score for placement in the typology.

Data Analysis – Recommendations for Program Reform

The fourth and final step in applying the conceptual model AM program evaluation framework is to suggest recommendations for reform based on the performance assessment and risk assessment of AG and AM components and subcomponents of concern. Recommendations are based primarily on reducing risk identified as high or moderately high according to the standardized risk rating scale and are intended to be implemented to improve the structure and function of AG and AM in the restoration program.

Conclusion

I used two case studies as my research methodology to implement a field trial application of the conceptual model restoration program evaluation framework. I used multiple lines of evidence to collect data, including review of documents and archival records; direct and participant observation; and surveys and interviews. This data was evaluated to gain a more complete understanding of AG and AM components in both case studies, the TRRP and the PRRIP. Survey and interview data were coded using NVivo software to elicit general themes and sentiment in responses. That general understanding of components of AG and AM in both case studies was then processed with a thorough reading of responses and documents to complete a structural/functional performance assessment of 15 subcomponents of AG and 15 subcomponents of AM, a risk assessment of those 30 subcomponents, and placement of both base studies in the AG/AM risk typology. The results of that analysis were used to develop recommendations for reform in both restoration program case studies.

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Online survey data for this research was generated using Qualtrics software, Version July 2020 of Qualtrics. Copyright © 2020 Qualtrics. Qualtrics and all other Qualtrics product or service names are registered trademarks or trademarks of Qualtrics, Provo, UT, USA. https://www.qualtrics.com

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CHAPTER 6

FIELD TRIAL APPLICATION OF THE CONCEPTUAL MODEL RESTORATION PROGRAM EVALUATION FRAMEWORK: RESULTS

Introduction

In this chapter, I present the results of field trial application of the conceptual model restoration program evaluation framework on two case study restoration programs: the TRRP and the PRRIP. General themes and sentiment that emerged from the performance assessment, results of the risk assessment, placement of both programs in the proposed AG/AM risk typology, and recommendations for program form are all presented here.

Case Study #1 – TRRP

AG Performance Assessment

General Observation – It is imperative for large-scale restoration programs like the TRRP to provide a clear articulation of their purpose and overall goal. All decisions made by a program's decision-making body should relate back to satisfying this purpose and goal, and more detailed objectives, management actions, and the overall AM framework should generate information important for this decision-making. Failure to clearly identify these key program building blocks is an early indicator that a program may be drifting away from a central focus that can account for measures of progress and success. This is a fundamental challenge in the TRRP.

Results of the AG component performance assessment are summarized in Table

6.1 and discussed in more detail below. Appendix D includes word hierarchy color sunburst charts from NVivo.

Table 6.1. Summary of TRRP AG component autocoding analysis from NVivo (2020).

Case Study #1 – TRRP			
	Overall Sentiment Reference	**Range of Theme Codes**	**Key Words from Word Frequency Query**
AG Components			
Legitimacy	54% negative	40	Fish, program, goal, flow, projects
Structure/Capacity	54% negative	26	Staff, science, program, decisions
Decision-Making Process	Even split	35	Restoration, fish, program

Legitimacy – Overall sentiment references in the coded themes for the legitimacy component were 54% negative (246 negative sentiment references, 211 positive sentiment references). This sentiment was spread across a range of 40 different themes related to accountability, responsiveness of the TRRP to constituencies above and below, specific goals and objectives for the program, a unifying foundational document, and program authority. The negative sentiment coupled with a wide spread of themes in the survey and interview responses suggest overall poor performance of the AG legitimacy component. The aggregated most frequent words used in responses to questions related to the legitimacy component including “fish,” “program,” “goal,” “flow,” and “projects.” This suggests an awareness of the structure and viability of the program but further evaluation of interview and survey responses and the overall negative sentiment about this component point to a lack of clarity about the TRRP’s overall goals and objectives and an organizing vision. The TRRP is legitimate as directed by legislation and related statutory authority, as noted in the Implementation Plan (USFWS et al., 2000).

Authorizing legislation and a set of foundational documents provide guidance for the development and implementation of the TRRP. The life-cycle of the TRRP is not clearly specified, but annual appropriations have kept the Program moving forward. There is a mix of goal and objective language in the foundational documents. Clarification, revision, and specification is required, but the raw materials are present.

Structure & Capacity – Overall sentiment references in the coded themes for the structure and capacity component were 54% negative (285 negative sentiment references, 247 positive sentiment references). This sentiment was spread across a range of 26 different themes related to polycentrism, coordination, scale, stakeholder engagement, communication, and technical capacity. The negative sentiment coupled with a generally wide spread of themes in the survey and interview responses suggest overall poor performance of the AG structure and capacity component. The aggregated most frequent words used in responses to questions related to the legitimacy component including "staff," "science," "program," and "decisions." This suggests the TRRP is functioning at some levels but the overall negative sentiment and a review of interview and survey responses point to challenges in the structure and function of the TRRP. The decision-making body should be the TMC but there is some language in documents that suggests decision-making by both the TMC and the Executive Director. The TMC is inclusive of key tribal, federal, state, and local agencies, but does not engage other stakeholders directly in decision-making. The geographic scale of the TRRP is relevant and manageable. The time scale of the TRRP is not specified. The TRRP has technical staff capacity related to the most relevant data needs for decision-making. There appears to be regular communication within the TRRP and among decision-making entities but that communication does not appear to always be effective. Communication between the TMC and the TAMWG and other advisory committees needs work. This is a significant issue for the TRRP. The Program does maintain a web site with current and historic information.

Decision-Making Process – Overall sentiment references in the coded themes for the decision-making process component were split evenly between negative and positive (247 negative sentiment references, 245 positive sentiment references). This sentiment was spread across a range of 35 different themes related to shared decision-making, fair and transparent processes, use of consensus, linkage between decisions and program goals and objectives, dispute resolution, adapting to surprises, and the ability to incorporate learning into decision-making. The even split of sentiment coupled with a wide spread of themes in the survey and interview responses suggest overall poor performance of the AG decision-making process component. The aggregated most frequent words used in responses to questions related to the decision-making component including “restoration,” “fish,” and “program.” This suggests an awareness of what the TRRP is supposed to be doing but a lack of clarity about what the decisions are and how best to make them. Decision-making is not shared, at least not inclusive of some level of stakeholders beyond agencies. It is not clear how or if the TMC works to achieve consensus with all decisions. With a lack of clarity on goals and objectives and without an AM Plan, it is not clear how science is moved out of the “science pile” and into decision-making. This also relates to uncertainty about how the TRRP responds to science learning and surprises in the response of anadromous fisheries and the form/function of the Trinity River to management actions.

AG Risk Assessment

My analysis of AG risk in the TRRP covered 15 subcomponents organized across three key AG components of interest. Table 6.2 summarizes the performance assessment and risk assessment data for all TRRP AG subcomponents. Figure 6.1 presents a graphical summary of the subcomponent risk ratings. Risk analysis results are summarized below by grouping all TRRP AG subcomponents into three categories of risk.

High risk subdomains requiring reform (risk rating 16-25)

My analysis identified 8 subcomponents of AG that require reform to enable the TRRP to successfully develop and manage a functional AG structure that enables AM within the program. Four of the 8 subcomponents were identified as having the highest risk rating possible when applying the standardized criteria. One of the most significant high-risk subcomponents is *decisions linked to goals and objectives*. This is not the case in the TRRP as there is not organizational agreement on the overall goal and high-level objectives of the program. This poses the most risk to successfully implementing AM successfully because that would require explicit linkage to agreed-upon goals and objectives for the TRRP.

Three other subcomponents also received the highest risk rating and are generally descriptive of the same issue of a lack of shared decision-making. Those subcomponents are *shared decision-making, stakeholders involved in decision-making,* and *responsiveness to constituencies.* Decision-making is not shared in the TRRP as stakeholders, outside of agencies and Tribes, are relegated to an advisory committee that is now disbanded. This creates issues with communication and trust, and further exacerbates a lack of clarity about goals and objectives and what the TRRP is attempting to achieve on the ground.

Consensus and *polycentric* are AG subcomponents in the moderately high risk category. The TRRP does not operate on a consensus basis and super-majority voting is a constant source of acrimony within the TMC. There is some level of polycentrism within the TRRP as it has developed a structure that is closer to the resource but the lack of shared-decision making and lack of clarity about TMC functions disrupts the flow of decisions. *Scale (time)* is of moderate high risk because there is no negotiated time period for the TRRP to operate, it continues to operate despite it challenges as long as funding is appropriated. *Coordination and communication* remains a moderately high risk AG subcomponent. There is poor communication with stakeholders, there is a mix of staff from multiple program participants raising issues of conflict of interest, the independent science review panel is underutilized, and while technical information is utilized in the TMC it is unclear how or if that information relates to goals and objectives.

Medium risk subcomponents may require adjustment (risk rating 11-15)

My analysis identified 4 subcomponents of AG that may require adjustment within the TRRP. There is an issue of *accountability* within the TRRP that relates to how power is shared among the TMC and how the program deals with issues of conflict of interest. This also relates to concern about whether the TRRP is *fair and transparent*. Because the TRRP does not currently organize its structure or function around a clear set of goals and objectives and have a plan for linking science learning to decision-making, the AG subcomponents of *adapt to surprises* and *ability to incorporate learning into decision-making* may need program attention.

Low risk subcomponents not requiring adjustment (risk rating 10 and below)

My analysis identified 3 subcomponents of AG that are at low risk of failure. There is no set process for *dispute resolution* but the TMC does make decisions, though the super-majority voting pattern can allow a single entity to always stop progress. The *scale (geography)* of the program is clearly defined and has matched the TRRP with a logical bioregion around which to organize. One key strength of the TRRP is its *technical capacity* both within program staff and also within TRRP partner entities.

Table 6.2. Output from AG subcomponent risk assessment of the TRRP.
C = Consequence rating, L = Likelihood, R = Risk rating (Consequence X Likelihood).

AG Subcomponent	Subcomponent Description for the TRRP	C	L	R (CxL)	Risk Rating Justification
AG Component – Legitimacy					
Accountability	The TRRP is an official federal river restoration program that is legitimate and accountable as directed by three key foundational documents and several legislative authorities. The TRRP is enabled with decision responsibility through the foundational documents and related legislation.	4	3	12	The ROD was not negotiated by Program partners. Authority for the TRRP is not currently bound by a specified timeline for making decisions or achieving goals or objectives. Funding has been relatively stable over the years but the linkages between funding and milestones are weak. Decisions at the TMC level focus on annual budget line items, not on making management decisions/adjustments tied back to the foundational documents.
Responsiveness to Constituencies	The TRRP is a public program affecting resources with direct links to local landowners, river users, and communities. The Program is authorized and funded through federal legislation, largely managed by a federal agency (Bureau of Reclamation), overseen by federal regulatory agencies (U.S. Fish and Wildlife Service and National Marine Fisheries Service), and is also connected to two Tribes, the State of California, and other federal and local partners.	5	5	25	The TMC is the decision-making body and is comprised of federal, tribal, state, and local entities. Technical committees are also structured in a similar collaborative manner. Discussions with TRRP partners suggest improvements need to be made in addressing the concerns and priorities of these partners. Though annual funding is consistent, it is not clear how the TRRP is viewed at the highest levels of the Department of Interior or among legislative entities. The TAMWG is the official committee for basin stakeholder interests and is part of the TMC but not a voting member. The TAMWG has been deemed "administratively inactive" by Interior and is currently not functioning. When active, the general feeling among TAMWG members was that their concerns and ideas were ignored by the TRRP. River landowners and river users provide regular feedback to the TRRP on operations and impacts on river land and activities such as fishing, much of it negative.
AG Component – Legitimacy Average Risk Rating				19	
AG Component – Structure/Capacity					
Polycentric	TRRP decisions are generally made by the TMC which serves as a "Board of Directors". The TMC receives input from the TAMWG, the Science Advisory Board (SAB), and several technical workgroups and is guided by an Executive Director and staff.	4	4	16	The decision-making body should be the TMC but there is language in the foundational documents suggesting decisions are to be made both by the TMC and the Executive Director. The TMC is ultimately advisory to the Secretary of the Interior, so decisions such as flow management actions are subject to review and approval by the Department of the Interior. The TRRP is generally organized according to Figure 1 in the Implementation Plan which is drawn heavily from a similar structure found in the Glen Canyon Adaptive Management Program. The relationships between the TMC, the TAMWG, and the AWAM Team (TMAG and RIG) are not well-defined or understood. The TRRP is nested within a larger suite of water management-related programs in California and in a broader area, including the CVPIA and issues related to the Klamath River. The TMC is inclusive of key tribal, federal, state, and local agencies but does not engage other stakeholders directly in decision-making. The TMC could serve as a centralized decision-making body but currently does not fully function well in this capacity. There is a lack of clarity about the role of the Executive Director and staff in the TRRP – do the ED and staff serve as "honest brokers" implementing the TRRP on behalf of the TMC, or does the TMC essentially rely on the ED and staff to make program decisions beyond day-to-day implementation?
Coordination and communication	The ED and staff are responsible for most coordination and communication within the TRRP. This includes coordinating upward to the TMC from technical workgroups and the SAB, and downward from the TMC to technical workgroups and the public.	4	4	16	Coordination and communication of the TRRP is derived from Figure 1 in the Implementation Plan, which is based on a similar structure utilized in the Glen Canyon Adaptive Management Program. The TMC is the decision-making body and the ED and staff implement the Program on behalf of the TMC. The ED Office is comprised of both Reclamation staff and USFWS staff (Science Coordinator). There seem to be many technical committees/work groups, with redundancies in some cases. There is a mix of communication between and among technical aspects of the TRRP – technical issues

AG Subcomponent	Subcomponent Description for the TRRP	C	L	R (CxL)	Risk Rating Justification
					are discussed at TMC meetings and communication also occurs via reports and memos. Public coordination occurs largely through TMC meeting comment periods and via letters and emails to the ED Office. The SAB is largely coordinated by the TRRP Science Coordinator (a USFWS employee). Most information is contained on and communicated through the TRRP website. The clarity of coordination between the TMC, advisory committees, work groups, and the ED/ED Office is mixed. Much of this mixed clarity stems from a lack of internal TRRP agreement on goals, objectives, and vision. An ED Office comprised of staff from two separate federal agencies without clear, coordinated ED oversight responsibilities for all staff creates internal staff tension and mixed messages to the TMC. Advisory committees/work groups seem to take on a larger role than just evaluating technical aspects of the TRRP and making recommendations to the TMC. The SAB is largely under-utilized and is largely divorced from interaction with the TMC, thus reducing its effectiveness in helping to provide the TMC with independent science review of Program implementation, analysis, and synthesis. There is regular communication within the TRRP and among decision-making entities, but that communication is not always effective. There is poor communication between the TMC and the TAMWG.
Scale (geography)	The TRRP is focused on the area of the Trinity River between Lewiston Dam and the North Fork Trinity River in northern California. This is only a segment of the mainstem Trinity, which continues below the North Fork until its confluence with the Klamath River and subsequent extension to the Pacific Ocean.	**3**	**3**	**9**	The TRRP does focus its on-the-ground work on the portion of the Trinity River between Lewiston Dam and the North Fork Trinity. While the TRRP focuses its work on the segment of the Trinity that is included in the ROD, the success/failure of the TRRP in terms of fisheries restoration is highly influenced by the fact that anadromous species move past the TRRP segment and are impacted by activities on the Trinity River outside the TRRP area, by activities on the Klamath River, and by ocean conditions and activities.
Scale (time)	The TRRP is not defined by a time increment, end date, or other time component in the Flow Study, Implementation Plan, ROD, or associated legislation.	**4**	**4**	**16**	The Program operates on an annual basis in terms of projects and funding but is not constrained by any identified time increment for achieving goals and objectives. The TRRP appears to operate under the premise that it will continue implementation if annual funding is provided.
Stakeholders involved in decision-making	The TMC is the decision-making body for the TRRP. Stakeholders are involved in the TRRP in an advisory capacity through the TAMWG.	**5**	**5**	**25**	The TMC is the decision-making body for the TRRP and is comprised of representatives of federal agencies, Tribes, and the State of California. Stakeholders such as local landowners, river users, etc. are part of the TAMWG which is an advisory body. A TAMWG representative participates in TMC meetings but does not have an official vote. The TAMWG believes that it is routinely ignored by the TMC and that it does not have any influence on TRRP decision-making. As of April 2018, the Department of Interior has rendered the TAMWG "administratively inactive" and it no longer even is serving in an advisory capacity for the TRRP.
Technical capacity	Program staff and the technical portions of the AEAM organization (RIG, TMAG, and associated advisory committees and work groups) are strong and provide detailed technical capacity for the TRRP.	**4**	**2**	**8**	Formal structure of ED, Program staff, advisory committees, work groups, and AEAM Team (RIG and TMAG) provides sound TRRP technical capacity. SAB is utilized to provide some independent science review. The staff split between Reclamation and the Service in the ED Office confuses lines of communication and work between and among technical aspects of the TRRP. Despite this, there is constant and strong work being done within technical committees and work groups that keep the TRRP well-positioned to act on science learning and data analysis and synthesis. There is some concern about leadership and staff/technical representative turnover.
AG Component – Structure/Capacity Average Risk Rating				**15**	
AG Component – Decision-Making Process					

AG Subcomponent	Subcomponent Description for the TRRP	C	L	R (CxL)	Risk Rating Justification
Shared decision-making	Decisions are made at the TMC level, which includes a mix of federal, tribal, and state representatives but does not include stakeholders as official voting members.	5	5	25	Questions about relative balance between TMC members and the influence each entity has on TRRP decisions. Confusion about roles of Reclamation and the Service, and what it means that the Hoopa Valley Tribe signed the ROD. Much concern about issues of "conflict of interest", how TRRP money is distributed, and this influences decision-making and Program progress. Stakeholders represented on the TAMWG but do not have a TMC vote.
Fair and transparent	TMC decisions are recorded in meeting minutes that are made publicly available and TMC meetings are open to the public. The basis for TRRP decision-making is often not clear.	4	3	12	The TMC makes decisions for the TRRP. Those decisions are voted on in public meetings and recorded in meeting minutes posted on the TRRP web site. Lack of clarity in TRRP goals and objectives, mistrust among TMC entities, and lack of inclusion of stakeholders does not provide a clear basis for Program decisions. "Fairness" is a concern, given issues related to conflicts of interest in TMC decision-making, how Program funds are allocated, and how the Program measures its progress.
Consensus	The TMC operates on a super-majority basis.	4	4	16	TMC decisions are formalized via voting through a super-majority process. Six out of eight votes are required to formalize a decision. A super-majority ensures that no one entity can always stop TMC decision-making. However, this also can cause a situation where one or two TMC entities are repeatedly dissatisfied with the outcome of voting and decision-making. That dissatisfaction can then be used to disrupt TRRP functions. There is also the belief among some TRRP entities that while the TMC makes decisions, ultimately the TMC is only advisory to the Secretary of the Interior and that DOI really makes final TRRP decisions. Most decision-making appears to be focused on budget related matters.
Decisions linked to goals/objectives	Given the lack of clarity on the overall TRRP goal and related objectives, and the lack of an AM Plan for the TRRP, TMC decisions are only loosely-based at best on TRRP goals/objectives.	5	5	25	TMC decisions are generally made based on recommendations from the ED and Program staff, as well as the AEAM Team and advisory committees/work groups. Most TMC decisions at the current time revolved around annual budgets and how to allocate funds to TRRP projects, "legacy" projects, and TRRP science.
Dispute resolution	The TRRP operates on a super-majority basis and does not have a formal means for dispute resolution.	3	3	9	TMC decisions are made via super-majority vote (6 out of 8 votes) with no formal means for reaching consensus or resolving disputes. Disaffected parties exist from vote to vote (for example, the two Tribes are often on the opposite side of super-majority votes) and are left to express that dissatisfaction via other means.
Adapt to surprises	This relates to the ability of the TRRP to adapt to surprises that arise on the landscape or that influence application of AM on the Trinity River.	3	4	12	The ED Office, AEAM Team, and advisory committees/work groups handle technical matters for the Program and make recommendations to the TMC. Any surprises on the landscape or in response to management actions would bubble up to the TMC for decision-making purposes through this technical structure. TRRP science is proceeding but not under an official AM Plan. Surprises in river or fisheries responses are not necessarily being anticipated by the Program.
Ability to incorporate learning into decision-making	The TRRP does not operate under a formal AM Plan so does not have a formal process or set procedures for using Program science learning as an input in decision-making.	3	4	12	The TMC makes decisions on how to spend Program funds on science projects, data analysis, and data synthesis. There is no agreed-upon AM Plan or set of Big Questions and priority hypotheses. Proposals for individual TRRP science projects, data analysis, data synthesis, etc. are developed through the technical aspects of the Program and work their way up to the TMC for final approval (largely through the annual TRRP budget process). Results are presented to the TMC in the form of reports and/or presentations, but the lack of an AM Plan and a lack of clarity about Program goals and objectives do not regularly facilitate using this learning to help make TRRP decisions.
AG Component – Decision-Making Process Average Risk Rating				16	
Overall AG Average Risk Rating				17	

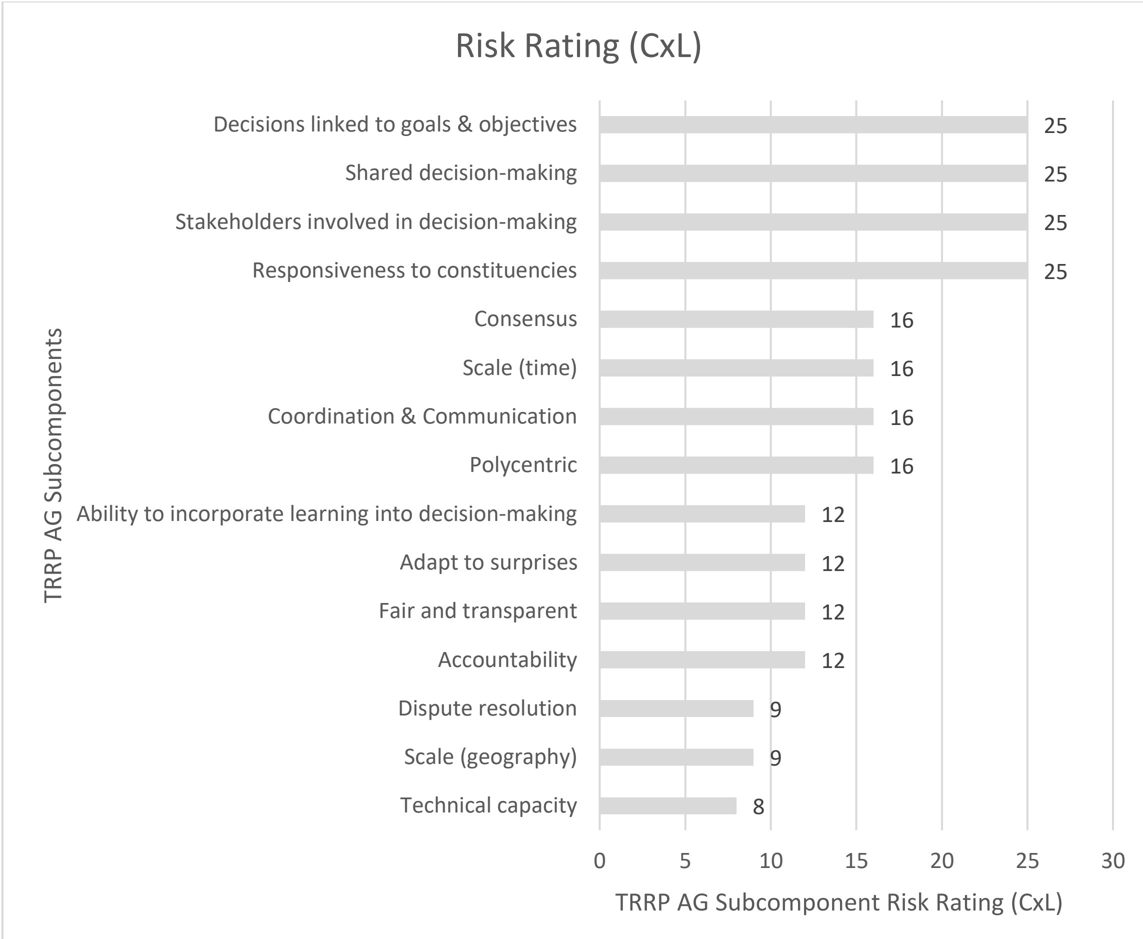

Figure 6.1. Risk ratings for all TRRP AG subcomponents showing the relative risk profile (i.e. decreasing risk from top to bottom).

AM Performance Assessment

General Observation – The TRFE (USFWS and Hoopa Valley Tribe, 1999), Implementation Plan (USFWS et al., 2000), and ROD (DOI, 2000) all call for development of an AEAM Program, or AM Program. While documents like the Integrated Assessment Plan (IAP; TRRP and ESSA, 2009) contain some of the important details that are necessary to build a true AM Plan, the TRRP does not appear to be operating under or implementing a negotiated and agreed-to AM Plan. With no Program AM Plan, there is no agreed-to definition of AM for the Program that is written down in a

TRRP foundational or guidance document. All of this means the TRRP is being challenged by a lack of direction in its science program and decision-making is most likely disconnected from data that is being collected. This challenge is exacerbated by ambiguity in Program goals and objectives. The Implementation Plan does provide an example set of hypotheses and objectives for implementing peak flows during certain water year types. The IAP builds on this kind of detail for a series of Program hypotheses, management objectives, and management actions. However, it is not clear what the standing of the IAP is within the Program, whether it has been officially adopted, and how it relates to the TRRP foundational documents. Ideally, this kind of detail would be wrapped up within a TRRP AM Plan.

Results of the AM component performance assessment are summarized in Table 6.3 and discussed in more detail below. Appendix D includes word hierarchy color sunburst charts from NVivo.

Table 6.3. Summary of TRRP AM component autocoding analysis from NVivo (2020).

Case Study #1 – TRRP			
	Overall Sentiment Reference	**Range of Theme Codes**	**Key Words from Word Frequency Query**
AM Components			
Assess	52% negative	35	Fish, program, science, management
Design	52% negative	41	Fish, program, projects, science, flow
Implement	52% negative	43	Fish, flow, projects, program
Monitor	57% negative	40	Fish, program, science, projects
Evaluate	57% negative	43	Fish, program, science, projects
Adjust	55% negative	45	Projects, program, science

Assess – Overall sentiment references in the coded themes for the Assess component were 52% negative (247 negative sentiment references, 228 positive sentiment references). This sentiment was spread across a range of 35 different themes related to problem definition and agreement, decisions affected by AM learning and linked to program goals and objectives, and a collaborative process for developing this information. The negative sentiment coupled with a wide spread of themes in the survey and interview responses suggest overall poor performance of the AM Assess component. The aggregated most frequent words used in responses to questions related to the Assess component including “fish,” “program,” “science,” and “management.” This suggests the building blocks of a science program are present but there is a lack of clarity on how that science is linked to decision-making. The goals and objectives of the TRRP are not clear. There is no AM Plan and a definition of AM is not agreed to and written down. Critical uncertainties and components of a good AM Plan like Conceptual Ecological Models (CEMs) and/or conceptual management models can be found in documents like the IAP but are not finalized and agreed-to by the TMC. This is similarly true for other AM specifics such as alternative management actions, indicators/triggers, spatial and temporal bounds, and assumptions. There is no clear indication of how what is learned through TRRP AM will be used for decisions. Technical information is largely mandated from the top-down or only from science teams and is not developed and negotiated collaboratively.

Design – Overall sentiment references in the coded themes for the Design component were 52% negative (200 negative sentiment references, 188 positive sentiment references). This sentiment was spread across a range of 41 different themes related to explicit management objectives and management actions and monitoring and research protocols linked to priority hypotheses and questions from decision-makers. The negative sentiment coupled with a wide spread of themes in the survey and interview responses suggest overall poor performance of the AM Design component. The aggregated most frequent words used in responses to questions related to the Design component including “fish,” “program,” “projects,” “science,” and “flow.” This suggests an awareness of what a TRRP AM program should be designed around but a lack of clarity on direction and linkages to decision-making at the TMC level. The decision on how or if to implement AM in the TRRP is driven by the overall structure of the TRRP and whether the program is going to just implement mandated actions or operate as a collaborative program with an AM Plan that includes alternative management actions. There is a lack of clarity about measurable objectives/management actions. Modeling, monitoring, and data management plans are present but are not tied to a TRRP AM Plan (it does not exist). The TRRP time scale and budget process seem to focus just on annual appropriations without a long-term plan.

Implement – Overall sentiment references in the coded themes for the Implement component were 52% negative (217 negative sentiment references, 201 positive sentiment references). This sentiment was spread across a range of 43 different themes related to implementation of management actions and monitoring with project oversight. The negative sentiment coupled with a wide spread of themes in the survey and interview responses suggest overall poor performance of the AM Implement component. The aggregated most frequent words used in responses to questions related to the Implement component including “fish,” “flow,” “projects,” and “program.” This suggests implementation of ROD management actions is occurring as is monitoring but both remain poorly connected to decision-making. Management actions and monitoring are being implemented, just not according to an AM Plan. TRRP staff retain project oversight but issues of conflict of interest hamper staff function and coordination.

Monitor – Overall sentiment references in the coded themes for the Monitor component were 57% negative (186 negative sentiment references, 143 positive sentiment references). This sentiment was spread across a range of 40 different themes related to whether implementation, effectiveness, and validation monitoring are being conducted in a way that provides the correct data to answer AM hypotheses and decision-maker questions. The negative sentiment coupled with a wide spread of themes in the survey and interview responses suggest overall poor performance of the AM Monitor component. The aggregated most frequent words used in responses to questions related to the Monitor component including "fish," "program," "science," and "projects." This suggests the TRRP is implementing monitoring related to management actions and indicators like fish but there remains a lack of clarity as to what end that information will be utilized. Monitoring is being implemented, just not according to an AM Plan. No document has been developed by the TRRP or agreed-to by the TMC that guides all levels of monitoring and that contains regularly-updated protocols.

Evaluate – Overall sentiment references in the coded themes for the Evaluate component were 57% negative (190 negative sentiment references, 145 positive sentiment references). This sentiment was spread across a range of 43 different themes related to specifying the path from data to management decision-making and what learning means for goals, objectives, and hypotheses. The negative sentiment coupled with a wide spread of themes in the survey and interview responses suggest overall poor performance of the AM Evaluate component. The aggregated most frequent words used in responses to questions related to the Evaluate component including “fish,” “program,” “science,” and “projects.” Again, this suggests the building blocks of a science program are present but there is a lack of clarity on how that science is linked to decision-making. The TRRP has conducted a good amount of data analysis to date, but no true synthesis. Internal discussions about synthesis are underway, but without a clear direction in terms of goals/objectives and an AM Plan it is hard to see how synthesis documents can be developed. The Science Advisory Board (SAB) provides some independent science review but it is not clear what the current mission and focus of the SAB is and what regular reporting and communication to the TMC occurs. Discussions are ongoing about an annual review of program materials but that kind of synthesis is difficult to complete without the ability to report program learning against clear goals and objectives.

Adjust – Overall sentiment references in the coded themes for the Adjust component were 55% negative (182 negative sentiment references, 149 positive sentiment references). This sentiment was spread across a range of 45 different themes related to making clear management decisions utilizing program learning as one input. The negative sentiment coupled with a wide spread of themes in the survey and interview responses suggest overall poor performance of the AM Adjust component. The aggregated most frequent words used in responses to questions related to the Adjust component including “projects,” “program,” and “science.” Again, the TRRP is conducting good science but there is a lack of clarity about how any science learning (structured or unstructured) can be operationalized for TMC decision-making. This component is in limbo unless and until an AM Plan is developed and process is determined for synthesizing program data, communicating it to the TMC, and having the TMC make decisions with this information as an input.

AM Risk Assessment

My analysis of AM risk in the TRRP covered 15 subcomponents organized across six key AM components of interest. Table 6.4 summarizes the performance assessment and risk assessment data for all TRRP AM subcomponents. Figure 6.2 presents a graphical summary of the subcomponent risk ratings. Risk analysis results are summarized below by grouping all TRRP AM subcomponents into three categories of risk.

Table 6.4. Output from AM subcomponent risk assessment of the TRRP.
C = Consequence rating, L = Likelihood, R = Risk rating (Consequence X Likelihood).

AM Subcomponent	Subcomponent Description for the TRRP	C	L	R (CxL)	Risk Rating Justification
AM Component – Assess					
Problem definition and agreement	There is a lack of clarity within the TRRP on the overall goals and objectives of the Program and there is not an agreed-upon definition of AM or an AM Plan.	5	5	25	There is no agreed-upon Program goal statement. There are numeric fish population goals, but most consider those values outdated or unachievable. The TRRP is not bound by a timeline for making decisions or achieving goals or objectives. There is no single, unifying foundational TRRP document that spells out the Program goal. There is a lack of clarity among TRRP decision-makers as to the overall Program goal and objectives. Decisions at the TMC level focus on annual budget line items, not on making management decisions/adjustments based on Program data analysis and synthesis.
Roadmap of goals, objectives, hypotheses	There is a lack of clarity within the TRRP on the overall goals and objectives of the Program and there is not an AM Plan.	4	3	12	TRRP science activities often relate back to the IAP and guidance in the ROD and Implementation Plan, but there is no agreed-upon set of hypotheses.
Decisions affected by information	TRRP decisions are based largely on annual funding priorities and are not solidly linked back to a set of Program goals, objectives, and hypotheses.	4	3	12	The TMC makes decision for the TRRP. TMC decision-making receives various levels of input from the ED/EDO, advisory committees and work groups, the TAMWG, and the SAB. Decisions at the TMC level focus on annual budget line items, not on making management decisions/adjustments based on Program data analysis and synthesis and linked to an AM Plan.
Collaborative process to develop this information	The TRRP has not initiated a collaborative process to develop a Program AM Plan and focus efforts to reach agreement on critical uncertainties and how to address them.	5	5	25	The foundational documents (TRFE, ROD, Implementation Plan) were not negotiated or built through a collaborative process of all key TRRP parties. The IAP was developed in a more collaborative manner but has never been formally adopted by the TMC.
AM Component – Assess Average Risk Rating				19	
AM Component – Design					
Management objectives	Several TRRP documents includes language that could form specific management objectives (including the TRFE and the IAP) but this language needs to be unified and tied back to TRRP goals, objectives, and an AM Plan.	3	3	9	The TRFE contains a set of what can be described as management objectives. The IAP includes a set of six "primary objectives" that can be identified as management objectives for the TRRP. TRRP implementation at this point focuses more on three higher-order objectives from the foundational documents – annual flow regime, mechanical channel rehabilitation, and sediment management.
Management actions	The ROD and Implementation Plan provide guidance on implementing an annual flow regime, mechanical channel rehabilitation, and sediment management as TRRP management actions, but those actions are not currently implemented against clear goals, objectives, and an AM Plan.	2	2	4	The ROD and Implementation Plan specify annual flow volumes, 47 project sites for channel rehabilitation and side-channel rehabilitation, and sediment introduction volumes. These actions are being implemented but not in the context of an AM Plan or against a clear set of TRRP goals and objectives.
Monitoring/research protocols tailored to hypotheses and key questions from decision-makers	The TRRP does implement monitoring and research but not clearly in the context of agreed-upon goals, objectives, hypotheses, and Big Questions that relate to TMC questions important for decision-making.	3	3	9	The TRRP has a strong track record of project-specific and species monitoring and research. Most monitoring is related to implementation of the major TRRP "management actions" – annual flow volumes, rehabilitation projects, and sediment introduction. Monitoring and research are implemented based on annual projects and their intended objectives, rather than being implemented to deliver information useful in decision-making related to TRRP goals, objectives, and hypotheses.
AM Component – Design Average Risk Rating				7	
AM Component – Implement					
Plan for implementation of management actions and monitoring	The TRRP is proceeding with management actions and monitoring on the ground but that implementation is not linked back to an agreed-upon AM Plan.	3	3	9	The Implementation Plan provides the best information on Program structure and operation, including specifying roles for the ED/EDO and the AEAM Team. The guidance provided in the Implementation Plan has thus far not served to help build and operate a truly collaborative program that is functioning in a manner that can support

AM Subcomponent	Subcomponent Description for the TRRP	C	L	R (CxL)	Risk Rating Justification
					implementation of an AM Plan and related TMC decision-making.
Project oversight	In general, the ED and Program staff are responsible for day-to-day implementation of the TRRP, though several TMC entities are also involved in implementation and evaluation.	4	4	16	The ED and EDO provide day-to-day oversight of TRRP implementation. Project-specific oversight of TRRP management actions are often overseen by a mix of EDO staff and TRRP partner staff. There is tension within the EDO given the split of federal agency representation (Reclamation and Service) and the presence of TRRP partner staff. Project oversight seems to be handled on a case-by-case basis with different levels of oversight by and involvement of TRRP partner staff.
AM Component – Implement Average Risk Rating				13	
AM Component – Monitor					
Implementation, effectiveness, and validation monitoring	The TRRP conducts implementation and effectiveness monitoring but does not conduct clear validation monitoring due to lack of clarity in overall goals and objectives and lack of an AM Plan that links science learning back to goals, objectives, hypotheses, Big Questions, and decision-making.	4	4	16	The TRRP has a strong track record of project-specific and species monitoring and research. Most monitoring is related to implementation of the major TRRP "management actions" – annual flow volumes, rehabilitation projects, and sediment introduction. Monitoring and research are implemented based on annual projects and their intended objectives (implementation and effectiveness), rather than being implemented to deliver information useful in decision-making related to TRRP goals, objectives, and hypotheses (validation).
AM Component – Monitor Average Risk Rating				16	
AM Component – Evaluate					
Data analysis	The TRRP conducts rigorous science and has conducted a good amount of data analysis to date.	2	2	4	Strong collection and analysis of implementation and effectiveness monitoring data. Some analysis of validation monitoring data, but there is a lack of consensus about data collection and analysis methods for key metrics such as fish population numbers.
Data synthesis	In 2017, the TRRP began to tackle data synthesis efforts though it remains unclear how, or if, these efforts unifying multiple lines of Program evidence and the results of data synthesis will be reported to the TMC and used in decision-making.	4	4	16	The TRRP began the process of developing several data synthesis reports in 2017. It is not clear how the TRRP synthesis reports now in development fit together to tell a full "story" of AM implementation, and how the conclusions of these efforts will link to TMC decision-making.
Independent science review	The SAB provides independent science review for the TRRP, and there is also project-by-project peer review of TRRP work proposals. Linkages to the TMC and the utility of this review as a factor in TMC decision-making are not robust or well-understood.	4	4	16	The TRRP has a standing independent science review panel in the form of the SAB. Independent peer review is utilized at least at the project review level when the Program is attempting to prioritize annual work and budgets. The TRRP has successfully published on topics such as sediment introduction. The SAB is underutilized, and no clear linkages exist between the SAB and the TMC. SAB work is conducted at the request of the Science Coordinator but does not seem to operate under a specific TRRP charter or an annual work plan approved by the TMC. Peer review is utilized at the project review/planning stage but does not seem to be regularly used to evaluate data analysis and/or synthesis reports.
AM Component – Evaluate Average Risk Rating				12	
AM Component – Adjust					
AM results communicated to decision-makers and used in decision-making	This subcomponent is in limbo for the TRRP unless and until an AM Plan is developed and a process is determined for synthesizing Program data, communicating it to the TMC, and having the TMC make decisions with this information as an input.	5	5	25	AM is not really being implemented in the TRRP, so science learning communicated to the TMC comes in the form of individual project reports. Without TRRP clarity on overall goals and objectives, and without an AM Plan that specifies priority hypotheses and addresses scientific and technical Big Questions of relevance to the TMC, this subcomponent remains largely non-functional.
Documentation of decision-making results	This subcomponent is in limbo for the TRRP unless and until an AM Plan is developed and a process is determined for synthesizing Program data, communicating it to the TMC, and having the TMC make	3	3	9	Decision-making results are reported largely in the form of TMC minutes. There is TRRP reporting but it is focused on project-by-project results and does not yet come in the form of synthesis reports. The TRRP began the process of some synthesis reporting in 2017. TMC decision-making at this point generally centers around

AM Subcomponent	Subcomponent Description for the TRRP	C	L	R (CxL)	Risk Rating Justification
	decisions with this information as an input.				annual budget priorities. Though the TRRP has begun the process of synthesis reporting, it is not clear how those synthesis reports relate to TMC questions or decision-making.
AM Component – Adjust Average Risk Rating				**17**	
Overall AM Average Risk Rating				**14**	
Combined AG + AM Risk Rating Overall Average for AG/AM Risk Typology				**16**	

High risk subdomains requiring reform (risk rating 16-25)

My analysis identified 7 subcomponents of AM that require reform to enable successful AM within the TRRP. The *lack of problem definition and agreement*, the lack of a *collaborative process to develop AM information*, and the program's failure to have *results communicated and used in decision-making* are the highest risk AM subcomponents and can generally be viewed as fatal flaws to TRRP AM. Structure and function challenges with the program's AG components are compounded by the lack of an AM Plan, no agreed-on definition of what AM means to the TRRP, and currently a decision-making process that does not promote collaboration or working toward a common vision and clear goals and objectives. This elevates these subcomponents of AM to the highest level of concern and need for immediate reform.

The other AM subcomponents of concern relate to the general structure and function of a good AM program. *Project oversight* is largely conducted by program staff but the presence of staff from multiple program entities and concerns about conflicts of interest make oversight and implementation problematic. *Implementation, effectiveness, and validation monitoring* are being conducted with various levels of success but are not being conducted within the structure of an AM Plan or linked to hypotheses and questions of relevance to decision-makers. The TRRP is attempting to improve its efforts at *data synthesis* and also to address inconsistency and lack of clarity in how best to use *independent science review*.

Medium risk subcomponents may require adjustment (risk rating 11-15)

My analysis identified 2 subcomponents of AM that may require some adjustment to better enable AM within the TRRP. There is raw material within the program that can be assembled into a *roadmap of goals, objectives, and hypotheses* but the TRRP needs to move expeditiously to build this roadmap. At the same time, the TRRP needs to address AG structural and functional challenges to ensure that TMC *decisions are affected by AM information*.

Low risk subcomponents not requiring adjustment (risk rating 10 and below)

My analysis identified 6 subcomponents of AM that are either working or that are currently being addressed by the TRRP. The TRRP does implement the key *management actions* identified in the ROD (DOI, 2000). The program conducts good science with a strong record of *data analysis* and publication of results. *Management objectives* are specified in the IAP (TRRP and ESSA, 2009) though the IAP has not been officially adopted by the TRRP as a foundational or guidance document. At least within the technical structure of the TRRP, *monitoring and research protocols are tailored* to questions of interest and unofficially to objectives and hypotheses in the IAP. The *implementation plan* for the TRRP is based on the ROD management actions and works through the implementation branch of program staff. And the TRRP does provide *documentation of decision-making results* through publicly-available TMC minutes.

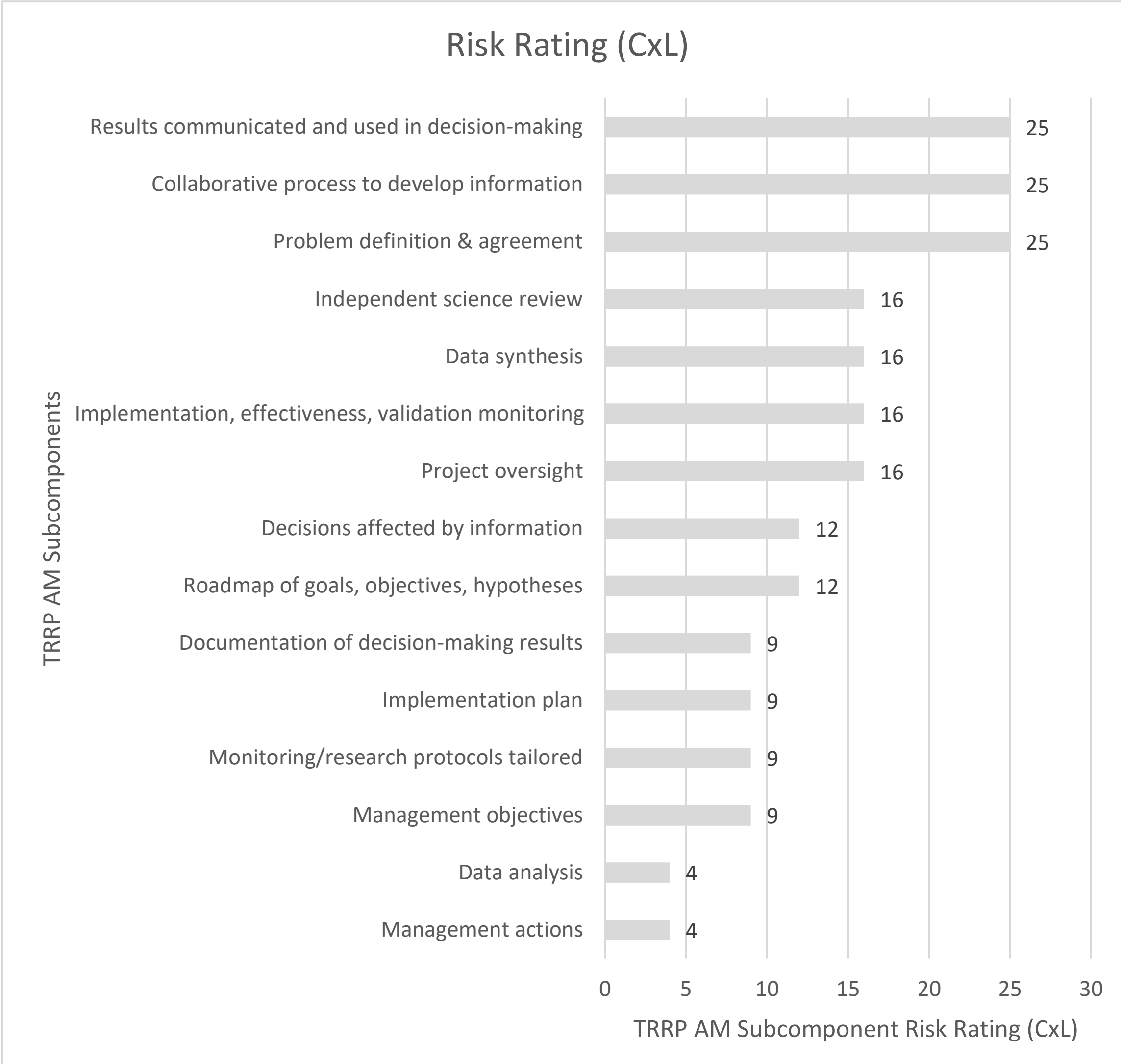

Figure 6.2. Risk ratings for all TRRP AM subcomponents showing the relative risk profile (i.e. decreasing risk from top to bottom).

Case Study #2 – PRRIP

AG Performance Assessment

General Observation – The PRRIP revealed itself to be a generally structurally sound and functioning restoration program that has a strong AG structure with a history of using AM learning as an input to decision-making. The Governance Committee (GC) of the program has made all decisions by consensus over the course of 13 years of implementation and is assisted by independent implementation through its unique approach to hiring and independent Executive Director and staff. Trust is high among decision-makers and within the program and the program's success led to an Extension of the PRRIP for 13 more years through the year 2032. Table 6.2 provides a summary

Results of the AG component performance assessment are summarized in Table 6.5 and discussed in more detail below. Appendix E includes word hierarchy color sunburst charts from NVivo.

Table 6.5. Summary of PRRIP AG component autocoding analysis from NVivo (2020).

Case Study #2 – PRRIP			
	Overall Sentiment Reference	**Range of Theme Codes**	**Key Words from Word Frequency Query**
AG Components			
Legitimacy	55% positive	13	Water, habitat, species, target
Structure/Capacity	66% positive	17	Stakeholder, decision, program, water
Decision-Making Process	64% positive	20	Water, decisions, species, objectives, program

Legitimacy – Overall sentiment references in the coded themes for the legitimacy component were 55% positive (66 positive sentiment references, 55 negative sentiment references). This sentiment was spread across a range of 13 different themes related to accountability, responsiveness of the PRRIP to constituencies above and below, specific goals and objectives for the program, a unifying foundational document, and program authority. The positive sentiment coupled with a narrow spread of themes in the survey and interview responses suggest an overall structurally and functionally sound AG legitimacy component. The aggregated most frequent words used in responses to questions related to the legitimacy component including “water,” “habitat,” “species,” and “target.” This suggests an that Program participants are in agreement with and aware of the specific PRRIP goal and objectives and that the program is focused on implementing management actions related to water and habitat for target species. Interview and survey responses indicated that the PRRIP is focused on the program’s contribution to recovery of the target species, on securing defined benefits for those species, and that there is a close linkage between these goals and objectives and the activities of the program. The budget is tied to the goals and objectives which are specified in the single foundational document, the Final Program Document (PRRIP, 2006b).

Structure and Capacity – Overall sentiment references in the coded themes for the structure and capacity component were 66% positive (88 positive sentiment references, 45 negative sentiment references). This sentiment was spread across a range of 17 different themes related to polycentrism, coordination, scale, stakeholder engagement, communication, and technical capacity. The positive sentiment coupled with a generally narrow spread of themes in the survey and interview responses suggest an overall structurally and functionally sound AG structure and capacity component. The aggregated most frequent words used in responses to questions related to the legitimacy component including “stakeholder,” “decision,” “program,” and “water.” This suggests the PRRIP is functioning well and engages stakeholders at the right bioregional level to use information and make decisions. There is high trust within the PRRIP with all sides represented in a collaborative decision-making structure. Seeking consensus can take more time but the GC does make decisions and all of those decisions in 13 years of implementation have been by consensus. The right stakeholders are at the table, the GC is clearly the decision-making body, and the program is implemented by an independent Executive Director and staff on behalf of the GC.

Decision-Making Process – Overall sentiment references in the coded themes for the decision-making process component were 64% positive (83 positive sentiment references, 47 negative sentiment references). This sentiment was spread across a range of 20 different themes related to shared decision-making, fair and transparent processes, use of consensus, linkage between decisions and program goals and objectives, dispute resolution, adapting to surprises, and the ability to incorporate learning into decision-making. The positive sentiment coupled with a generally narrow spread of themes in the survey and interview responses suggest an overall structurally and functionally sound AG decision-making process component. The aggregated most frequent words used in responses to questions related to the decision-making component including “water,” “decisions,” “species,” “objectives,” and “program.” This suggests a functioning decision-making process within the PRRIP focused on making decisions relative to objectives for target species with a focus on water management. There is clear communication within the PRRIP and between the GC and the technical aspects of the program, the GC is empowered to make decisions, AM learning is used as an input in decision-making, and decisions are linked to goals and objectives. Some concern about what those decisions ultimately mean for the target species and how the PRRIP and specifically the GC will deal with surprises in the future such as drought or the onset of another invasive species like Phragmites.

AG Risk Assessment

My analysis of AG risk in the PRRIP covered 15 subcomponents organized across three key AG components of interest. Table 6.6 summarizes the performance assessment and risk assessment data for all PRRIP AG subcomponents. Figure 6.3 presents a graphical summary of the subcomponent risk ratings. Risk analysis results are summarized below by grouping all PRRIP AG subcomponents into three categories of risk.

Table 6.6. Output from AG subcomponent risk assessment of the PRRIP.
C = Consequence rating, L = Likelihood rating, R = Risk rating (CxL).

AG Subcomponent	Subcomponent Description for the TRRP	C	L	R (CxL)	Risk Rating Justification
AG Component – Legitimacy					
Accountability	The PRRIP is an official federal river restoration program that is legitimate and accountable as directed by the negotiated Final Program Document (with the Extension Addendum); Program Agreement signed by the Secretary of the Interior and the Governors of Colorado, Wyoming, and Nebraska; and Congressional legislation. The PRRIP is enabled with decision responsibility through the Program Document and related legislation.	2	1	2	The Final Program Document is the ultimate statement of PRRIP authority and was negotiated by the Program partners. The PRRIP is implemented in 13-year increments. The First Increment is complete (2007-2019) and Congress approved a 13-year Extension of the First Increment in late 2019 keeping the PRRIP functional through 2032. Funding has been relatively stable over the years and tightly linked to the Program goal, First Increment Objectives, and management objectives in the AMP. The PRRIP is being implemented, has a full independent Program staff, and has a decision-making body in the GC. Decisions at the GC level are made regarding budget priorities, management actions, land and water acquisition, direction of Program activities, and other priorities. Some lack of clarity on what "recovery" means. The PRRIP is an official endangered species Recovery Implementation Program (RIP), similar in nature to several other Bureau of Reclamation RIPs. But there is disagreement among GC members about the extent to which the Program is responsible for species recovery and what that means.
Responsiveness to Constituencies	The PRRIP is a public program affecting resources with direct links to local landowners in Nebraska, water users, and communities. The Program is authorized and funded through state and federal legislation and is managed by a collaborative decision-making body (GC) that includes stakeholders (waters users and environmental entities) at the decision-making table with federal and state agency representatives.	2	1	2	The PRRIP decision-making body is the Governance Committee (GC) which is comprised of federal and state agencies, waters users, and environmental entities. Below the GC, technical advisory committees are also structured in a similar collaborative manner. Landowners in Nebraska are part of the Land Advisory Committee. All meetings of the GC and technical advisory committees are open to the public. All information (meeting agendas, meeting documents, etc.) are made widely available on the Program's web site. Annual funding (primarily federal funds, with some funding from Colorado and Wyoming) remains consistent. The GC approves the annual budget in December of each year following extensive discussion of draft budget priorities at open public meetings of the technical advisory committees. River landowners in Nebraska are part of the Land Advisory Committee. The Program acquires land in fee title and pays market rates based on appraisal. The Program pays taxes on all land holdings like any private landowner. The Platte River Recreation Access Program opens up Program land to outdoor recreation activities such as hunting and fishing to the public.
AG Component – Legitimacy Average Risk Rating				2	
AG Component – Structure/Capacity					
Polycentric	PRRIP decisions are made on a consensus basis by the GC. The GC receives input from the Technical Advisory Committee (TAC), Water Advisory Committee (WAC), Land Advisory Committee (LAC), and Independent Scientific Advisory Committee (ISAC). The Program is guided by an independent Executive Director and staff.	2	1	2	The GC is the decision-making body for the PRRIP. The "Signatories" include the two Department of the Interior agencies (Bureau of Reclamation and U.S. Fish and Wildlife Service) and the three states (CO, WY, and NE). One "no" vote from a Signatory can stop a decision from moving forward but that has not occurred in the Program's 13-year history so far. All decisions at the GC level are successfully made on a consensus basis. All GC entities operate under a charter that describes how GC members are to be selected, who they represent, and provide guidance to Program entities for coordination and communication to occur within those entities. The PRRIP chose to hire an independent Executive Director (not an employee of any PRRIP entity) who then created a small consulting company (Headwaters) to bring on Program staff. The PRRIP is an official restoration program but because of its unique structure and collaborative nature does not identify as a typical federal restoration program. The GC is inclusive of key federal and state agencies but also includes stakeholders (water users, environmental entities) at the decision-making

AG Subcomponent	Subcomponent Description for the TRRP	C	L	R (CxL)	Risk Rating Justification
					table. The Executive Director's Office remains independent from all Program entities and operates in an "honest broker" role. This is a unique feature of the PRRIP not replicated in any other major restoration program in the U.S. Decision-making in the PRRIP has been delegated down to representatives who are closest to the resource but who also have the authority and responsibility to make binding decisions. Some concern about (but openness to) the need to always consider whether all constituencies are being fairly represented (river landowners, conservation groups from CO and WY, lower Platte River entities, etc.).
Coordination and communication	The ED and staff are responsible for most coordination and communication within the PRRIP. This includes coordinating upward to the GC from technical advisory committees and independent science review processes, and downward from the GC to technical advisory committees and the public.	**2**	**1**	**1**	The coordination (and communication) of the PRRIP is specified in the Final Program Document. The GC is the decision-making body and the ED and staff implement the Program on behalf of the GC. The ED Office (EDO) is comprised of independent staff hired and managed by the Executive Director. All meetings are open to the public (GC and advisory committees) and all meeting agendas, minutes, and supporting documents are publicly-available via the Program's web site. The ED Office coordinates public outreach and communications and represents the Program at numerous conferences, public events, and educational opportunities throughout the year. Strong communication within and between the EDO, GC, advisory committees, and the public. The advisory committees have maintained their role of discussing the more technical aspects of land management, water management, and habitat management and science, reporting up to the GC with recommendations based on that technical expertise. The advisory committees operate under charters contained in the Final Program Document that provide guidance on membership, operations, and issues. The ISAC reports to the GC annually on issues related to implementation and review of AM. There is regular communication between and coordination among GC entities before and between meetings to discuss issues of significance. The PRRIP has maintained its own website since 2007 and it was updated in 2018 to provide a more useful central repository of Program events and current and historical Program information. General feeling within the Program that communication processes and structures are strong and working well. Need to be mindful of complacency – letting the EDO do too much, making sure all advisory committees are engaged and providing input to the GC, etc.
Scale (geography)	PRRIP management actions are focused on a 90-mile reach in central Nebraska. This area, called the Associated Habitat Reach (AHR), is the focal area because of its historic use by and administrative designation as critical habitat by the target bird species – whooping crane, interior least tern, piping plover. The scale matches the bioregion in terms of species use/occurrence and contribution of water to the Platte River – Platte water is largely snowmelt from the Rocky Mountains that originates in Colorado and then flows through the eastern plains of Colorado and through a system of federal reservoirs in Wyoming into Nebraska. A reach of the lower Platte River between the confluence with the Elkhorn River and the mouth at the Missouri River is also considered part of the AHR because of the presence of the fourth	**3**	**3**	**9**	The focus of PRRIP habitat and land acquisition and management is the 90-mile stretch of river in central Nebraska between Lexington and Chapman. While the PRRIP focuses its work on the AHR in central Nebraska, the Program's success/failure in terms of contributions to the recovery of the target species is highly influenced by the fact that all three bird species are migratory and are impacted by the condition of wintering grounds, actions along the migratory pathway, weather events, climate change, etc. The Program continues to struggle with how to incorporate the pallid sturgeon into the actions of the Program and as written, the Program Document does not contemplate direct management activity outside of the AHR in central Nebraska, including on the AHR reach on the lower Platte.

AG Subcomponent	Subcomponent Description for the TRRP	C	L	R (CxL)	Risk Rating Justification
	Program target species, the pallid sturgeon.				
Scale (time)	The PRRIP was negotiated to operate in a series of 13-year increments. The First Increment was 2007-2019 and in 2019 Congress approved a 13-year Extension of the First Increment through the year 2032.	**1**	**1**	**1**	The length of the time increments (13 years) was negotiated by Program participants. That increment is roughly one-third of the time of the 40-year FERC license for Kingsley Dam on the North Platte River in western Nebraska (the relicensing process for Kingsley Dam was the impetus for the Program). The PRRIP operates on an annual basis in terms of projects and funding. Reclamation provides annual appropriations, if approved by Congress, through its agency budget. Colorado and Wyoming provide some Program funding that is not tied to an annual appropriation. The PRRIP has established budgeting, policy, and AM procedures that ensure timely decisions are made relative to evaluating Program performance against goals and objectives. The time increment is not biological in nature (for example, tied to some kind of reproductive success timeline for one of the target bird species) but so far has proven long enough to provide meaningful data to help the Program address critical uncertainties through AM.
Stakeholders involved in decision-making	The GC is the decision-making body for the PRRIP and includes stakeholders such as water users from all three states and environmental entities. Those stakeholders helped negotiate and design the Program. River landowners hold seats on the Land Advisory Committee (LAC).	**2**	**2**	**4**	The GC is the decision-making body for the PRRIP and is comprised of representatives of federal agencies, state agencies (CO, WY, and NE), water users from all three states, and environmental entities. There are 11 members with 10 votes. Environmental entities have three representatives and two votes on the GC. There are five Signatories – Bureau of Reclamation, U.S. Fish and Wildlife Service, Colorado, Wyoming, and Nebraska. All of these Program partners operate under a charter negotiated as part of the Program Document that establishes guidelines for membership and procedures. River landowners in Nebraska hold seats on the Program's LAC since that is where Program management actions take place and where the Program acquires interest in land. The GC operates through consensus decision-making. While one Signatory can stop further progress on a decision, that has not happened in 13 years of implementation. All GC decisions since 2007 have been resolved by consensus. As such, there is a general feeling of trust among Program parties which enables consensus decision-making and careful consideration of options and outcomes. Some indication that attention should be paid to the potential need to consider other parties being represented within the Program (environmental entities from Colorado and Wyoming, lower Platte River stakeholders, more representation for landowners, etc.). Concern that turnover within Program, especially at the GC level, will lead to loss of significant institutional knowledge at an important time. Need to develop procedures for better integrating new representatives into the Program.
Technical capacity	The EDO is the center of technical and implementation capacity for the PRRIP. Advisory committees, including the Technical Advisory Committee (TAC) and the Independent Scientific Advisory Committee (ISAC), provide the EDO and GC with detailed technical support relative to Program goals, objectives, management objectives, management actions, and overall implementation of the AMP.	**3**	**2**	**6**	Formal structure of EDO with Program staff, advisory committees, and special working groups when necessary provides the PRRIP with strong technical capacity. Independent science review – ISAC for reporting to GC on overall implementation of AM; peer review process for important technical publications, reports, or studies; and publication of Program manuscripts. EDO provides a constant line of communication with the GC regarding key uncertainties and important scientific and technical questions. Regular interaction with the TAC regarding AM implementation and associated analysis and synthesis, though some attention needs to be paid to more routine interaction in the Extension as the AMP is revised and as new members cycle onto the TAC. Annual State of the Platte Report provides a roll-up of Program analysis and other synthesis reporting (like the Tern/Plover Synthesis Chapters and the Whooping Crane Synthesis Chapters). ISAC used well during the First Increment, need to establish a better plan for more regular interaction with and input from the ISAC during

AG Subcomponent	Subcomponent Description for the TRRP	C	L	R (CxL)	Risk Rating Justification
					the Extension. Identified need to re-establish the Adaptive Management Working Group (AMWG) with a small number of technical experts to assist with revision of the AMP for the Extension.
AG Component – Structure/Capacity Average Risk Rating				4	
AG Component – Decision-Making Process					
Shared decision-making	Decisions are made at the GC level, which includes not only federal and state agency representatives but also representatives of water user groups and environmental entities.	2	1	2	The GC includes federal and state agency representatives and also representatives of water user groups and environmental entities. This representation is shared downward within the PRRIP on the advisory committees. 11 GC members, with 10 votes total. Environmental entities have three seats at the GC table but only two votes. River landowners have seats on the Land Advisory Committee (LAC) to represent the concerns of landowners along the central Platte River where Program management actions and land acquisition take place. Stakeholders are integrated into decision-making through representation on the GC. Some commentary on the need to consider additional representation within the Program (environmental groups from CO and WY, lower Platte River interests, etc.). Five Signatories and if one votes no on an issue then progress is stopped. Stakeholders do not have this authority. However, in 13 years of implementation, this has never happened and all decisions have been made by consensus.
Fair and transparent	All GC meetings and all advisory committee meetings are open to the public. Meeting agendas, supporting documents, and final minutes are posted on the Program's website. All Program documents and reports deemed final by the GC are posted for public consumption on the Program's website. The EDO is independent from all Program entities (no federal agency employees, for example).	3	3	9	The GC makes decisions for the PRRIP. Those decisions are voted on in open session during public meetings and recorded in meeting minutes posted on the PRRIP website. The EDO is independent from all Program entities. GC decision-making is linked to Program goals and objectives and all motions are voted on during open public meetings. These motions and subsequent decisions relate to expenditure of Program funds, management actions, land and water acquisition, implementation of AM, and general Program management. The independent EDO and staff approach their roles in an "honest broker" format attempting to present information fairly and without entity bias for the purposes of GC decision-making. Given that the EDO now has the great command of Program data and analysis and also is integral to implementation on behalf of the GC, need to make sure this independence is maintained.
Consensus	The GC operates on a consensus basis and all GC decisions since the Program began in 2007 have been decided with a consensus vote.	1	1	1	The GC attempts to reach consensus on all motions and votes during each year. Since the Program began in 2007, all GC decisions have been made via consensus. Signatories can individually stop a decision but that has not happened within the PRRIP during its existence. The consensus process can be slow, with some issues needing to spill over into future meetings to give more time for issues to be resolved. The successful consensus approach has engendered a high level of trust among GC members and within the Program as a whole, which has led to Program success during the First Increment. The long term of Program function and success has led to a fairly smooth decision-making process within the GC. Lack of clarity on some objectives such as how to handle pallid sturgeon, what recovery means for the Program, etc. remain challenges to Program function but have not stopped forward progress thus far.
Decisions linked to goals/objectives	The Program Document clearly specifies the Program purpose, goals, objectives, and management objectives for the AMP. All goals and objectives are consistently referenced when developing annual budgets, plans for management actions, science synthesis reports like the annual State of the Platte Report, etc.	4	3	12	Program goals and objectives clearly spelled out in the Program Document and referenced by nearly all survey respondents as being the organizing principles of the PRRIP. This includes a set of 10 Milestones (land, water, depletions plans, AMP implementation, etc.) that are referenced by policy-makers within the GC as measures of success. PRRIP decisions have all largely centered around the First Increment Objectives of land (10,000 acres) and water (130,000-150,000 acre/feet year of reductions to flow shortages). This also includes a focus

AG Subcomponent	Subcomponent Description for the TRRP	C	L	R (CxL)	Risk Rating Justification
					on learning through AM during the First Increment. General concern among respondents about resolving issues related to pallid sturgeon, trying to determine what it means to "recover" the target species (or what the Program is on the hook for relative to recovery), and how to sustain the Program in the near-term and long-term if AMP management objectives are being met.
Dispute resolution	The GC operates on a consensus basis but does not have a formal process for dispute resolution, other than a Signatory being able to stop forward progress on an issue.	**3**	**2**	**6**	GC decision-making occurs through a consensus-based process. This is not a formal dispute resolution process but rather a well-worn approach dating back to the 10-plus years of negotiation to build the PRRIP. In terms of decision, 11 members of the GC have 10 votes (environmental entities have three GC seats but two votes). 5 Signatories = Bureau of Reclamation, U.S. Fish & Wildlife Service, Colorado, Wyoming, and Nebraska. All GC decisions since the Program began in 2007 have been via consensus. One Signatory "no" vote can stop a decision but that has not happened during Program implementation thus far. Unlikely that all decisions by the GC will achieve consensus forever, so consider developing a more formal dispute resolution process for when that happens.
Adapt to surprises	The Program has had to deal with surprises such as the influx of the invasive plant Phragmites and the onset of both drought conditions and exceptionally wet conditions.	**4**	**5**	**20**	The general structure of the PRRIP and the openness to learning and incorporating that learning into decision-making suggest the ability to be flexible and respond to surprises. Consensus decision-making has been an important tool for the PRRIP, but it is slower and more deliberative thus making it harder to respond to surprises. Similarly, shared decision-making with stakeholder involvement has been an important tool for the PRRIP, but the multitude of interests represented on the GC and the differences of opinion that exist on key issues like target flows, recovery (species benefits), and pallid sturgeon suggest difficulty lies ahead if more surprises face the PRRIP. No real planning for the onset of a major drought, or if the PRRIP would be implemented during a long period of consistently less water or more flashy events like floods exacerbated by climate change.
Ability to incorporate learning into decision-making	The Program spent a good deal of time during the First Increment deciding how best to incorporate learning into decision-making and use that learning to enable the GC to make more informed decisions. Tools such as Structured Decision Making (SDM) have been employed to facilitate this effort.	**2**	**1**	**2**	The GC makes decisions on how to spend Program funds on science projects, data analysis, and data synthesis. The AM Plan was negotiated as part of the Program Document. It is being revised for the Extension but during the First Increment contained the conceptual models, management objectives, hypotheses, monitoring protocols, and other critical components of true AM that have been the focus of implementation and evaluation since 2007. Proposals for PRRIP AM implementation, data analysis, data synthesis, etc. are developed through the technical aspects of the Program and work their way up to the TMC for final approval (largely through the annual PRRIP budget process). This includes review by and discussion with the ISAC, peer reviewers when necessary, and other forms of independent science expertise. Results are presented to the GC on a regular basis – quarterly meetings, annual AMP Reporting Session, periodic EDO updates. The EDO generates an annual State of the Platte Report that rolls up Program learning (analysis and synthesis) to date and tracks learning relative to AMP management objectives against a set of Big Questions with underlying hypotheses. The GC agreed to use an SDM process at the end of the AM cycle for one key issue (river flow, its ability to build and maintain tern/plover nesting habitat, and tern/plover productivity on such habitat). This led to a decision to change management actions and thus completion of one full cycle of the six AM steps. Some concern about how this will proceed in the Extension now that several central critical uncertainties have been addressed during the First Increment.
AG Component – Decision-Making Process Average Risk Rating				**7**	
Overall AG Average Risk Rating				**4**	

High risk subdomains requiring reform (risk rating 16-25)

My analysis identified only one subcomponents of AG that requires reform to continue to enable a highly-functional AG structure within the PRRIP that supports the successful implementation of AM. The PRRIP needs to focus on preparing to *adapt to surprises* such as unexpected droughts, potential long-term changes in water supply availability, and the possibility of the establishment of additional invasive species like Phragmites. This effort will require the ability to perform forecasts, risk assessments, and tradeoff and consequence analyses that the GC can use to inform decisions during the Extension through the year 2032 and also negotiations for a Second Increment that would begin in 2033.

Medium risk subcomponents may require adjustment (risk rating 11-15)

My analysis did not identify any subcomponents of AG in this risk category.

Low risk subcomponents not requiring adjustment (risk rating 10 and below)

My analysis identified 14 subcomponents of AG that are either working or that are currently being addressed by the PRRIP. This cluster of subcomponent represent a low risk of AG failure and include: (1) *coordination and communication*; (2) *scale (time)*; (3) *consensus*; (4) *accountability*; (5) *ability to incorporate learning into decision-making*; (6) *polycentric*; (7) *responsiveness to constituencies*; (8) *shared decision-making*; (9) *decisions linked to goals and objectives*; (10) *stakeholders involved in decision-making*; (11) *technical capacity*; (12) *dispute resolution*; (13) *scale (geography)*; and (14) *fair and transparent*. The success of these subcomponents reflect the PRRIP as a highly-functional and well-structured restoration program that has developed a unique AG structure incorporating shared decision-making. By developing a single, unifying foundational document that clearly spells out goals and objectives, the PRRIP has provided relatively clear direction for implementation and decision-making. However, all of these subcomponents need continuous attention and refinement as the PRRIP continues through the Extension to avoid complacency that might result in decreased function.

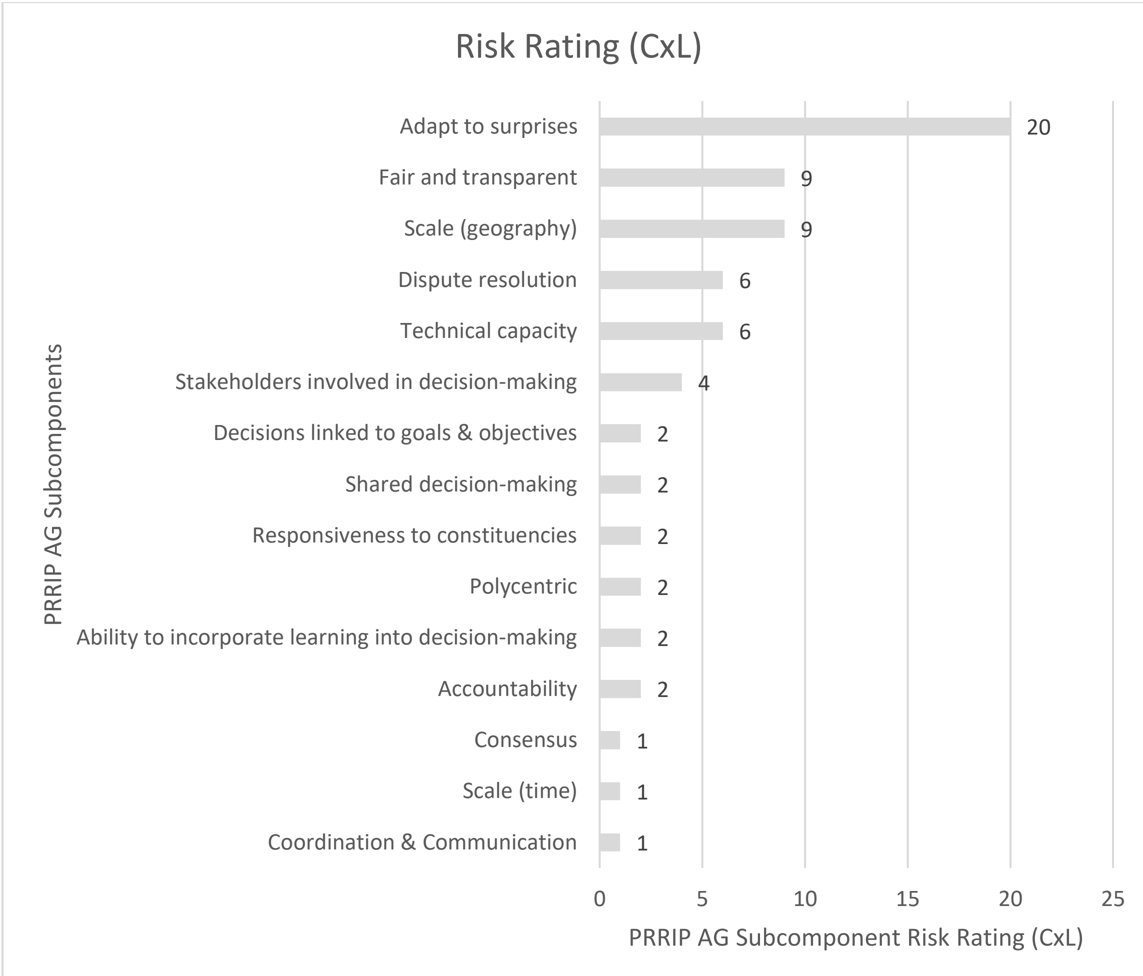

Figure 6.3. Risk ratings for all PRRIP AG subcomponents showing the relative risk profile (i.e. decreasing risk from top to bottom).

AM Performance Assessment

General Observation – The PRRIP has successfully completed one full iteration of the six-step AM cycle on an issue related to water management actions, habitat management actions, and reproductive success of two target species (interior least tern and piping plover). The GC used a Structured Decision Making (SDM) process to help integrate AM learning with decision-making in the Adjust step, which results in changing recommendations for management that focused more on off-channel nesting habitat and less on manipulating water releases in an attempt to develop on-channel nesting habitat. This process was well-structured and well-documented and represents a clear example of AM success at a large scale. It is apparent this success is a direct result of the structure and function of AG within the PRRIP.

Results of the AM component performance assessment are summarized in Table 6.7 and discussed in more detail below. Appendix E includes word hierarchy color sunburst charts from NVivo.

Table 6.7. Summary of PRRIP AM component autocoding analysis from NVivo (2020).

Case Study #2 – PRRIP			
	Overall Sentiment Reference	**Range of Theme Codes**	**Key Words from Word Frequency Query**
AM Components			
Assess	59% positive	18	Management, program, water, species, decisions
Design	58% positive	22	Water, species, management actions
Implement	55% positive	36	Water, program, agency, decisions
Monitor	56% positive	20	Water, program, decisions, questions
Evaluate	62% positive	22	Water, program review, peer review
Adjust	60% positive	30	Water, program, decision, information

Assess – Overall sentiment references in the coded themes for the Assess component were 59% positive (54 positive sentiment references, 38 negative sentiment references). This sentiment was spread across a range of 18 different themes related to problem definition and agreement, decisions affected by AM learning and linked to program goals and objectives, and a collaborative process for developing this information. The positive sentiment coupled with a narrow spread of themes in the survey and interview responses suggest an overall structurally and functionally sound AM Assess component. The aggregated most frequent words used in responses to questions related to the Assess component including “management,” “program,” “water,” “species,” and “decisions.” This suggests that AM in the PRRIP is organized around management decisions and actions that relate to the target species, with particular focus on water management. The PRRIP does have a negotiated Adaptive Management Plan (AMP; PRRIP, 2006a) that is part of the Final Program Document (PRRIP, 2006b). PRRIP participants share a common understanding of management strategies, management actions, and priority hypotheses, as well as a set of Big Questions that serve to roll up several hypotheses into more manageable questions that can be addressed through implementation of the AMP. The approach to AM in the PRRIP is cross-disciplinary and is intended to reduce uncertainty and help the PRRIP learn. There is a need to revise the Big Questions for the Extension, develop new hypotheses, and address larger areas of uncertainty such as how the PRRIP should integrate pallid sturgeon into the revised AMP as a target species.

Design – Overall sentiment references in the coded themes for the Design component were 58% positive (52 positive sentiment references, 38 negative sentiment references). This sentiment was spread across a range of 22 different themes related to explicit management objectives and management actions and monitoring and research protocols linked to priority hypotheses and questions from decision-makers. The positive sentiment coupled with a generally narrow spread of themes in the survey and interview responses suggest an overall structurally and functionally sound AM Design component. The aggregated most frequent words used in responses to questions related to the Design component including “water,” “species,” and “management actions.” This suggests a tight focus within PRRIP AM on designing AM actions that test hypotheses related to management actions for the target species, particularly related to flow management actions. There is general agreement within the PRRIP on having a large amount of flexibility in implementing management actions, though there are constraints related to water and land availability. There is uncertainty about what “recovery” of the target species means for the PRRIP and how factors outside the control of the PRRIP will affect the target species. The general understanding is that the PRRIP is intended to provide benefits, not be responsible for species recovery.

Implement – Overall sentiment references in the coded themes for the Implement component were 55% positive (44 positive sentiment references, 36 negative sentiment references). This sentiment was spread across a range of 36 different themes related to implementation of management actions and monitoring with project oversight. The relatively equal sentiment references coupled with a wide spread of themes in the survey and interview responses suggest the AM Implement component needs some attention. The aggregated most frequent words used in responses to questions related to the Implement component including “water,” “program,” “agency,” and “decisions.” This data and a review of the interview responses suggest the performance assessment of this AM component hinges on the need to better specify a plan for implementation of AM during the Extension. There is general agreement that independent implementation helps the PRRIP to build in independence into its processes and is a tool to overcome issues of trust, power dynamics, and agency bias. Some respondents wondered why this approach is not used more in large restoration programs. The ED and staff act as honest brokers of information for the GC and provide the PRRIP with objectivity.

Monitor – Overall sentiment references in the coded themes for the Monitor component were 56% positive (33 positive sentiment references, 26 negative sentiment references). This sentiment was spread across a range of 20 different themes related to whether implementation, effectiveness, and validation monitoring are being conducted in a way that provides the correct data to answer AM hypotheses and decision-maker questions. The relatively positive sentiment coupled with a generally narrow spread of themes in the survey and interview responses suggest an overall structurally and functionally sound AM Monitor component. The aggregated most frequent words used in responses to questions related to the Monitor component including “water,” “program,” “decisions,” and “questions.” This suggests that monitoring is generally linked well to AM hypotheses and questions from decision-makers. Interview respondents generally agreed that PRRIP monitoring does provide data useful to GC decision-makers.

Evaluate – Overall sentiment references in the coded themes for the Evaluate component were 62% positive (42 positive sentiment references, 26 negative sentiment references). This sentiment was spread across a range of 22 different themes related to specifying the path from data to management decision-making and what learning means for goals, objectives, and hypotheses. The positive sentiment coupled with a narrow spread of themes in the survey and interview responses suggest an overall structurally and functionally sound AM Evaluate component. The aggregated most frequent words used in responses to questions related to the Evaluate component including “water,” “program,” “review,” and “peer review.” This suggests that PRRIP data is analyzed, synthesized, and subjected to rigorous independent science review. There is strong agreement that the PRRIP conducts successful data synthesis as a way to communicate AM learning to the GC and to the public. Use of the Big Questions, the annual State of the Platte Report, and the annual AMP Reporting Session were cited as useful tools for synthesizing and communicating PRRIP learning. There is general agreement that the Independent Scientific Advisory Committee (ISAC) provides useful input to the GC and that the PRRIP uses independent peer review well. Some concerns were raised about the ISAC being underutilized and the PRRIP needing to better define the structure and function of the ISAC for the Extension.

Adjust – Overall sentiment references in the coded themes for the Adjust component were 60% positive (36 positive sentiment references, 24 negative sentiment references). This sentiment was spread across a range of 30 different themes related to making clear management decisions utilizing program learning as one input. The positive sentiment coupled with a generally narrow spread of themes in the survey and interview responses suggest an overall structurally and functionally sound AM Adjust component. The aggregated most frequent words used in responses to questions related to the Adjust component including “water,” “program,” “decision,” and “information.” This suggests that AM information is being utilized in the decision-making process and that learning is informative for key PRRIP issues such as water management to benefit target species. There is general agreement that the use of SDM in the Adjust step of the AM cycle is a powerful tool to assist the GC with integrating AM learning into the decision-making process. PRRIP participants feel they are implementing rigorous AM through the six-step cycle and are prepared to continue this process during the Extension.

AM Risk Assessment

My analysis of AM risk in the PRRIP covered 15 subcomponents organized across six key AM components of interest. Table 6.8 summarizes the performance assessment and risk assessment data for all PRRIP AM subcomponents. Figure 6.4 presents a graphical summary of the subcomponent risk ratings. Risk analysis results are summarized below by grouping all PRRIP AM subcomponents into three categories of risk.

Table 6.8. Output from AG subcomponent risk assessment of the PRRIP.
C = Consequence rating, L = Likelihood rating, R = Risk rating (CxL).

AM Subcomponent	Subcomponent Description for the TRRP	C	L	R (CxL)	Risk Rating Justification
AM Component – Assess					
Problem definition and agreement	Clearly-stated and agreed-upon goals and objectives for the PRRIP in the Program Document. A negotiated and agreed-upon AMP that includes a definition of AM, management objectives, management strategies and actions, and a set of priority hypotheses to test.	1	1	1	There are agreed-upon Program goals and objectives that are written into the negotiated Program Document which is the single unifying foundational document for the PRRIP. GC focus on First Increment objectives for habitat (10,000 acres) and water (130,000-150,000 acre/feet per year in shortage reductions) informed by learning from the AMP. AM is defined in the AMP and provides a common understanding of AM for the PRRIP. AMP includes four management objectives tied to the target species, management strategies and actions, and a set of 47 priority hypotheses. First Increment AMP implementation focused on prioritizing the hypotheses into a smaller set of Big Questions that served to focus AM implementation efforts but also as a means of communicating AM learning back to the GC for decision-making purposes. Biggest challenge for the PRRIP is to repeat the Assess step for the Extension – identify the next set of Big Questions and hypotheses, establish management actions, and specific what learning is expected and how it will be translated back to the GC for decision-making during the Extension and for negotiations for a Second Increment that would start in the year 2033.
Roadmap of goals, objectives, hypotheses	Negotiated AM Plan included as part of Program Document. AMP is linked back to Program goals and objectives through management objectives, management strategies and actions, and a set of priority hypotheses.	4	3	12	PRRIP has agreed-upon AMP with definition of AM and key components – management objectives, management strategies and actions, and priority hypotheses. PRRIP began using Big Questions during the First Increment to roll up several hypotheses into overarching questions of interest to GC decision-makers and that could help better link AM learning to decision-making. Respondents generally agreed there is a common understanding of the purpose of the AMP and

AM Subcomponent	Subcomponent Description for the TRRP	C	L	R (CxL)	Risk Rating Justification
					the hypotheses being tested. General agreement that the purpose of AM in the PRRIP is to learn, reduce uncertainty, and provide information to the GC for decision-making. Big Questions provide useful tool to communicate learning to the GC and show a more direct link between decisions the GC will make and AM learning. General agreement about the nature of uncertainties that need addressed for the PRRIP – water for species, long-term habitat and flow management, incremental benefits of water (how much water do we need?), and target flows. Concern about specifying how to address pallid sturgeon, how to relate species responses to management actions, and impacts of events outside the control of the PRRIP such as drought and climate change. Need to address these issues for Extension, develop a revised AMP that fills out the roadmap going forward. Consider developing a more formal process for integrating AM learning into GC decision-making – will SDM always be used in the Adjust step of the AM cycle? How does the GC functionally use AM learning as an input to decision-making about management actions, water acquisition, etc.?
Decisions affected by information	PRRIP has successfully completed one full cycle of the six AM steps regarding a key uncertainty (flow, sandbar habitat, and tern/plover nesting) and adjusted management activities as a result of Program learning.	**3**	**2**	**6**	The GC makes decision for the PRRIP. For decision-making purposes, the GC receives various levels of input from the EDO, advisory committees and work groups, and independent science review (ISAC and peer review). The GC makes decisions on a consensus basis. On a functional basis, most decisions at the GC level focus on annual budget line items, acquisition of land and water resources, and higher-level policy issues. The intent of the First Increment was to be the "learning" increment focused on implementation of the AMP. That resulted in prioritization of key uncertainties and hypotheses, development of the Big Questions, refinement of independent science review processes, and efforts to analyze and synthesis Program data through tools like the annual State of the Platte Report and the annual AMP Reporting Session. The GC used Structured Decision Making (SDM) to help use Program learning in the Adjust step of AM. Linkages between AM learning and decision-making are not specified in the AMP so some attention needs to be paid to developing a more formal process for GC decision-making in the Adjust step of AM (i.e. use of SDM, more clearly specific decisions that need to be/will be made, etc.)
Collaborative process to develop this information	Negotiated AMP is part of the Final Program Document and was specifically developed to guide Program learning in the First Increment as a collaborative means to address key uncertainties and disagreements about how to manage Program resources to benefit target species (e.g. use of flow versus use of mechanical means to create and maintain habitat).	**2**	**3**	**6**	The AMP includes key components such as conceptual models, management objectives, management strategies and actions, hypotheses, monitoring protocols, and direction on data analysis. During the First Increment, the EDO and advisory committees developed Big Questions to help organize hypotheses and AM learning and the Big Questions were approved by the GC. The AMP was developed and negotiated as part of the process of finalizing the Program Document. The GC intended the First Increment to be the "learning increment" through application of AM. The PRRIP is built on a shared-decision making structure that engages stakeholders in GC decision-making and includes those stakeholders in all advisory committees and implementation of the AMP. Collaborative process in place, PRRIP needs to continue work on developing Big Questions, hypotheses, and management actions for the Extension.
AM Component – Assess Average Risk Rating				**6**	
AM Component – Design					
Management objectives	The PRRIP AMP includes four specific management objectives and AM learning is reported to the GC against those management objectives as a decision-making input.	**4**	**3**	**12**	The AMP includes four management objectives: three that are specific to the Program's target species (tern/plover, whooping crane, and pallid sturgeon) and a "catch-all" objective for other species of concern. These management objectives were retained unchanged for the Extension (2020-2032) by the GC. General agreement that management objectives have thus far not included

AM Subcomponent	Subcomponent Description for the TRRP	C	L	R (CxL)	Risk Rating Justification
					specific species metrics because the bird species are migratory that are impacted by factors outside the control of the Program. Idea was to provide benefits for species rather than being tied to any range-wide recovery metrics. The management objectives are used by the PRRIP to help organize and prioritize uncertainties and hypotheses to be addressed by AM implementation. The tern/plover and whooping crane management objectives do include metrics for assessing performance of the Program against the management objectives, but internal PRRIP discussion and review by the ISAC suggest those metrics are really proxies for true measurements of reproductive success (tern/plover) and river use (whooping crane). The pallid sturgeon management objective is written as a "do no harm" objective, meaning the current language directs the Program to "avoid adverse impacts" to pallid sturgeon and their habitat in the lower Platte River due to PRRIP management actions in the central Platte River. The PRRIP has not specified any metrics for measuring progress of the Program against the pallids sturgeon management objective. The PRRIP has not attempted to address the fourth management objective, which is to avoid ESA listing of additional species of concern. Liked the pallid sturgeon management objective, the species of concern objective includes no metrics for measurement of progress over time. The GC retained all four management objectives for the Extension. Internal PRRIP discussion and ISAC review suggest the need to re-consider the management objectives and the metrics used to measure progress toward achieving the objectives.
Management actions	Specific management actions identified in the AMP as tests of two possible management strategies (flow-related versus mechanical-related) that are linked to the priority hypotheses and AM implementation.	**2**	**2**	**4**	Two management strategies are identified in the AMP and intended to be implemented in parallel as possible to test two theories of how best the PRRIP can create and maintain habitat for the target species and expect positive outcomes – FSM (Flow-Sediment-Mechanical) and MCM (Mechanical Creation & Maintenance). The AMP includes specific management actions that comprise the two management strategies to be implemented by the PRRIP during the First Increment – flow releases, sediment augmentation, mechanical habitat restoration, and specific habitat development such as palustrine wetlands and off-channel sand and water habitat (nesting habitat for terns/plovers). AMP management actions have been the subject of much of the implementation work and success of the PRRIP during the First Increment. Successful implementation of flow tests, on-channel habitat construction, off-channel habitat construction, channel width creation, etc. Research, monitoring, data analysis, and data synthesis during the First Increment has focused on the results of management action implementation and habitat, river, and species responses. The PRRIP took advantage of multiple high-flow events during the First Increment (2007-2020) to learn about the impact of high flows on habitat creation and maintenance and species responses and use, which allowed the Program to learn about the potential effects of a flow management action like short-duration high flow (SDHF) without full implementation of that management action. As of August 2020, somewhat unclear what the exact management actions will be during the Extension, though the PRRIP is actively engaged in a process to revised the AMP and specify management actions that can be implemented to provide AM learning useful for GC decision-making during the Extension and that can be useful in Second Increment negotiations toward the end of the Extension. General agreement that even with management actions specified, the GC retains a large amount of flexibility to adjust those actions or otherwise respond to learning when necessary to speed learning and help with decision-making.

AM Subcomponent	Subcomponent Description for the TRRP	C	L	R (CxL)	Risk Rating Justification
Monitoring/research protocols tailored to hypotheses and key questions from decision-makers	The AMP includes specific monitoring protocols related to the target species and developed additional monitoring and research protocols during the First Increment linked to the Program's agreed-upon goals, objectives, management objectives, hypotheses, and Big Questions.	2	2	4	The PRRIP spent considerable time and effort prior to the beginning of the First Increment and during the First Increment to develop, implement, and refine sound and consistent monitoring protocols for the target bird species (tern/plover, whooping crane) and aspects of river geomorphology, sediment transport, etc. Consistent monitoring throughout the First Increment has provided the PRRIP with a large dataset relative to target species use and reproductive success. Long-term monitoring on river geomorphology, vegetation, and sediment transport instrumental in implementation and evaluation of the AMP. Monitoring protocols have been refined over time to respond to learning relative to species' migratory patterns, critical information needs, use of new technology, etc. Consistent annual funding for monitoring that is clearly tied to AM implementation, learning, and decision-making needs. All monitoring protocols have been subjected to independent science review to ensure the use of sound methodology. The PRRIP used directed research projects such as research on the ability of flow to remove vegetation such as phragmites to fill information gaps.
AM Component – Design Average Risk Rating				7	
AM Component – Implement					
Plan for implementation of management actions and monitoring	The AMP provides clear specification of management actions and monitoring protocols. The PRRIP developed a process for implementation during the course of the First Increment.	3	2	6	The AMP includes specific management actions and monitoring protocols but does not include a full implementation plan for those actions and monitoring. The EDO developed an Implementation Plan during the First Increment and the PRRIP generally developed implementation approaches and priorities that were followed throughout the First Increment. The EDO, in collaboration with the Technical Advisory Committee (TAC) and Independent Scientific Advisory Committee (ISAC) developed an implementation plan for AM during the First Increment that included the design of actions, associated monitoring and research, and plans for data analysis. During the course of the First Increment, the PRRIP developed general procedures and processes for implementing AM actions and associated monitoring. The PRRIP needs to refine its implementation plan for AM for the Extension based on how the AMP is revised.
Project oversight	The PRRIP utilizes independent implementation, meaning the ED and Program staff (EDO) are not employees of any of the Program parties but are rather employees of a private natural resources consulting firm. The EDO is responsible for day-to-day implementation of the PRRIP on behalf of the GC.	1	1	1	The ED and Program staff (EDO) are employees of Headwaters Corporation, a private, for-profit natural resources consulting firm. The ED and Program staff are not employees of any PRRIP entity and are thus independent. The PRRIP decided to utilize independence implementation to build in independence, avoid agency bias, and overcome issues of trust and power dynamics. The EDO acts as "honest brokers" for the GC, providing objectivity and independent assessment of Program learning. General feeling this is the best approach to staffing a Program like the PRRIP. Some concerns about it slowing down the process of implementation and decision-making, EDO staff size and costs over time, and also the need to ensure the EDO does not end up guiding the GC (instead of acting as honest brokers). Question asked by respondent – the pros are so strong, why isn't this approach used more by restoration programs?
AM Component – Implement Average Risk Rating				4	
AM Component – Monitor					
Implementation, effectiveness, and validation monitoring	The PRRIPP conducts implementation, effectiveness, and validation monitoring linked to AMP implementation and the management objectives, hypotheses, Big Questions, and management actions.	2	2	4	The PRRIP has a strong track record of project-specific and species monitoring and research. Most monitoring is related to implementation of the major PRRIP management actions including flow tests, habitat creation, sediment augmentation, etc. Monitoring and research are implemented primarily to deliver information useful in decision-making related to PRRIP goals, objectives, management actions, Big Questions, and hypotheses (validation). Implementation and effectiveness monitoring of specific management actions and their impact on river form/function and target

AM Subcomponent	Subcomponent Description for the TRRP	C	L	R (CxL)	Risk Rating Justification
					species habitat provide critical data inputs. General agreement that PRRIP monitoring provides useful data to decision-makers.
AM Component – Monitor Average Risk Rating				4	
AM Component – Evaluate					
Data analysis	The PRRIP conducts rigorous science with extensive data analysis, peer review, and publication of results.	2	2	4	Strong collection and analysis of research and monitoring data. Continued effort to discuss all data collaboratively within the EDO, TAC, and ISAC. Continued use of internal peer review and publication of results to ensure rigor.
Data synthesis	A strong suit of the PRRIP developed over time through the use of tools such as Big Questions, data synthesis chapters, the State of the Platte Report, and the annual AMP Reporting Session.	2	1	2	PRRIP uses Big Questions as a tool to roll up several underlying priority hypotheses and discuss strong inference of multiple lines of evidence with the GC. EDO has developed two sets of synthesis chapters (tern/plover, whooping crane). State of the Platte Report summarizes annual AM learning and learning over time for the GC. Synthesis discussed during the annual AMP Reporting Session which includes the GC, TAC, ISAC, EDO, contractors, and other interested parties. General agreement this is a strong suit of the PRRIP. Synthesis chapters on terns/plovers and whooping cranes have formed the basis of AM learning conclusions after several years of implementation. Most of the individual chapters have been published in refereed journals. Annual State of the Platte Reports for the GC include EDO assessments (thumbs up, thumbs down, not certain) of the Big Questions giving the GC direction on what the Program has learned to date relative to those questions and the underlying hypotheses. All synthesis, Big Question assessments, and general conclusions from learning are discussed in detail at the annual AMP Reporting Session. Some concern raised as to making sure that the EDO and others do not jump to conclusions, let the data speak and make sure clear linkages exist to Big Questions and hypotheses.
Independent science review	The ISAC provides independent science review on AM implementation to the GC. The PRRIP also utilizes peer review through its own peer review process for critical Program documents, monitoring protocols, reports, etc. and then seeks publication when warranted for additional peer review and to ensure scientific rigor.	3	2	6	The PRRIP has a standing independent science review panel in the form of the ISAC that reports directly to the GC. Independent peer review following the Program's internal peer review process is utilized, when directed by the GC, for particular Program reports, monitoring protocols, and other key documents. The PRRIP has a proven track record of publication. The ISAC generates an annual report to the GC based on questions from the EDO, TAC, and GC directly; discussions and presentation at the annual AMP Reporting Session; drafts of the annual State of the Platte Report; and other webinars and discussions throughout the year. The GC has asked the ISAC to weigh in on certain issues over time, including pallid sturgeon and the Platte River caddisfly. Some feeling that the ISAC may be underutilized especially as the PRRIP pivots to the Extension, attention needs to be paid to ISAC structure and function for the Extension to ensure their continued utility. The PRRIP has used peer review a few times during the First Increment as directed by the GC (for example, on the stage change study, monitoring protocols, etc.). That peer review follows a specific process collaboratively developed by PRRIP entities and the EDO. To provide additional peer review and to seek additional independent science input, the PRRIP utilizes publication of manuscripts. For example, most of the tern/plover and whooping crane synthesis chapters have been published in established refereed journals.
AM Component – Evaluate Average Risk Rating				4	
AM Component – Adjust					
AM results communicated to decision-makers and used in decision-making	To date, the most successful example of this in the PRRIP is the use of Structure Decision Making (SDM) to help connect AM learning to GC decision-making.	2	2	4	The EDO reports on AM learning to the GC at all quarterly GC meetings. Some members of the GC participate in the annual AMP Reporting Session. Workshops and GC Special Sessions are used to communicate and discuss AM learning and how that learning can be used to inform GC decisions. The primary

AM Subcomponent	Subcomponent Description for the TRRP	C	L	R (CxL)	Risk Rating Justification
					example of how the PRRIP has handled this issue is the use of SDM to provide the GC with decision-making context for considering management actions related to tern/plover nesting habitat. Tradeoffs, consequences, and expected outcomes were part of the SDM process which led to the GC deciding to adjust management actions related to flow management for terns and plovers and a focus on off-channel nesting habitat. General agreement that the GC found this to be a helpful and successful effort that should be repeated. Need to develop a more formal, repeatable process for linking AM learning to GC decision-making for the Extension.
Documentation of decision-making results	GC decisions are clearly recorded in the minutes of all GC decisions, which are made public on the PRRIP website. Final reports from efforts like the tern/plover SDM process are also posted for public consumption on the PRRIP website. Changes in management actions or new approaches are also detailed in the annual PRRIP budget and work plan.	1	1	1	GC decisions all recorded in quarterly meeting minutes that are posted for public consumption on the PRRIP website. Results of the tern/plover SDM process also posted on the PRRIP website in the form of a final report. The PRRIP generates an annual work plan with its annual budget that details how money will be spent on management actions, monitoring, analysis, and synthesis in the coming year. All GC meetings are open to the public and all discussions are recorded in public minutes.
AM Component – Adjust Average Risk Rating				3	
Overall AM Average Risk Rating				5	
Combined AG + AM Risk Rating Overall Average for AG/AM Risk Typology				5	

High risk subdomains requiring reform (risk rating 16-25)

My analysis did not identify any subcomponents of AM in this risk category.

Medium risk subcomponents may require adjustment (risk rating 11-15)

My analysis identified 2 subcomponents of AM that may require some adjustment to better enable AM within the PRRIP. For the Extension, the PRRIP needs to develop a clearer *roadmap of goals, objectives, and hypotheses* that will guide AM implementation. As a policy decision, the GC agreed to retain the current *management objectives* for the Extension. However, there is discussion within the Technical Advisory Committee (TAC) and the ISAC regarding the need to refine these objectives to incorporate more useful indicators and make the objectives more measurable. This would enable the PRRIP to better report progress against the management objectives over time.

Low risk subcomponents not requiring adjustment (risk rating 10 and below)

My analysis identified 13 subcomponents of AM that are either working or that are currently being addressed by the PRRIP. This cluster of subcomponents represent a low risk of AM failure and include: (1) *documentation of decision-making results*; (2) *project oversight*; (3) *problem definition and agreement*; (4) *management actions*; (5) *data analysis*; (6) *monitoring and research protocols tailored to hypotheses and decision-maker questions*; (7) *implementation, effectiveness, and validation monitoring*; (8) *data synthesis*; (9) *results communicated and used in decision-making*; (10) *implementation plan*; (11) *decisions affected by information*; (12) *independent science review*; and (13) *collaborative process to develop information*. The success of these subcomponents reflect the PRRIP is implementing rigorous AM that is linked to decisions made by the GC and that is directing learning at PRRIP goals, objectives, management objectives, and hypotheses. The current AMP has provided the PRRIP with relatively clear direction for AM implementation during the course of the First Increment. However, the PRRIP needs to develop new Big Questions and hypotheses for the Extension, consider changes to management objectives, design management actions to test the hypotheses, and plan for how learning will be communicated to the GC and used in decision-making. As with the low risk AG subcomponents, all of these AM subcomponents need continuous attention and refinement as the PRRIP continues through the Extension to avoid complacency that might result in decreased function.

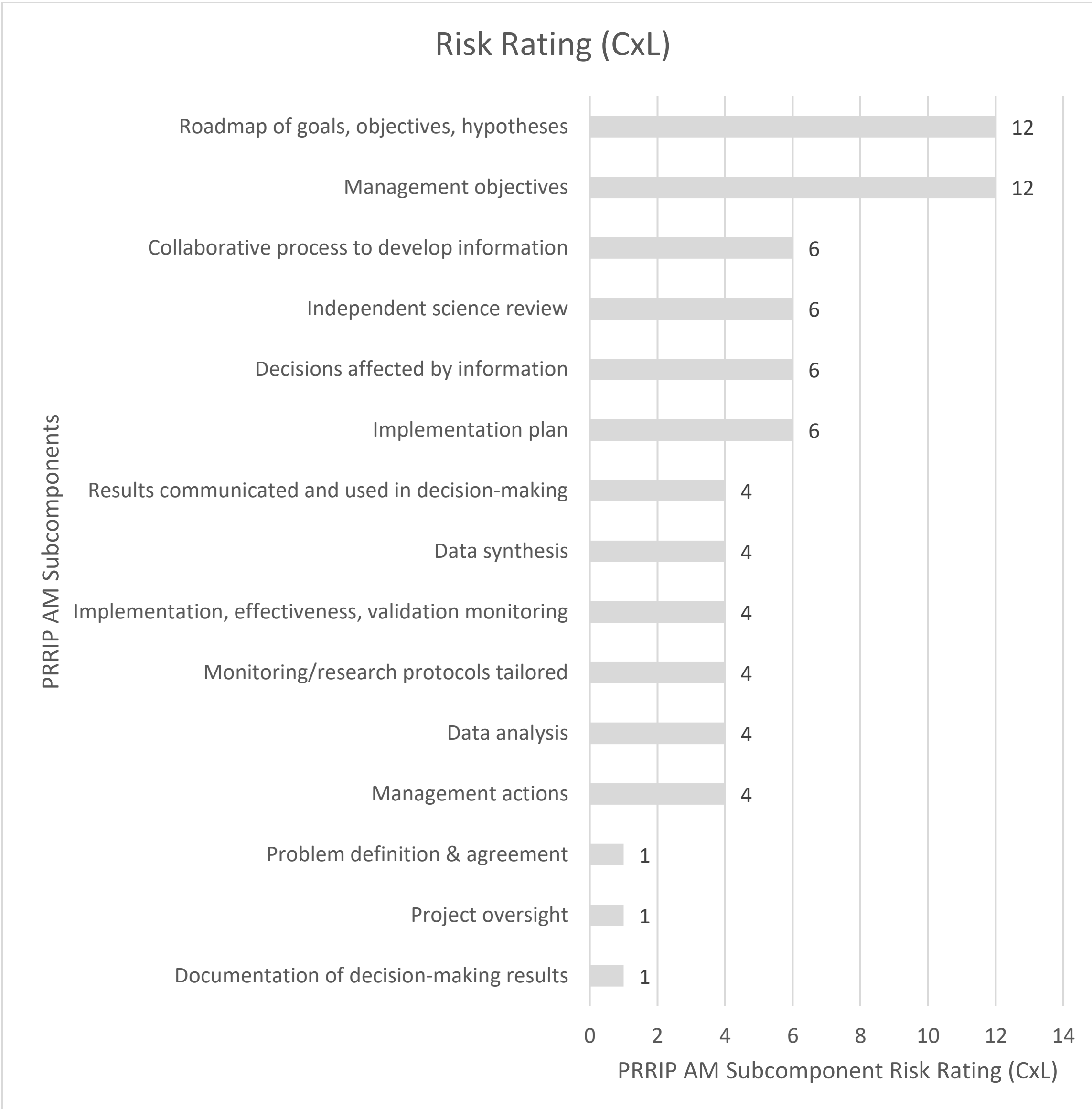

Figure 6.4. Risk ratings for all PRRIP AM subcomponents showing the relative risk profile (i.e. decreasing risk from top to bottom).

AG/AM Risk Typology

Case Study #1 – TRRP

With a combined AG and AM risk rating of 16, the TRRP falls into the bottom right "Struggle" quadrant of the proposed AG/AM risk typology (Figure 6.35). This quadrant reflects a moderately high risk of AG and AM failure and is designated as the quadrant where a restoration program would struggle to function. There is no agreement as to how (or if) the TRRP defines adaptive management and whether the TRRP is implementing adaptive management at all (or whether it wants to, or whether it can). In terms of the typology, without an AM Plan and a clear process for utilizing adaptive management within the TRRP, all the good science being conducted by the Program is largely falling into an ever-expanding "science pile". While the TMC is inclusive of several Tribal, federal, state, and local entities, there is no true shared decision-making in the TRRP since stakeholders are kept at arm's length and TMC voting procedures do not foster a climate of consensus decision-making. There is no formal, agreed-upon goal for the TRRP, clear objectives, and established hypotheses that are clearly linked to questions TMC decision-makers have and that would provide useful information for decision-making. Given the information contained in the foundational documents and the IAP, the technical capacity within the TRRP, and the passion of those working for the Program on the Trinity River, the TRRP can move itself into the upper left "Survive" quadrant of the AG/AM risk typology (where AM is successful) by re-organizing its structure (AG), ensuring that structure functions as intended, and re-focusing its efforts to build and implement a TRRP Adaptive Management Plan.

Case Study #2 – PRRIP

With a combined AG and AM risk rating of 5, the TRRP falls into the bottom left "Succeed" quadrant of the proposed AG/AM risk typology (Figure 6.35). This quadrant reflects low to no risk of AG and AM failure and is designated as the quadrant where a restoration program would succeed in its AG structure and function and in implementation of AM. Overall, the PRRIP is in strong shape as a restoration program that uses AM as its science framework. PRRIP participants consider it one of the most effective AM programs in the country based on successfully completing one full iteration of the six-step AM cycle and comparing that success with the lack of AM success in most other similar programs. The PRRIP does not intend to depart from the structure and processes that have made it successful over the past 13 years of implementation. There is a need to address some AM specifics for the Extension (Big Questions, hypotheses, management action design) and to avoid complacency. Issues like water pricing, drought, and even institutional challenges like personnel changes in the Executive Director's Office and within PRRIP participant entities will require attention. However, the PRRIP is looking to Extension to further refine its successful AG structure and continue to implement rigorous AM at a large scale.

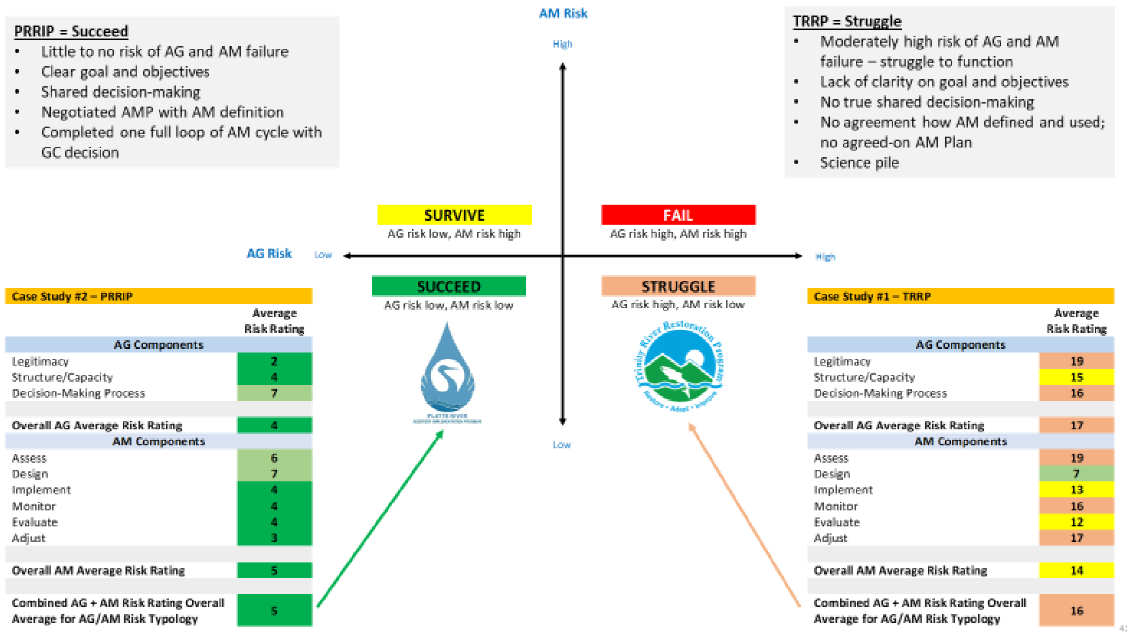

Figure 6.5. AG/AM risk typology with PRRIP and TRRP case studies scored and categorized based on the combined AG and AM risk rating from the case study risk assessments.

Recommendations for Reform

Case Study #1 – TRRP

Based on the results of the field trial application of the conceptual model restoration program evaluation framework and its risk assessment of AG and AM, it is apparent the challenges and weaknesses identified above will not be fixed with a top-down solution, with a short series of workshops, or by a series of motions from the TMC. Rather, refining the TRRP will require a re-organization of the program, assuming there is a desire to build and implement such a program. This assumption underlies all reform recommendations and is the first step that needs to be taken by the parties that comprise the TRRP. The ROD states that “restoration must provide a meaningful fishery” as part of trust obligations to the Hoopa Valley Tribe and the Yurok Tribe and also to ensure recreational, commercial, and sport fisheries. After nearly two decades of implementation, the TRRP has not achieved this milestone. Is this a function of ongoing uncertainty about flow releases from Lewiston Dam, habitat restoration, and gravel augmentation and the resulting impacts on fish populations? Is it a function of factors outside the control of the TRRP (ocean conditions, Klamath River conditions, harvest below the program area, etc.)? Is enough known about the ability of TRRP management actions to affect fish populations that the program does not need to implement adaptive management but rather just implement management?

If enough is known about the impact of the technical flow recommendations (and other management actions) specified in the TRFE and mandated by legislation, the Implementation Plan, and the ROD on fish populations, then AM is not warranted and the TRRP can focus on implementing management actions in the long term less as a restoration program and more as management program that is largely driven by the ROD. If instead there is still significant uncertainty as to the response of fish populations to TRRP management actions within the program area, then the TRRP should tackle this challenge under a new construct as recommended below.

If TRRP participants believe there are uncertainties that can be addressed collaboratively through AM, if management actions can be implemented to reduce those uncertainties, and if TRRP participants can negotiate and operate under a redesigned collaborative decision-making structure, then these reform recommendations can provide a way forward. The recommendations below build on key strengths of the TRRP (people, technical capacity, and the raw material for refining the TRRP structure) to address key TRRP weaknesses and build a program that can be successful in the long term. These recommendations are offered as a means to improve TRRP structure and function within the confines of the current ROD and the preferred alternative in the EIS/EIR.

TRRP Reform Recommendation #1 – Cooperative Agreement to amend ROD

The current ROD is signed by the Department of the Interior (by extension, the Bureau of Reclamation and the U.S. Fish and Wildlife Service) and the Hoopa Valley Tribe. This document gives foundational force to the TRRP and provides a set of management actions and implementation guidance. But, given weaknesses in the current TRRP governance structure, changes are recommended to improve program decision-making. This structural change should be codified in the ROD after being negotiated by TRRP participants. The Cooperative Agreement tool was used by parties to the Platte River Recovery Implementation Program (PRRIP) to provide those parties with the space and time to negotiate and agree on a collaborative decision-making structure in addition to all other components of that program. This tool can be successfully used again for the TRRP to develop a new approach to governance and decision-making and serve as an enforceable tool supported at the highest level of the Department of the Interior to give TRRP participants the room to create a new structure. The TRRP needs authority and a template to re-structure in a way that will ensure success. A Cooperative Agreement would give high-level support for TRRP to enter into negotiations to develop this new structure and write a Final Program Document. This will also be the opportunity for the TRRP to negotiate and resolve balance of power and decision-making issues that currently hamper program progress. The ultimate purpose of a Cooperative Agreement would be to set the bounds for negotiation and development of a single, unified Program

Agreement. This should include identification of non-signatory parties that will be part of the negotiation process and that will be expected to be a part of the TMC in the future. This reform recommendation is intended to address key TRRP weaknesses including decision-making not being shared and challenges in governance structure and processes.

TRRP Reform Recommendation #2 – Program Document

The current ROD can and should stand, but the Cooperative Agreement described above should give TRRP participants (Signatories and non-signatories) the ability to develop a single foundational document that can guide TRRP implementation and decision-making – a TRRP Program Document. Ultimately amending the existing ROD by adding this negotiated, agreed-upon Program Document will keep the current ROD in place but result in a single guidance document for the TRRP. This step is needed to avoid having to reference multiple "foundational" documents that are not always clear and sometimes contradictory and to house all critical TRRP information and guidance in one place. The TRRP needs to operate under a single foundational document that sets program goals and objectives and provides a roadmap for implementing AM, program activities, organizational structure and function, and financial obligations and management. This will codify all program activities in a single document that will serve as the long-term reference manual for the TRRP. This process will include negotiating a revised TRRP organizational structure. This structure should be made to fit the parties involved and the needs of the TRRP, but at a minimum should include a revised TMC that includes stakeholders at the decision-making table, higher-level TMC representation, a plan for consensus decision-making, and a revision to the technical committee structure of the TRRP. TRRP parties need to provide clarity on the financial structure of the Program. This means developing a plan for identifying and tracking funding contributions on an annual basis and indexing of federal funds, likely reserving funding for certain Tribal actions, and developing a long-term budget for TRRP implementation. The TRRP should also establish a unified ED Office. The TRRP ED should have full authority for day-to-day implementation activities and be directly linked to the re-structured TMC, and all staff should report directly to the ED and be responsible for program work to the ED. All staff should identify as TRRP staff, not as individuals from other agencies/entities that happen to do TRRP work. This unified model could take the form of an independent ED and staff, considering the process used by the PRRIP to do the same but adapting the idea to fit the needs of the TRRP. Under that approach, current TRRP staff would need to remain with their agencies to work on a re-organized TRRP as representatives of those agencies/entities. In the TRRP, this also will mean retention of Tribal staff and expertise to work on projects that may or may not be part of the TRRP Final Program Document but that contribute to overall TRRP understanding and that relate to trust obligations identified in the ROD. That activity should be funded in a consistent, transparent manner that may be separate from the TRRP and that insulates the TRRP from the issue of conflict of interest that was a prevalent theme in our review of the program. Another approach might be for Reclamation to retain the ED position but adjust staffing so that all staff members identify as TRRP staff. That might mean staff contributions from the Fish and Wildlife Service, the Tribes, and other entities but all of those staff members would be direct reports to the ED, not to their respective agencies/entities. If the TRRP retains the current leadership model of ED, Implementation Branch Chief, and Science Coordinator, all three of those positions should be from the same entity, should be considered Program staff, and should be fully overseen by and report to the ED. This issue will be a priority for negotiation and the TRRP will have to determine for itself the best approach for re-structuring the ED and staff given the current challenges and the unique integration of the Tribes into program implementation. This will also be an opportunity for TRRP negotiators to discuss the program's time scale. Determining an agreed-upon time period for program implementation, assessment, and approved funding provides an important milestone to track progress and keep activities focused on achieving goals and objectives. This reform recommendation is intended to address key TRRP weaknesses including a lack of clear goals/objectives, decision-making not being shared, organizational structure, role of ED and ED Office, lack of cohesion in TRRP staffing, coordination and communication, and the program's time scale.

TRRP Reform Recommendation #3 – Adaptive Management Plan

The ROD provides a set of management actions for the TRRP and both the ROD and the EIS/EIR suggest implementation of Adaptive Environmental Assessment and Management (AEAM, which is the progenitor of adaptive management or AM). Documents like the Integrated Assessment Plan (IAP) provide details that are commonly found in an AM Plan but that has never been formally adopted by the TRRP. If the TRRP is going to implement AM under a new foundational Program Document, it needs to develop an official AM Plan to guide implementation of AM for the TRRP. The TRRP needs a negotiated, agreed-upon AM Plan to guide implementation. This plan would be part of the Final Program Document and would identify critical hypotheses, Big Questions, monitoring protocols, and plans for data analysis and synthesis. This effort would build off existing foundational documents and the IAP. There is an enormous amount of raw material within the TRRP that can make the process of developing an agreed-upon AM Plan quicker and smoother than most programs that have to start from scratch. The AM Plan should be nested within goals and objectives of TRRP that emerge from the negotiation process of the Program Document. This is also the time for the TRRP to be explicit about what the program can control/influence and what it cannot (Klamath River, ocean fisheries, harvest, etc.). This reform recommendation is intended to address key TRRP weaknesses such as the lack of an AM Plan, the need to identify and agree on key hypotheses and Big Questions, data synthesis, and clearer and more holistic use of independent science review.

Case Study #2 – PRRIP

Based on the results of my risk analysis, the PRRIP is structurally and functionally sound overall and its AG and AM components are generally in lower risk categories. The analysis does not suggest the PRRIP needs to make any true reforms. Overall, the PRRIP is a model program for consideration by other restoration programs looking to improve linkages between AG and AM. The primary area of risk for the PRRIP is the issue being adaptable to potential surprises and ensure the program itself is resilient to changing conditions. This suggests the PRRIP should formally prepare for change and surprises in the form of more formal and in-depth contingency planning for water availability and use, developing a process for integrating forecasts into planning for program water management and flow management actions, and ensuring AM implementation can be responsive to surprises like the onset of another invasive species like Phragmites.

For AG, the PRRIP needs to ensure its current unique structure and its strong function continue. This means avoiding complacency and letting this structure and function erode over time. During the Extension, the PRRIP should continue to implement the Program Document and Extension Addendum and conduct decision-making linked to the goals and objectives of these documents. Some attention should be paid to the issue of what “recovery” means for the Program, whether the Program will be held accountable for meeting certain metrics of species recovery, and if so how to set those metrics. The PRRIP should continue to operate as an open, collaborative restoration program, keeping an eye on the need for potential changes in representation on the GC and/or advisory committees over time. This includes nurturing the internal structure of the PRRIP and ensuring that all advisory committees are engaged and functioning.

The PRRIP is generally matched well to a bioregion in terms of the AG structure. A key challenge is to identify, within the scope and authority of the PRRIP, if and how to better integrate pallid sturgeon as a target species in the way that the whooping crane, tern, and plover have been addressed through the AMP. During implementation of the Extension, the PRRIP should watch the relationship between critical uncertainties and the time expectation for delivering useful information for decision- making purposes given that the Extension is only authorized through the year 2032 and negotiations for a Second Increment beyond that will begin much sooner. The shared, consensus decision-making process for the PRRIP is functioning well and should continue but the program will have to pay attention to participant turnover and make sure new participants, especially GC representatives, are educated on the history, current status, and direction (purpose) of the PRRIP. The PRRIP should continue its successful "experiment" with an independent ED and staff, monitored through GC oversight to ensure the ED and staff maintain their honest broker roles. The PRRIP should invest time now in more difficult policy issues (target flows, species recovery, pallid sturgeon) to avoid policy traps late in the Extension.

For AM, the PRRIP should set as a goal repeating the process of completing a full AM cycle for other critical uncertainties during the Extension (likely related to whooping cranes). The program will have to complete the ongoing effort to specify Big Questions, hypotheses, management actions, and the decision-making process relative to AM learning for the Extension resulting in a revised AMP for the Extension. The PRRIP should attempt to agree to a set of metrics for measuring progress against the tern/plover, whooping crane, and pallids sturgeon management objectives in order to help develop clearer linkages between the management objectives, measures of progress, and the communication and use of AM learning as an input to GC decision-making during the Extension. Based on the contents of the revised AMP, the PRRIP should refine monitoring protocols over time as AM learning demands and as needed to maintain clear links between monitoring outputs and use of that learning as an input in GC decision-making. The PRRIP uses independent science review well but should address the structure and function of the ISAC for the Extension, ensuring it meets the needs of the GC in terms of providing advice on AM implementation.

Conclusion

The field trial application of my conceptual model restoration program evaluation framework successfully provided a more complete understanding of AG and AM in two case studies, the TRRP and the PRRIP. The TRRP performance assessment revealed generally negative sentiment about all components of AG and AM that were analyzed. This translated into areas of significant risk for the TRRP related to a lack of clear goals and objectives, no shared decision-making, no agreed-upon AM Plan, and no clear guidance or agreement on the problems and uncertainties to be addressed through implementation of rigorous AM. The PRRIP performance assessment revealed a generally low risk and well-functioning restoration program with an AG structure matched to the bioregion and the scope of authority, clear goals and objectives, shared decision-making, unique independent implementation, and an AM program that is matched to questions from decision-makers and that has successfully used AM learning as an input in GC decision-making. These performance and risk assessments placed the PRRIP in the "succeed" quadrant of the AG/AM risk typology and the PRRIP in the "struggle" quadrant. To move out of this quadrant, I recommended specific reforms for the TRRP including development of a cooperative agreement for the TRRP to move forward with refinement, a single unifying Program Document, and a clear AM Plan linked to TRRP goals and objectives. The PRRIP is generally a model restoration program for consideration by other programs interested in better linking AG and AM. Going forward, it should continue is successful shared consensus decision-making and use of AM to inform those decisions, avoiding complacency that would erode structure and function over time.

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CHAPTER 7

A CONCEPTUAL MODEL RESTORATION PROGRAM EVALUATION FRAMEWORK: CONCLUSIONS AND DISCUSSION

The central proposition of my dissertation is that governance of a large-scale aquatic system adaptive management program is determinative in successful implementation of adaptive management thus predicating program success. Overall, my analyses support this proposition. In this chapter, I explain how my analyses support the proposition and discuss the implications of my research.

Initial evaluation of the two case studies, the TRRP and the PRRIP, against concepts of panarchy, resilience, and comparative components of AG and AM detailed in Chapter 3 resulted in leading indicators that functional AG in the PRRIP was a significant contributor to AM success, while lack of functional AG in the TRRP was impeding forward progress on AM. The Platte River basin emerged from the window of opportunity in the panarchy/AG adaptive cycle (see Figure 3.2 in Chapter 3) with the PRRIP that formalized an AG structure characterized by shared decision-making and a clear, negotiated roadmap of goals and objectives to organize around. In contrast, the TRRP emerged from the window of opportunity with a desire to emulate the AEAM approach being utilized in the Glen Canyon Dam Adaptive Management Program but with a governance structure more typical of most restoration programs. Critical Tribal, federal, and state agencies are involved but stakeholders are not engaged in decision-making and the TRRP appeared to be struggling with a lack of clear goals and objectives.

Field trial application of my conceptual model restoration program evaluation framework resulted in much greater insight into key components of AG and AM in both case study restoration programs and the formal qualitative risk analysis brought these components into relief. This analysis affirmed the leading indicators in the PRRIP and the TRRP. Overall, the PRRIP faces low risk of any AG or AM subcomponent failure. My analysis points to clear themes throughout the program that support this result. The AG structure in the PRRIP is collaborative, incorporates shared decision-making with stakeholders involved, focuses on consensus, and organizes decision-making around a Program Document that, as the result of nearly 10 years of negotiations, includes specific statements of goals and objectives.

The presence of that collaborative AG structure and the processes that emerged and were sustained during the negotiation phase (and that continue after 13 years of implementation) allowed AM to emerge as a robust way to address critical uncertainties that, if reduced, could inform program decision-making. Like the Program Document, the PRRIP also negotiated and has implemented a formal AM Plan that includes management objectives, hypotheses, management actions, and other expected components of a robust and implementable AM Plan. The AM Plan continues to be successfully implemented and the program has completed at least one full iteration of the six-step AM cycle. The necessary interrelationship between a functional AG structure that is matched to the right bioregional scale where the system in question (Platte River basin) and the institutional arrangement (PRRIP) are compatible (Huitema et al., 2009) and successful AM was clearly revealed through application of my conceptual model restoration program evaluation framework and associated analysis.

In contrast, my analysis revealed the interrelationship between AG and AM is not fully realized in the TRRP and AM, and the program overall, is struggling. Multiple subcomponents of AG and AM are at high risk or moderately high risk of failure in the TRRP. The current AG structure excludes stakeholders, does not generally function in a collaborative manner, and does not support consensus decision-making. There is no clear statement of or agreement on program goals and objectives, pointing to an immediate disconnect between TRRP decision-making and AM. While the TRRP does conduct robust science, it is rarely, if ever, operationalized as an input into decision-making. The TRRP continues to receive funding and continues to implement management actions identified in the ROD (DOI, 2000) but my analysis reveals it is locked in a rigidity trap (Gunderson et al., 2010). There is high human and natural resource capital available to move the TRRP into a more functional state, and there is high potential for successful emergent AG because of the potential compatibility between the bioregion (TRRP project area) with the institutional arrangement (TRRP). But the current structure and function of the TRRP is leading to an avoidance of learning, low trust among program participants, and feedback loops that encourage maintenance of the status quo both in governance and in current attempts to implement AM. In this context, AG is not fully present in the TRRP and, as predicted, AM is not successful.

I found the conceptual model restoration program evaluation framework to be a powerful analytical tool for the structural and functional components of both AG and AM and, by extension, suggesting critical restoration program reforms. A review of other AG and AM evaluation tools (as described in Chapter 3) reveals that none of them tie together the same set of key AG and AM components and subcomponents into a robust framework for analysis. Lockwood et al. (2010) provide an informative set of principles for good governance but do not propose a framework for evaluating those principles and suggest using the principles as a foundation for developing evaluation instruments for governance. Lebel et al. (2006) provide a set of governance attributes and utilize a set of case studies to explore how those attributes function. But the case studies were assembled post hoc and were not organized or questioned in such as way as to address issues of governance structure and function (Lebel et al., 2006). Pahl-Wostl and Knieper (2014) introduce an ideal governance typology and use set-theoretic methods to evaluate governance regime configurations but do not focus on specific components of governance and do not extend their analysis to AM. The Adaptive Water Governance Project team identify key concepts of “good governance” and conduct an assessment of resilience, governance, and law in six North American water basins but do not build in a similar assessment of AM or apply tools such as risk assessment (Cosens et al., 2014). The most applicable and informative governance assessment framework comes from Dale et al. (2013 and 2016) who developed and applied a risk analysis methodology for the Great Barrier Reef as a case study. I used the methods and results of this analysis to build key foundational elements of my conceptual model evaluation framework but the Dale et al. (2013 and 2016) work was specific only to components of governance and I had to adapt the approach to extend to an assessment of AM.

Assessments of AM have largely focused on problems with the implementation of AM successfully at a large scale (Walters, 2007) or the particular challenges common to implementation failure (Allen and Gunderson, 2011). Grieg et al. (2013) use the results of workshop discussions with AM practitioners to provide insight into factors that would allow AM to proceed but do not categorize that insight according to all six steps of the AM cycle and do not link to a specific assessment of related governance components. LoSchaivo et al. (2013) is one of several examples of a "lessons learned" type of analysis specific to a particular program (in this case, the Comprehensive Everglades Restoration Program or CERP) that are similar to the Grieg et al. (2013) assessment approach in terms of AM but also does not link specifically to an assessment of governance. Thom et al. (2016) assess AM performance in seven large aquatic recover programs in the U.S. confirming conclusions in work like that of Allen and Gunderson (2011) and LoSchaivo et al. (2016) but also do not conduct a specific review of AG structure or function. The most applicable AM assessment framework comes from Chaffin and Gosnell (2015) who developed a set of questions to evaluate AM according to the six-step cycle. That framework was tested by evaluating the Glen Canyon Adaptive Management Program and generated important results providing a way forward for assessing AM in other large-scale restoration programs. However, Chaffin and Gosnell (2015) again developed an assessment framework specific only to AM within a connection to an assessment framework for AG.

Huitema et al. (2009) discuss AG through the lens of adaptive co-management and key concepts of governance but conclude that more work needs to be done to "collate" empirical work that joins AM and AG. Pahl-Wostl et al. (2012) analyze AG in river basins but conclude that the evaluation should be conducted in U.S. river basins. My research was a successful attempt to, unlike any of the other evaluation frameworks cited above, unify the intertwined concepts of AG and AM in a repeatable assessment format with the specific intention to apply the framework in case studies comprised of river restoration programs in the U.S. The conceptual model evaluation framework presented in my dissertation and field trialed on two case studies is the first evaluation method to combine AG and AM and provide a methodological means to assess the structure and function of AG and AM components in parallel in the same restoration program. In particular, the use of formal qualitative risk analysis adapted in part from Dale et al. (2013 and 2016) facilitates repeatable system analysis and results that can be both tracked over time and used and understood by restoration program participants. While my dissertation research was built around field trial application of the conceptual model evaluation framework, the depth of analysis and the extent of the results suggest that the field trial results can be considered more fully developed benchmark assessments (Dale et al., 2016) of the two case study restoration programs that could be used for actual program reform. In fact, the Trinity Management Council (TMC) of the TRRP has accepted and adopted the reform recommendations and in May 2020 the TRRP hired me to serve as the Trinity River Refinements Coordinator to lead the TRRP through the process of implementing the reform recommendations and refining the structure and function of the program.

Limitations

Case study research is time-consuming and needs to be paired with a robust methodology for collecting data (Yin, 2014). My overall data collection process for both the PRRIP and the TRRP and generally for an understanding of AG and AM spanned nearly 13 years including review of published literature, review of program documents and archival records, direct and participant observation, and informal discussions about program structure and function with participants. The process of conducting surveys and interviews and completing the performance assessment and risk assessment for both case studies occurred over two-year period. While this amount of effort would not be required or expected in all cases and did give me a much better understanding of the theory and practice of AG and AM and the two case study restoration programs, the extent of effort required to generate this kind of analysis on additional restoration programs will be a challenge.

The application of the conceptual model evaluation framework amounts to the collection and analysis of cross-sectional data (one point in time) as opposed to longitudinal data (repeat interviews through time for comparison purposes). As noted above, though the design of conceptual model framework, the identification of critical components of AG and AM, the development of survey and interview questions, application of the surveys and interviews, and analysis of data were influenced by many years of work with both case study programs, the results presented in my dissertation explain the PRRIP and the TRRP as they exist now. Tracking both case studies over time and in essence applying the evaluation framework as a means to accumulate longitudinal data that captures program reforms and refinements would strengthen the evaluation framework as a repeatable tool and the conclusions that can be drawn from applications of that tool.

Given my personal work for and with both case study programs over the years, I did attempt to avoid bias in collecting and analyzing data. I used methods such as only collecting anonymous survey data from PRRIP participants and not conducting in-person follow-up interviews out of concern that, as a program staff member, participants would not answer in-person questions honestly in my role as a researcher. I attempted to overcome concerns about the subjectivity of analyzing and coding large amounts of interview data (Young et al., 2018) by first analyzing autocoded themes, word references, and sentiment references from NVivo (March 2020) to explore general thematic topics in the data. The AG and AM components used in the conceptual model evaluation framework were selected after extensive review of AG and AM published literature, comparison of other AG and AM analysis tools, and personal experience with AG and AM in large-scale restoration programs. Similarly, the survey and interview question set for both case studies were developed after careful consideration of my accumulated knowledge of the theory and practice of AG and AM as well as my initial review of both case studies. But I did not pilot the interview questions before conducting the actual online survey and interviews, a step which may have improved the structure of my questions and better focused responses and collected data. Given the enormous amount of data collected through the online surveys and interviews, I recommend piloting questions when the conceptual model evaluation framework is applied again.

The field trial of my conceptual model evaluation framework using case study research methods was a successful initial exploratory application that concluded with insight into the two case studies and the utility of the evaluation framework for repeat application over time in the TRRP and the PRRIP to provide longitudinal data and also for initial application in other restoration programs. However, my analysis and the related results were limited in terms of exploring variance in responses to surveys, between categories of interviewee responses (for example, analyzing differences in interview responses between decision-makers and technical staff), and the range of responses to the

AG and AM questions. I weighted all survey responses equally as an initial step in analysis because I treated my case study interviewees as single groups (one group for the TRRP and one for the PRRIP) to provide initial programmatic insight into components of AG and AM in each case study. However, I did collect identification data so that each interviewee group can be categorized by interviewee type (decision-maker, technical staff, stakeholder, and independent scientist). Additional data analysis may be possible within and between those categories to explore variance in responses, the range of responses to questions, and the frequency of certain responses types (Mercer et al., 2018). This is represented to some degree with the initial NVivo autocoding data for thematic codes, word frequency, and sentiment references. My case study research results in a very large and detailed dataset comprised of narrative responses to open-ended surveys and interviews. Initial application of my conceptual model evaluation framework to this dataset provided informative initial insight into the performance of AG and AM components in the two cases studies, the risk of failure of those components, and a cross-study comparison of the two case studies. But, prior to publication, it may prove useful to break the case study interviewee groups into sub-categories and explore sampling variance. My sub-category sample size for each case study restoration program is likely too small to weight the survey data and might reduce accuracy of my analysis (Mercer et al., 2018). However, analyzing and reporting on the degree of variance in responses in sub-categories of interviewee responses may yield informative additional insight into the TRRP and PRRIP case studies prior to publishing the results of my research or if I apply the evaluation framework again over time in the two case studies or in an initial application in another restoration program.

Future Research and Conclusion

As noted in Chapters 1 and 2, examples of AM success at a large scale are few and far between. Yet, AM continues to be the “tonic of natural resources policy” (Ruhl and Fischman, 2010) and has become a “highly malleable term” (Doremus, 2001) found in some form in the guidance documents and legislation for nearly all major restoration programs in the U.S. As noted in Table 3.1 in Chapter 3, the Bureau of Reclamation alone is home to some of the largest and most well-known restoration programs that are routinely cited as examples of the use of AM at a large scale. These programs are generally engaged in river restoration, which overall is a one of the most significant forms of applied water-resource science and which supports a multibillion dollar industry around the world (Wohl et al., 2015). Such programs generally are facing “wicked problems” that ultimately cannot be solved but at least tamed through an incremental approach and by overcoming institutional and scientific barriers (DeFries and Nagendra, 2019; Camillus, 2008; Rittel and Webber, 1973).

To avoid AG and AM being applied in this contexts as panaceas (Ostrom, 2007; DeCaro et al., 2017) and to help programs break out of a governance and management panacea mindset (Young et al., 2018), I suggest my conceptual model restoration program evaluation framework can be used as an instructive diagnostic tool. With refinement and careful consideration of aspects like the survey and interview question set, the evaluation framework could be applied widely across the Bureau of Reclamation restoration program identified in Chapter 3, large U.S. Army Corps of Engineers restoration programs in the Everglades and on the Missouri River, and any other large restoration program that purports to use AM but is finding success to be a challenge.

Results from application of the evaluation framework and related program reform recommendations could be used to help solve identified problems if a program is placed in the "struggle" or "fail" quadrants of the AG/AM risk typology. The evaluation framework could also be applied to a system before starting a program and spending large amounts of money on implementation to help establish guidance for sound structure and function at the outset. While the results of applying the evaluation framework may seem provocative and could signal many restoration programs are challenged in the structure and function AG and AM, it provides a robust set of information and guidance that can allow for a course correction and at least a partial solution to the narrative of failed AM at large scales.

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APPENDIX A. Sample TRRP document review template.

Document # - Title	Type of Document	Version of Document	Date of Publication
01 – Trinity River Flow Evaluation Study (TRFE)	Foundational; report to the Secretary of the Interior	Final	April 1999
Name and Affiliation of Document Author(s)	U.S. Fish and Wildlife Service – Arcata Fish and Wildlife Office Hoopa Valley Tribe		
Date of Review	07/03/2017		

Page No. and Relevance Goals/Objectives AG AM	Document Text	Summary
xxv	surplus water could be exported to the Central Valley without harm to the fish and wildlife resources of the Trinity River	Objective of the TRD
xxv	have a functioning alluvial river (mixed-size rock, gravel, and sand deposited by river flow) that will provide the diverse habitats required to restore and maintain the fishery resources of the Trinity River	Restoration goal
xviii	restoring the gradually sloping bars provided stable amounts of rearing habitat throughout a wide range of flows	Flow and sediment objective
xviii	Rehabilitating the confined, trapezoidal channel to restore the pre-TRD channel morphology will provide high quality, stable habitat conditions that should greatly benefit young salmon and steelhead until they are ready to migrate to the ocean.	Flow, sediment, and mechanical objective
xviii	ten fundamental alluvial river attributes. These attributes are: (1) the channel morphology is spatially complex; (2) flows and water quality are predictably variable; (3) the channel bed surfaces are frequently mobilized; (4) the channel-bed surfaces are periodically scoured and refilled; (5) fine and coarse sediment supplies are approximately balanced in the upper Trinity River below Lewiston Dam ; (6) the channel location periodically migrates; (7) the channel has a functional floodplain; (8) the channel is occasionally “reset” during very large floods; (9) riparian plant communities are diverse and self-sustaining; and (10) the groundwater table (subsurface water level that surrounds rock, gravel and sand along the side of the river) fluctuates naturally with changing stream flows.	River restoration objectives
xxix	Year-round releases of 300 cfs to provide suitable spawning and rearing habitat for salmon and steelhead within the existing channel	Spawning habitat
xxix	Releases of 450 cfs from July 1 to October 14 to meet the summer/fall temperature objectives	Manage river temperature
xxix	Spring/summer releases that would provide improved conditions for smolt outmigration	Fish migration
xxix	Releases necessary to achieve flow-related geomorphic processes that create and maintain river habitats	River restoration

Page No. and Relevance Goals/Objectives AG AM	Document Text	Summary
xxix	A fundamental conclusion of this and other studies is that the present channel morphology, a direct result of TRD construction and operation, is inadequate to meet salmonid production objectives. If naturally produced salmonid populations are to be restored and maintained, the habitats on which they depend must be rehabilitated.	Population and restoration objective
xxix	Recommended future management to restore the fishery resources of the Trinity River must include reshaping selected channel segments, managing coarse and fine sediment input, prescribing reservoir releases to allow flow-related geomorphic processes to reshape and maintain a new dynamic channel condition, providing suitable spawning and rearing microhabitat, and providing favorable water temperatures for salmonids. This new channel morphology will be smaller in scale than that which existed pre-TRD, but it will exhibit the essential attributes of a dynamic alluvial river.	Restoration objective
xxx	(1) releases to provide suitable salmonid spawning and rearing habitat, (2) releases to mimic the spring snowmelt hydrograph (the high flow in the spring resulting from the melting snowpack and the gradual decrease in flow following the peak) to satisfy flow-related geomorphic and riparian vegetation objectives necessary for the creation and maintenance of diverse salmonid habitats and assist smolt outmigration, and (3) releases to meet appropriate water-temperature objectives for holding/spawning adult salmonids and outmigrating salmonid smolts.	Flow-related management objectives
xxx	Some processes and habitat conditions, such as favorable spawning and rearing microhabitat, are recommended for all water-year classes while others, such as floodplain inundation, are expected to be achieved only during the wetter water-year classes. Annual release schedules were developed by integrating the information requirements to meet spawning and rearing microhabitat, flow related geomorphic processes, and water temperature management objectives for the different water-year classes.	Flow objectives
xxx	maintaining 300 cfs as the fall/winter baseflow provides suitable spawning habitat throughout the chinook salmon, coho salmon, and steelhead spawning seasons and provides habitat for rearing salmon and steelhead.	Spawning habitat
xxx	The short, 5-day, peak release during all water-year classes (except Critically Dry) provides sufficient duration to initiate targeted flow related geomorphic processes and transport coarse bed material originating from tributaries in most years.	SDHF release objective
xxx-xxxi	The recommended Extremely Wet and Wet spring snowmelt hydrographs also have two distinct segments while flows are decreasing after the spring snowmelt peak flow (referred to as the “descending limb of the spring snowmelt hydrograph”). These periods are separated by a short-duration “bench” at 6,000 cfs. The “bench” promotes transport of fine	Flow release objectives

Page No. and Relevance Goals/Objectives AG AM	Document Text	Summary
	sediment once peak flows have mobilized the surface layer of the channel bed. Another "bench", at 2,000 cfs, is recommended for Extremely Wet, Wet, and Normal water years to inundate portions of alternate bars during the time-period when riparian vegetation releases seeds. This inundation prevents riparian encroachment along the low-flow channel and provides suitable temperatures for chinook salmon smolts, which outmigrate later in year than other salmonid species. A 36-day, 1,500-cfs "bench" during Critically Dry water years will discourage seedling germination on alternate bar flanks through inundation and provide some temperature benefits for outmigrating chinook salmon smolts.	
xxxi	Recommended releases for Extremely Wet, Wet, and Normal water years provide optimal salmonid smolt temperatures (Table ES4). Marginal smolt temperatures will be provided throughout much of the outmigration period during Dry and Critically Dry water years. The lower releases during these year classes will allow mainstem water temperatures to warm earlier in the outmigration period, which will cue salmonids to outmigrate (warming temperatures are an important physiological signal to begin smoltification and outmigration) before water temperatures in the lower watershed are likely to become too warm to insure smolt survival. Following smolt temperature control releases, 450 cfs releases will be maintained to provide suitable temperature regimes for holding and spawning adult spring-run and fall-run chinook (Table ES5).	Flow release objectives
xxxi	The intent of channel rehabilitation is to selectively remove the fossilized riparian berms (berms that have been anchored by extensive woody vegetation root systems and consolidated sand deposits) and recreate alternate bars. Channel rehabilitation is not intended to completely remove all riparian vegetation, but to remove vegetation at strategic locations to promote alluvial processes necessary for the restoration and maintenance of salmonid populations.	Mechanical action objective
xxxii	Therefore, construction of 24 of the 44 channel-rehabilitation sites in the first 3 years of implementation is recommended. The remaining projects may proceed following evaluation by the AEAM program	First mention of where/how AM may be used, everything else appears to be written in stone.

Page No. and Relevance Goals/Objectives AG AM	Document Text	Summary
xxxii	Sediment-management recommendations include (1) immediate placement of more than 16,000 cubic yards of properly graded coarse sediment (5/16 to 5 inches) between Lewiston Dam and Rush Creek to restore the spawning gravel deficit caused by the elimination of upstream coarse sediment supply by the TRD; (2) annual supplementation of coarse sediment to balance the coarse sediment supply along the Lewiston Dam to Rush Creek segment; (3) reduction of fine sediment (<5/16 inch) storage in the mainstem via recommended flow releases; (4) prevention of fine sediment input from tributaries by mechanical removal from sedimentation ponds; and (5) reduction of fine sediment storage in the mainstem via mechanical removal.	Sediment management objectives
xxxiii	Prevention of germination/establishment of riparian vegetation low on alternate bars	1,500 cfs flow objective
xxxiii	Mobilization of spawning gravels, Sand transport All effects realized at lower flow level	4,500 cfs flow objectives
xxxiii	Channel bed surface mobilization Significant mobilization of spawning gravels Fine sediment movement Channel migration Floodplain inundation Scour of 1-2-year-old seedlings Groundwater recharge of floodplain All effects realized at lower flow levels	6,000 cfs flow objectives
xxxiii	Surface mobilization of alternate bars Scour of bar margins Coarse sediment movement Scour of 2-3-year-old seedlings All effects realized at lower flow levels	8,500 cfs flow objectives
xxxiii	Significant scour of alternate bars Large coarse sediment movement Floodplain scour Side-channel formation/maintenance Sapling removal from alternate bars All effects realized at lower flow levels	11,000 cfs flow objectives
xxxiii	Water temperature objectives for the Trinity River salmonid smolts at the confluence of the Klamath and Trinity rivers for Extremely Wet, Wet, and Normal water year classes. These objectives are not met in Dry and Critically Dry water year classes because of the need to better synchronize Trinity River temperatures with those lower in the system. Water temperature objectives for the Trinity River during the summer, fall, and winter. Objectives are for the protection of holding and spawning salmon and steelhead.	SEE TABLE ON PAGE xxxiii
xxxiii	Use of AEAM will assure restoration and maintenance of the fishery resources of the Trinity River and wise use of available water.	AM objective
227	At least a two-fold increase in smolt production is a desirable goal to restore and maintain anadromous salmonid populations toward pre-TRD levels.	Fish population objective – increase productivity
227	The carrying capacity for fry and juvenile salmonids cannot be substantially increased within the confined riparian berms of the existing channel through	Fish population objective – increase carrying capacity

Page No. and Relevance Goals/Objectives AG AM	Document Text	Summary
	reservoir releases alone. Flows that only mobilize spawning gravels cannot reshape channel morphology to significantly improve spawning habitat and do little to increase rearing habitat.	
228	Several habitat types are now rare in the mainstem above the North Fork Trinity River confluence as a result of unnatural channel confinement by riparian berms. Specifically, the limited availability of suitable low-velocity habitats severely limits fry survival from midwinter through spring.	Fish population objective – increase survival
228	Management of TRD releases to provide optimal seasonal temperature regimes within the existing channel as a singular management action cannot increase smolt production necessary to restore and maintain salmonid populations.	Fish population objective – increase productivity
228-229	Only through the combination of mechanical reconstruction, managed releases, and sediment management can the alluvial channel be rehabilitated and maintained. The anticipated alluvial channel, however, will be a smaller version of the pre-TRD channel.	Channel restoration objective – create a more 'natural' river channel
229	This new, but smaller, channel morphology should increase rearing habitat, allowing at least a doubling of anadromous salmonid smolt production.	Fish population objective – increase productivity
229	Prescribe flows based on a water year classification to restore inter-annual flow variation	Flow objective – increase inter-annual variability
229	Restore snowmelt hydrograph components	Flow objective – recreate pulse flow
229	Prescribe variable releases to rejuvenate and maintain alluvial processes	Flow objective – create functional river
229	Prescribe releases that provide suitable habitat for all life stages of anadromous salmonids	Flow objective – provide salmonid habitat year-round
230	Prescribe releases that meet salmonid temperature needs	Flow objective – increase productivity and survival of salmonids
230	The mainstem below Lewiston Dam must (1) provide suitable seasonal water temperatures for holding and spawning of anadromous salmonids down to the North Fork Trinity River confluence, (2) improve growth and survival of smolt outmigrants by providing a suitable temperature regime for all three species to Weitchpec, and (3) provide a seasonal thermal regime suitable for year-round rearing of juvenile steelhead and coho salmon.	Flow objective – increase productivity and survival of salmonids
230	Mainstem channel modification will be required in selected reaches to encourage alluvial processes, such as frequent channelbed mobilization and alternate bar formation.	Mechanical objective – increase alluvial processes
230	preventing excess fine sediment from entering the mainstem must remain a priority. Coarse bed material supplementation upstream from Rush Creek will be required to rehabilitate a dynamic alluvial channel morphology.	Sediment management objective – increase large (>5/16 inch) sediment while decreasing amounts of fine sediments

Page No. and Relevance Goals/Objectives AG AM	Document Text	Summary
230	A dynamic alluvial channel morphology cannot be accomplished solely by prescribing releases. Mechanically removing riparian berms, minimally reshaping the existing channel in selected reaches, introducing coarse bed material above Rush Creek, and reducing or preventing sand input from tributaries also will be necessary.	Restoration objective – improve river function and alluvial processes
234	a 300-cfs release provides suitable microhabitat and macrohabitat for spawning and rearing chinook salmon, coho salmon, and steelhead in the Trinity River above the North Fork Trinity River in the current channel morphology.	Flow release objective – fish habitat
234	Flow-related management objectives: (1) releases to provide suitable salmonid spawning and rearing microhabitat, (2) snowmelt peak and recession hydrograph components to satisfy fluvial geomorphic and woody riparian objectives that are necessary for the creation and maintenance of diverse salmonid habitats, and (3) releases to meet appropriate water-temperature objectives for holding/spawning chinook salmon and outmigrating salmonid smolts.	Flow-related management objectives
234	On the basis of the analysis of habitat availability in the existing channel, and considering all anadromous salmonid life stages, a release of 150 cfs provides the greatest amount of microhabitat in the mainstem Trinity River from Lewiston Dam to Weitchpec	Flow-related management objective – improve microhabitats
235	Maintaining 300 cfs as the winter baseflow provides spawning habitat throughout the chinook salmon, coho salmon, and steelhead spawning seasons and protects early life stages throughout incubation and emergence periods for all salmonid species.	Flow-related management objective – improve spawning habitat
235	Fluvial geomorphic management objectives are based on the alluvial-attribute thresholds.	Restoration objective – improve river function and alluvial processes
236	· Mobilization of matrix particles (D84) on alternate bar surfaces (Attribute 3) · Channelbed scour greater than 2 D84's depth and redeposition of gravels on face of alternate bars · Transport sand out of the reach at a volume greater than input from tributaries to reduce instream sand storage · Transport coarse bed material at a rate near equal to input from tributaries to route coarse sediment, create alluvial deposits, and eliminate tributary aggradation (Attribute 5) · Periodic channel migration · Floodplain creation, inundation, and scour · Channel avulsion · Woody riparian mortality on lower alternate bar surfaces and woody riparian regeneration on upper alternate bar surfaces and floodplains · Maintain variable water table for off-channel wetlands and side channels	Fluvial geomorphic management objectives - extremely wet year

Page No. and Relevance Goals/Objectives AG AM	Document Text	Summary
236	· Mobilization of matrix particles (D84) on alternate bar surfaces · Channelbed scour greater than 1 D84's depth and redeposition of gravels · Transport sand out of the reach at a volume greater than input from tributaries to reduce instream sand storage · Transport coarse bed material at a rate near equal to input from tributaries to route coarse sediment, create alluvial deposits, and eliminate tributary aggradation · Periodic channel migration · Floodplain creation, inundation and occasional scour · Woody riparian mortality on lower alternate bar surfaces and woody riparian regeneration on upper alternate bar surfaces and floodplains · Maintain fluctuating water table for off-channel wetlands and side channels (Attribute 10)	Fluvial geomorphic management objectives – wet year
236	· Mobilization of matrix particles (D84) on general channelbed surface and along flanks of alternate bar surfaces · Channelbed scour and redeposition of gravels · Transport sand out of the reach at a volume greater than input from tributaries to reduce instream sand storage · Transport coarse bed material at a rate near equal to input from tributaries to route coarse sediment, create alluvial deposits, and eliminate tributary aggradation · Frequent floodplain inundation) · Woody riparian vegetation mortality along low water edge of alternate bar surfaces and woody riparian regeneration on upper alternate bar surfaces and floodplains) · Maintain fluctuating water table for off-channel wetlands and side channels	Fluvial geomorphic management objectives – normal year
236	· Channelbed surface mobilization of in-channel alluvial features (e.g., spawning gravel deposits) · Transport sand out of the reach at a volume greater than input from tributaries to reduce instream sand storage · Transport coarse bed material at a rate near equal to input from tributaries to route coarse sediment, create alluvial deposits, and eliminate tributary aggradation · Discourage germination of riparian plants on lower bar surfaces for a portion of the seed release period · Maintain variable water table for off-channel wetlands and side channels	Fluvial geomorphic management objectives – dry year
236	· Discourage germination of riparian plants on lower bar surfaces for the early portion of the seed release period · Minimally recharge groundwater	Fluvial geomorphic management objectives – critically dry year
237	Provide the greatest amount of spawning and rearing microhabitat for anadromous salmonids in the existing channel, given the needs of the various life-stages.	Salmonid microhabitat objectives – extremely wet, wet, and normal water years
237	Provide the greatest amount of spawning and rearing microhabitat for anadromous salmonids in the existing channel, given the needs of the various life-stages.	Salmonid microhabitat objectives – dry and critically dry water years

Page No. and Relevance Goals/Objectives AG AM	Document Text	Summary
237	Provide suitable temperatures for holding spring chinook and spawning spring and fall chinook by meeting temperature standards of: <60° F from July 1 to September 14 at Douglas City (RM 93.7), <56° F from September 15 to September 30 at Douglas City, and <56° F from October 1 to December 31 at the North Fork Trinity River confluence (RM 72.4). Provide optimal temperatures for anadromous salmonids throughout their outmigration by meeting temperature targets at Weitchpec (RM 0.0) of: <55.4° F prior to May 22 for steelhead smolts, < 59.0° F prior to June 4 for coho salmon smolts, and <62.6° F prior to July 9 for chinook salmon smolts.	Temperature objectives – extremely wet, wet, and normal water years
237	Provide suitable temperatures for holding spring chinook and spawning spring and fall chinook by meeting temperature standards of: <60° F from July 1 to September 14 at Douglas City (RM 93.7), <56° F from September 15 to September 30 at Douglas City, and <56° F from October 1 to December 31 at the North Fork Trinity River confluence (RM 72.4). Facilitate early outmigration of smolts by allowing water temperatures to warm and provide at least marginal temperatures for anadromous salmonids throughout most of their outmigration by meeting temperature targets at Weitchpec (RM 0.0) of: <59.0° F prior to May 22 for steelhead smolts, <62.6° F prior to June 4 for coho salmon smolts, and <68.0° F prior to July 9 for chinook salmon smolts.	Temperature objectives – dry and critically dry water years
240	From July through mid-October a release of at least 450 cfs provides suitable water temperatures for holding and spawning spring-run chinook salmon and spawning fall-run chinook salmon in the Trinity River, above the confluence with the North Fork Trinity River	Temperature objective – extremely wet, wet, and normal water years
241	A release of 450 cfs from October 1 through October 15 maintains water temperatures suitable for spawning spring-run chinook salmon and holding fall-run chinook salmon in the Trinity River above the confluence with the North Fork Trinity River.	
241	A release of 300 cfs from October 16 through April 21 provides suitable microhabitat for spawning and rearing chinook salmon, coho salmon, and steelhead within the existing channel.	Habitat objective – microhabitat
241	A release of 500 cfs from April 22 through April 28 provides optimal temperatures for steelhead (< 55.4° F), as well as for coho salmon (< 59.0° F) and chinook salmon (< 62.6° F) smolts.	Temperature objective
241	A release of 1,500 cfs from April 29 through May 5 provides optimal temperatures for steelhead, coho salmon, and chinook salmon smolts throughout the mainstem.	Temperature objective
242	A release of 2,000 cfs from May 6 through May 19 provides optimal temperatures for steelhead, coho salmon, and chinook salmon smolts throughout the mainstem.	Temperature objective

Page No. and Relevance Goals/Objectives AG AM	Document Text	Summary
242	A 5-day peak release of 11,000 cfs from May 24 to May 28 targets fluvial geomorphic processes that will create major alterations in the channel and channelbed. This release magnitude and duration will mobilize most alluvial features, scour the channelbed to a depth >2D84, transport sediment and route bedload, cause mortality of channel-encroaching plants and prevent germination of riparian plants, promote periodic channel migration and avulsion, and build floodplain features. This release magnitude will also provide optimal temperatures for coho salmon and chinook salmon smolts throughout the mainstem.	Fluvial geomorphic process objective
242 & 245	A 5-day release of 6,000 cfs from June 6 to June 10 facilitates the transport of fine bed material (sand) once higher flows have mobilized the surface layer of the general channelbed and alternate bars, while minimizing transport of coarse bed material. This release will transport fine sediment (sand), cause mortality of riparian vegetation seedlings, and inundate the flanks of bars to discourage germination and prevent encroachment of riparian plants. This release provides optimal temperatures for chinook salmon smolts throughout the mainstem.	Sediment transport, vegetation management, and temperature objective
245	A release of 2,000 cfs from June 30 to July 9 provides optimal temperatures for chinook salmon smolts throughout the mainstem. Alternate bar features will be inundated, causing mortality of riparian vegetation seedlings and preventing germination of riparian vegetation on lower bar surfaces. Some fine sediment (sand) transport occurs at this release magnitude.	Sediment transport, vegetation management, and temperature objective
246	Recommended releases decrease from 2,000 cfs on July 9 to 450 cfs on July 22 to reach summer temperature-control releases. The gradual decrease minimizes stranding of fry and juvenile salmonids and allows gradual warming of the mainstem to provide outmigration cues to any remaining smolts. A release of 450 cfs from July through September 30 maintains suitable water temperatures for holding and spawning spring-run chinook salmon in the Trinity River above the confluence with the North Fork Trinity River.	Temperature objective
246	A 5-day peak release of 8,500 cfs from May 17 to May 21 targets several fluvial geomorphic processes. This release magnitude and duration will mobilize most alluvial features, scour channelbed to a depth >1D84, transport fine sediment and route bedload, cause mortality of channel-encroaching plants and prevent germination on bar surfaces, initiate periodic channel migration, and inundate/create floodplains.	Fluvial geomorphic process objective

Page No. and Relevance Goals/Objectives AG AM	Document Text	Summary
273	Sediment management recommendations involve four separate actions: (1) immediate placement of coarse sediment (>5/16 inch) to restore spawning gravels lost through mainstem transport between Lewiston Dam and Rush Creek, (2) annual supplementation of coarse sediment (>5/16 inch) to balance the coarse sediment budget in the Lewiston Dam to Rush Creek reach, (3) fluvial reduction of fine sediment (<5/16 inch) storage in the mainstem, and (4) mechanical reduction of fine sediment (<5/16 inch) storage in the mainstem.	Sediment management objectives
276	Bank rehabilitation on a forced-meander bend, alternate bar rehabilitation over longer reaches, side channel construction over short reaches, and tributary delta maintenance (local removal of the very coarse sediment (boulders) that causes aggradation and hydraulic backwater effects upstream from deltas).	Channel restoration objectives
279	Revegetate reconstructed floodplains with native woody riparian species, emphasizing black cottonwood (Populus balsamifera) and Fremont cottonwood (Populus fremontia) to increase the seed source for natural regeneration.	Floodplain restoration objective
280	The primary hypothesis is that a combination of managed high-flow releases, mechanical riparian berm removal, and gravel augmentation will redirect geomorphic processes so that a more complex channel form will evolve, creating the mosaic of aquatic habitats necessary to enhance freshwater salmonid production.	Channel restoration objective
281	Reservoir releases and channel-rehabilitation projects should substantially increase carrying capacity (usable salmonid rearing habitat area) within the rehabilitated channel.	Habitat objective
281	the development of recommendations regarding permanent instream fishery flow requirements and Trinity River Division operating criteria and procedures for restoration and maintenance of the Trinity River fishery	Program Objective
281	Manage the reservoir releases to provide a much improved (near optimum) temperature regime. An optimum temperature regime increases fish residence time and growth rates, resulting in larger smolts exiting the system. Larger smolts have better survival leading to an increase in numbers of returning adults.	Temperature objective
281	Manage the river corridor to increase the shallow edge water and backwater habitats necessary for many anadromous young-of-year salmonids.	Habitat objective
281	Manage reservoir releases to control vegetation establishment on alluvial features. Schedule reservoir releases to scour seedlings on bars following the seed fall during the spring-summer period. Investigate superimposing reservoir releases on tributary flows when the opportunity is present.	Vegetation control objective

Page No. and Relevance Goals/Objectives AG AM	Document Text	Summary
281	Manage reservoir releases within the evolving channel to optimize hydraulic conditions for spawning, incubation, and young-of-year production for a given water year and channel form. As the channel changes from the present trapezoidal form toward the desired alternating point bar configuration, the slope of the hydrograph should be adjusted annually to maximize suitable conditions for a given year.	Habitat objective
285	the objective of the AEAM Program is to prescribe the precise magnitude and duration of reservoir releases confirming or modifying the OCAP for that year.	Adaptive management
287 & 289	The program would be directed by the Secretary through a designee, who would serve as the principal contact for the AEAM and as the focal point for issues and decisions associated with the program. His/her responsibility would include ensuring that the Department of the Interior fulfills its obligations to restore and maintain the Trinity River Fishery. Components of the Trinity AEAMP include a Trinity Management Council (TMC) supported by a Technical Modeling and Analysis Team (TMAT) and a rotating Scientific Advisory Board (SAB). The program would include consultation with other agencies and interested groups through periodic interaction through a Stakeholders Group. Scientific credibility would be assured through external peer review of operating plans, models, sampling designs, and projections	Governance structure
289	The TMC would be composed of fishery agency representatives. The Secretary's designee would serve as Executive Director. The TMC would approve fishery restoration plans and any proposed changes to annual operating schedules (described earlier in this chapter) submitted by the Technical Modeling and Analysis Team. The TMC would be the focal point for issues and decisions associated with the program. The Executive Director's responsibilities would include ensuring that the Department of the Interior fulfills its obligations for streamflow releases and rehabilitation of the river corridor habitats. The Executive Director in consultation with the Council members would review, modify, accept, or remand the recommendations from the TMAT in making decisions about any changes in reservoir releases, dam operations, and other management actions.	Governance structure

Page No. and Relevance Goals/Objectives AG AM	Document Text	Summary
289	The TMAT would consist of a permanent group of 4 to 8 scientists selected to represent the interdisciplinary nature of the decision process. Collectively, they must possess the skills and knowledge of several disciplines: water resources, engineering, geomorphology, water quality, fish population biology, riparian ecology, computer modeling, and data management. The TMAT responsibilities include design for data collection, methodology, analyses, modeling, predictions, and evaluating hypotheses and model improvements. This Team would have delegated from the Executive Director a budget and the responsibility for preparing requests for proposals (RFP) to conduct specialized data collections for model input and validation. Spatial coverage and sampling designs for long-term monitoring for status and trends would be developed in consultation with the management agencies and specific recommendations made to the TMC for funding. Funding for the long-term monitoring would remain with the TMC.	Governance structure
289 & 291	The SAB would be appointed by the Executive Director. This group would be composed of prominent scientists appointed and appropriately compensated for 2 to 3 year rotating terms. The SAB would be responsible for semiannual review of the analyses, models, and projections of the TMAT as well as providing a science review of the overall management plans and implementation of the annual operating criteria and procedures as directed by the TMC. The SAB would also select outside peer reviewers and conduct the review and selection process for any contracted data collection, research, or model development.	Governance structure

APPENDIX B. IRB approval letter for use of PRRIP and TRRP interview data.

University of Nebraska Lincoln

Official Approval Letter for IRB project #18542 - New Project Form

August 9, 2018

Chad Smith
School of Natural Resources

Craig Allen
School of Natural Resources
HARH 423, UNL, 685830984

IRB Number: 20180818542 EX
Project ID: 18542
Project Title: AN EVALUATION FRAMEWORK FOR LARGE-SCALE AQUATIC SYSTEM ADAPTIVE MANAGEMENT PROGRAMS: GOVERNANCE AND ADAPTIVE MANAGEMENT COMPONENTS AND SUB-COMPONENTS AFFECTING SUCCESSFUL OUTCOMES

Dear Chad:

This letter is to officially notify you of the certification of exemption of your project for the Protection of Human Subjects. Your proposal is in compliance with this institution's Federal Wide Assurance 00002258 and the DHHS Regulations for the Protection of Human Subjects (45 CFR 46) and has been classified as exempt. Exempt categories are listed within HRPP Policy #4.001: Exempt Research available at: http://research.unl.edu/researchcompliance/policies-procedures/.

o Date of Final Exemption: 8/9/2018
o Review conducted using exempt category 2 and 4 at 45 CFR 46.101
o Funding (Grant congruency, OSP Project/Form ID and Funding Sponsor Award Number, if applicable): N/A

1. This project can be conducted with the Platte River Recovery Implementation Program. Data from the Trinity River Restoration Program can be used once you have obtained permission from the Regional Solicitor from the Bureau of Reclamation. Please submit this permission as a change request once the documentation has been received.

We wish to remind you that the principal investigator is responsible for reporting to this Board any of the following events within 48 hours of the event:
* Any serious event (including on-site and off-site adverse events, injuries, side effects, deaths, or other problems) which in the opinion of the local investigator was unanticipated, involved risk to subjects or others, and was possibly related to the research procedures;
* Any serious accidental or unintentional change to the IRB-approved protocol that involves risk or has the potential to recur;
* Any publication in the literature, safety monitoring report, interim result or other finding that indicates an unexpected change to the risk/benefit ratio of the research;
* Any breach in confidentiality or compromise in data privacy related to the subject or others; or
* Any complaint of a subject that indicates an unanticipated risk or that cannot be resolved by the research staff.

This project should be conducted in full accordance with all applicable sections of the IRB Guidelines and you should notify the IRB immediately of any proposed changes that may affect the exempt status of your research project. You should report any unanticipated problems involving risks to the participants or others to the Board.

If you have any questions, please contact the IRB office at 402-472-6965.

Sincerely,

Becky R. Freeman

Becky R. Freeman, CIP
for the IRB

University of Nebraska-Lincoln Office of Research and Economic Development
nugrant.unl.edu

NUgrant

APPENDIX C. Email from Bureau of Reclamation Solicitor giving permission to use TRRP data.

Chad Smith

From: Teves, Steven <steves@usbr.gov>
Sent: Wednesday, September 4, 2019 5:53 PM
To: Chad Smith
Cc: Michael Dixon
Subject: Re: [EXTERNAL] Permission to use Reclamation/TRRP information in PhD dissertation

Hello Chad.

Since you confirmed that you will be using only publicly available reports that was generated for your TRRP work as your data source for your dissertation, I have no issue with the use of such information in your dissertation.

Best wishes with your education!

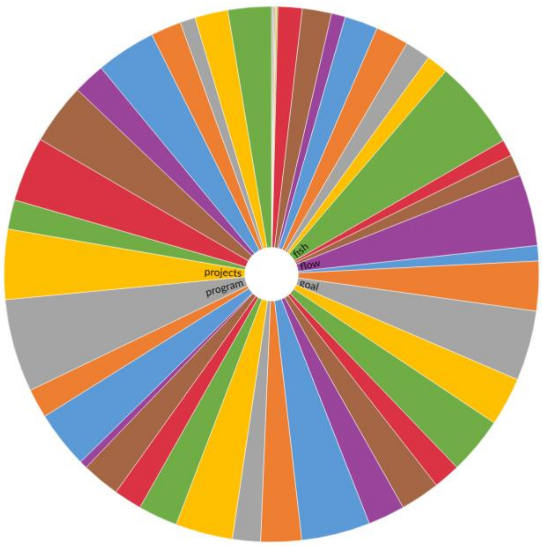
Thank you.

STEVEN TEVES
Bureau of Reclamation
Contracting Officer
Service/Supply Branch

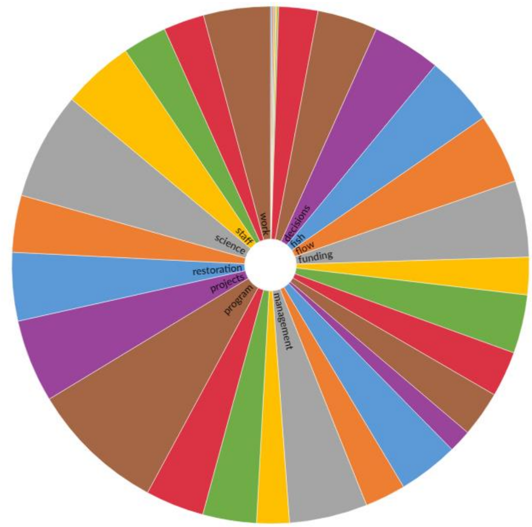
916 978-4302 (Ph)
916 978-5175 (Fax)

APPENDIX D. Aggregated word hierarchy color sunburst charts for TRRP data from NVivo.

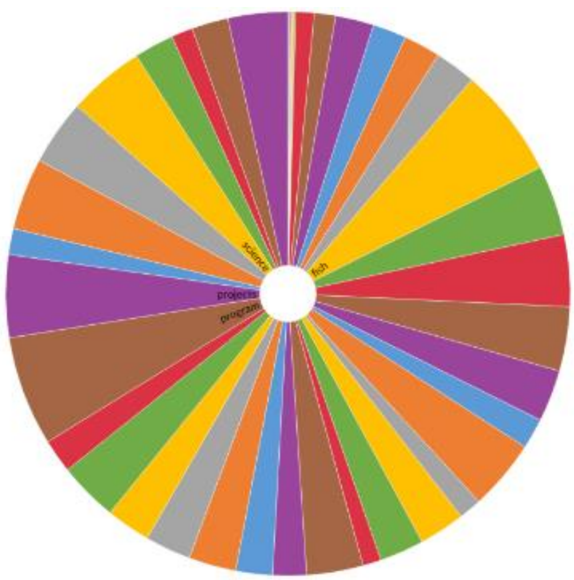
AG Component – Legitimacy



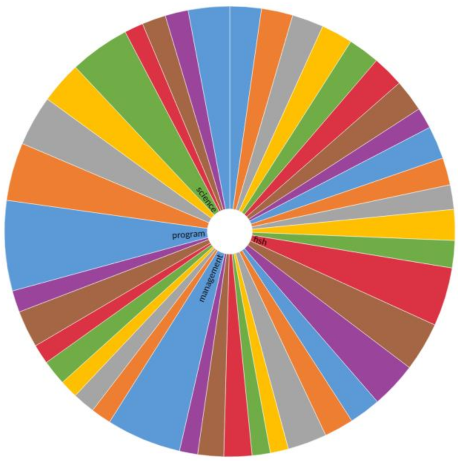
AG Component – Structure and Capacity



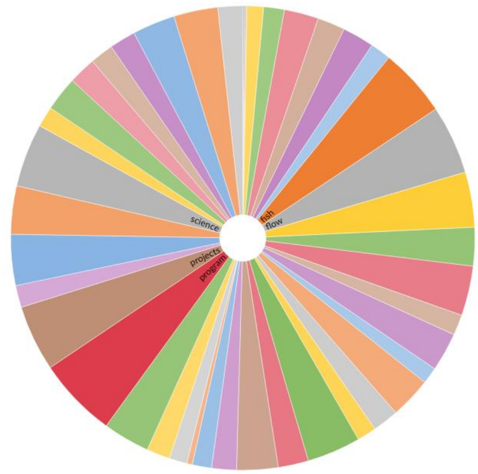
AG Component – Decision-Making Process



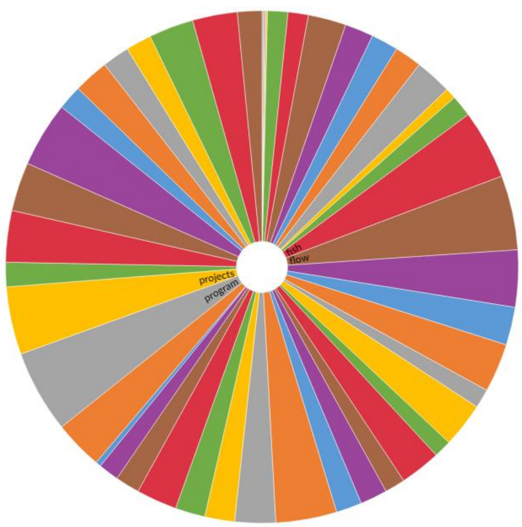
AM Component – Assess



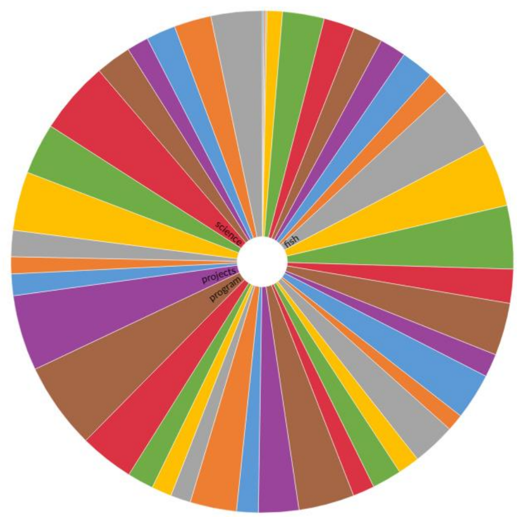
AM Component – Design



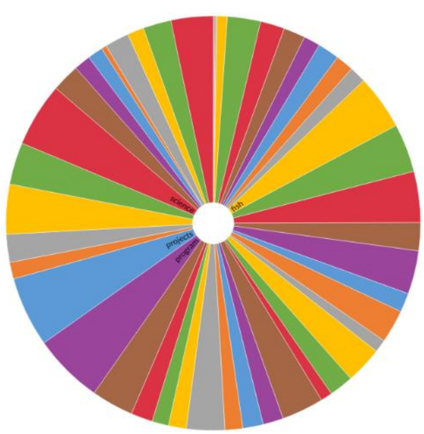
AM Component – Implement



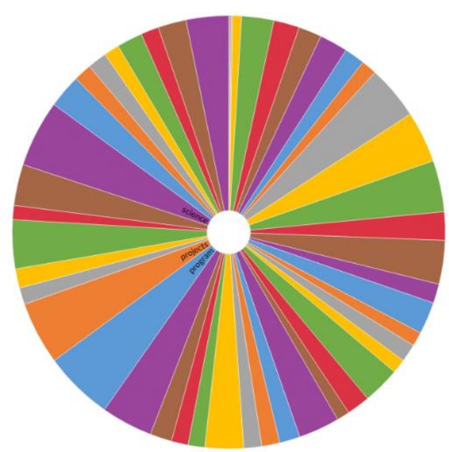
AM Component – Monitor



AM Component – Evaluate

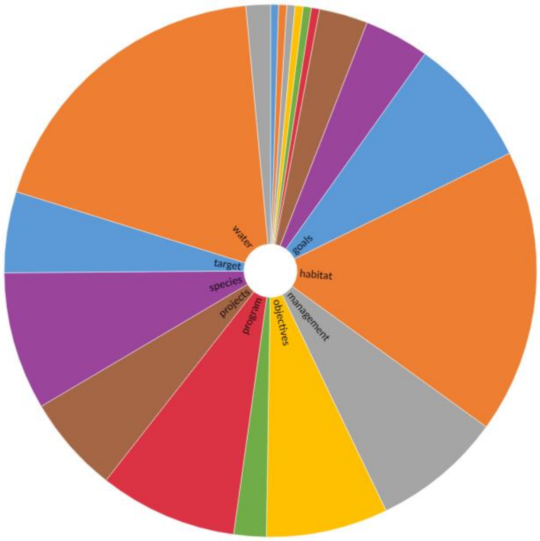


AM Component – Adjust

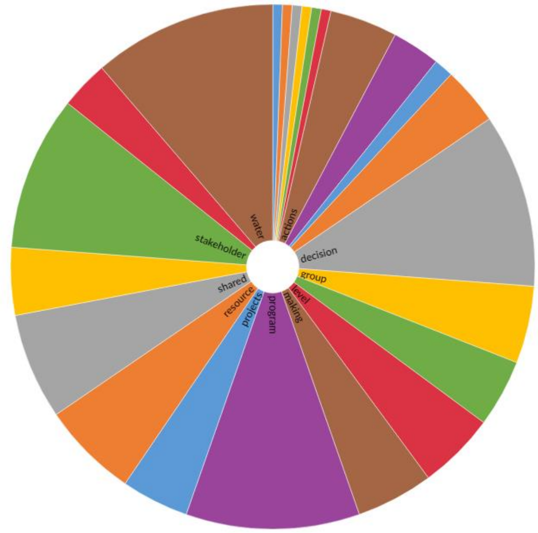


APPENDIX E. Aggregated word hierarchy color sunburst charts for PRRIP data from NVivo.

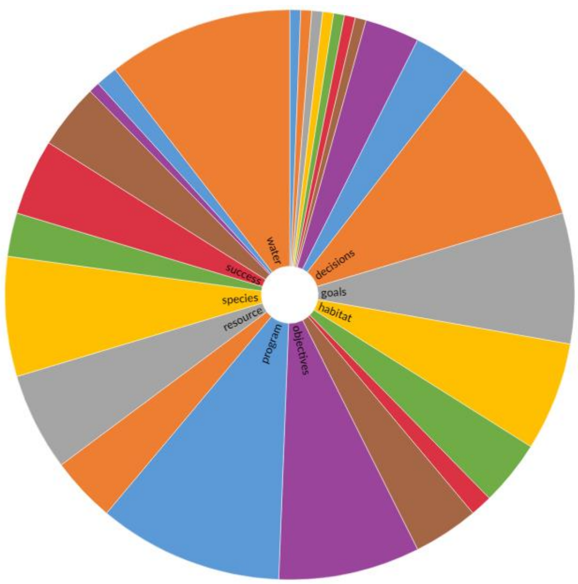
AG Component – Legitimacy



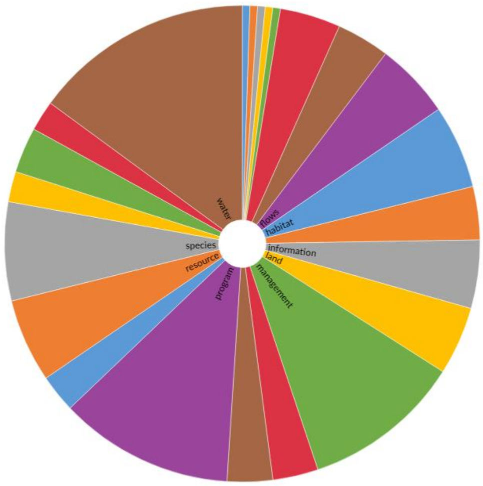
AG Component – Structure and Capacity



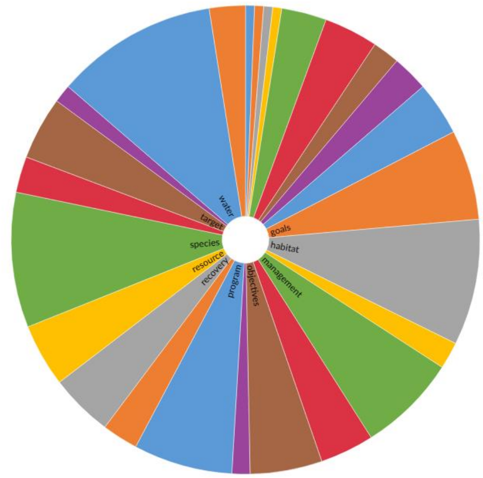
AG Component – Decision-Making Process



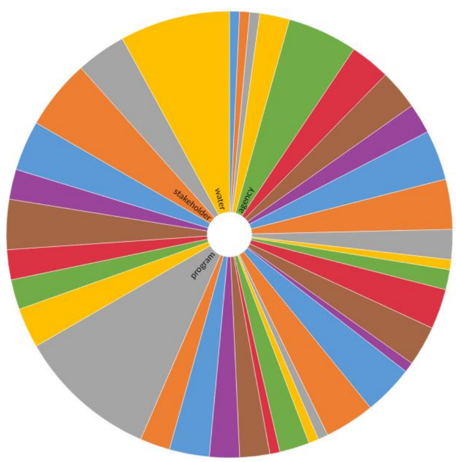
AM Component – Assess



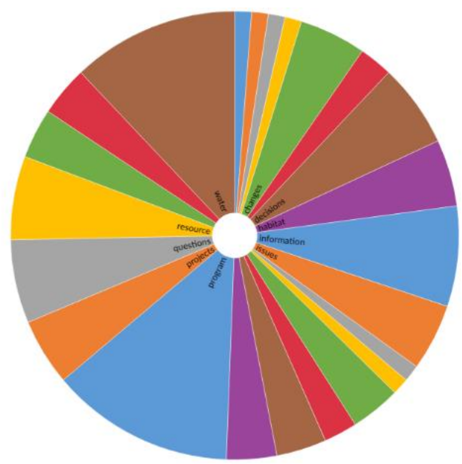
AM Component – Design



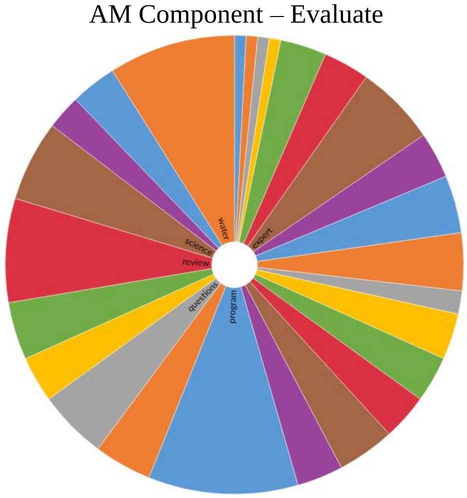
AM Component – Implement



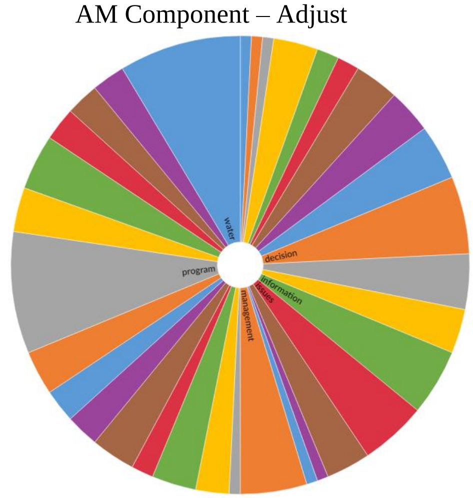
AM Component – Monitor



AM Component – Evaluate



AM Component – Adjust



APPENDIX F. Restoration Program Evaluation Framework Data Output Tables for TRRP AG and AM – Performance Assessment, Risk Assessment, Typology Fit, and Recommendations for Program Reform.

<table>
<tr><td>AG Component
Legitimacy</td><td colspan="2" rowspan="2">Subcomponent Description:
• Definition – Program is accountable and enabled with decision responsibility.
• The TRRP is an official federal river restoration program that is legitimate and accountable as directed by three key foundational documents (Trinity River Flow Evaluation Study, Implementation Plan, Record of Decision) and several legislative authorities (P.L. 98-541, P.L. 104-143, P.L. 102-575). The TRRP is enabled with decision responsibility through the foundational documents and related legislation.</td></tr>
<tr><td>AG Subcomponent
Accountability</td></tr>
<tr><td>Performance Assessment</td><td>Structural:
• The ROD is the ultimate statement of TRRP authority, but it was not negotiated by Program partners.
• Authority for the TRRP is not currently bound by a specified timeline for making decisions or achieving goals or objectives.
• Funding has been relatively stable over the years but the linkages between funding and milestones are weak.</td><td>Functional:
• The TRRP is being implemented, has a Program staff, and has a decision-making body in the TMC.
• Decisions at the TMC level focus on annual budget line items, generally not on making management decisions/adjustments that are clearly tied back to the foundational documents.</td></tr>
<tr><td>Consequences of Failure</td><td colspan="2">• The TRRP can only move forward with purpose if there is clarity in overall goals and objectives that come from foundational documents.</td></tr>
<tr><td>Consequence Rating (C)</td><td colspan="2">4</td></tr>
<tr><td>Likelihood of Failure</td><td colspan="2">• The three foundational documents provide guidance on the structure and function of the TRRP but differences between those three documents has led to Program drift over time.
• Despite the presence of these documents and prior reviews of the TRRP, there remains a feeling that the Program is stuck and needs refinements to move forward.</td></tr>
<tr><td>Likelihood Rating (L)</td><td colspan="2">3</td></tr>
<tr><td>Risk Rating (CxL)</td><td colspan="2">12</td></tr>
<tr><td>AG/AM Risk Typology “Fit”</td><td colspan="2">• AM is hard-wired into the TRRP though it is based on the original model of Adaptive Environmental Assessment and Management (AEAM).
• There is clear direction to implement some version of AM and route information back to decision-makers, but actual implementation of true AM has been slowed in large part due to a lack of clarity in Program goals and objectives, and explicit development of an agreed-upon AM Plan linked back to those goals and objectives.</td></tr>
<tr><td>Recommendations for Reform</td><td colspan="2">• Negotiate a single, unified TRRP Program Document that clearly spells out goals and objectives and provides clear guidance on how program implementation will be evaluated against these goals and objectives.</td></tr>
</table>

Governance Component Legitimacy **Subcomponent** Responsiveness to constituencies	**Subcomponent Description:** • *Definition* – Program is responsive to constituencies both above and below the level of the decision-making body. • The TRRP is a public program affecting resources with direct links to local landowners, river users, and communities. The Program is authorized and funded through federal legislation, largely managed by a federal agency (Bureau of Reclamation), overseen by federal regulatory agencies (U.S. Fish and Wildlife Service and National Marine Fisheries Service), and is also connected to two Tribes, the State of California, and other federal and local partners.	
Performance Assessment	Structural: • The TRRP decision-making body is the Trinity Management Council (TMC) which is comprised of federal, tribal, state, and local entities. • Below the TMC, technical committees are also structured in a similar collaborative manner. • The Trinity Adaptive Management Working Group (TAMWG) is the official committee for basin stakeholder interests. The TAMWG is part of the TMC but not a voting member.	Functional: • Discussions with TRRP partners suggest improvements need to be made in addressing the concerns and priorities of federal, tribal, and state partners. • Though annual funding is consistent, it is not clear how the TRRP is viewed at the highest levels of the Department of Interior or among legislative entities. • The TAMWG has been deemed "administratively inactive" by Interior and is currently not functioning. • When active, the general feeling among TAMWG members was that their concerns and ideas were ignored by the TRRP. • River landowners and river users provide regular feedback to the TRRP on operations and impacts on river land and activities such as fishing, much of it negative. This communication is conducted via letters to the TRRP and/or presentations at TMC meetings.
Consequences of Failure	• The structure and function of this subcomponent is likely a fatal flaw for the TRRP. The current "Board of Directors" approach taken by the TMC and the presence of a separate stakeholder body is common among large-scale programs like the TRRP. In nearly all cases, this is a key factor in program failure.	
Consequence Rating (C)	5	
Likelihood of Failure	• This subcomponent exhibits a structural flaw in that stakeholders are largely relegated to an advisory-only role rather than having a role in actual Program decision-making. • This creates a functional flaw in that stakeholders feel their concerns and ideas are being ignored. The designation of the TAMWG as "administratively inactive" by Interior reveals how easily stakeholders can be completely divorced from Program decision-making. • All TRRP entities shared frustrations regarding the TRRP and its effectiveness at addressing their concerns and priorities, even when those entities were at the TMC decision-making table.	
Likelihood Rating (L)	5	
Risk Rating (CxL)	25	
AG/AM Risk Typology "Fit"	• AM will not function properly at a large scale without a functioning collaborative decision-making/governance structure.	
Recommendations for Reform	• Negotiate a revised decision-making structure that incorporates stakeholders and a voting process that more adequately represents the range of TRRP interests and impacts.	

Governance Component Structure/Capacity **Subcomponent** Polycentric	**Subcomponent Description:** • *Definition* – Polycentric organizational structure with a centralized decision-making body but with explicit support from advisory committees and appropriate levels of authority. • TRRP decisions are generally made by the TMC which serves as a "Board of Directors". The TMC receives input from the TAMWG, the Science Advisory Board (SAB), and several technical workgroups and is guided by an Executive Director and staff.	
Performance Assessment	Structural: • The decision-making body should be the TMC but there is some language in the foundational documents suggesting decisions are to be made both by the TMC and the Executive Director. • The TMC is ultimately advisory to the Secretary of the Interior, so decisions such as flow management actions are subject to review and approval by the Department of the Interior. • The TRRP is generally organized according to Figure 1 in the Implementation Plan which is drawn heavily from a similar structure found in the Glen Canyon Adaptive Management Program. • The relationships between the TMC, the TAMWG, and the AWAM Team (TMAG and RIG) are not well-defined or understood. • The TRRP is nested within a larger suite of water management-related programs in California and in a broader area, including the CVPIA and issues related to the Klamath River.	Functional: • The TMC is inclusive of key tribal, federal, state, and local agencies but does not engage other stakeholders directly in decision-making. • The TMC could serve as a centralized decision-making body but currently does not fully function well in this capacity. • There is a lack of clarity about the role of the Executive Director and staff in the TRRP – do the ED and staff serve as "honest brokers" implementing the TRRP on behalf of the TMC, or does the TMC essentially rely on the ED and staff to make program decisions beyond day-to-day implementation?
Consequences of Failure	• Persistence of the current decision-making approach will continue to render the TRRP unable to make decisions and thus will impede progress.	
Consequence Rating (C)	**4**	
Likelihood of Failure	• The raw materials are present in the TMC to develop a true polycentric decision-making structure with lines of authority from the Department of the Interior to the TMC and through the TRRP, but the program currently does not function well in this manner.	
Likelihood Rating (L)	**4**	
Risk Rating (CxL)	**16**	
AG/AM Risk Typology "Fit"	• AM will only work in the TRRP if the decision-making structure and process are revised to represent a more polycentric, collaborative approach to implementing the program and making decisions.	
Recommendations for Reform	• Negotiate a revised decision-making structure that incorporates stakeholders and a voting process that more adequately represents the range of TRRP interests and impacts.	

<table>
<tr><td>Governance Component
Structure/Capacity</td><td rowspan="2" colspan="2">Subcomponent Description:
• Definition – Clear and regular coordination and communication among and between governance levels within the Program.
• The ED and staff are responsible for most coordination and communication within the TRRP. This includes coordinating upward to the TMC from technical workgroups and the SAB, and downward from the TMC to technical workgroups and the public.</td></tr>
<tr><td>Subcomponent
Coordination and Communication</td></tr>
<tr><td>Performance Assessment</td><td>Structural:
• The coordination (and communication) of the TRRP is derived from Figure 1 in the Implementation Plan, which is based on a similar structure utilized in the Glen Canyon Adaptive Management Program.
• The TMC is the decision-making body and the ED and staff implement the Program on behalf of the TMC.
• The ED Office is comprised of both Reclamation staff and USFWS staff (Science Coordinator).
• There seem to be many technical committees/work groups, with redundancies in some cases.
• There is a mix of communication between and among technical aspects of the TRRP – technical issues are discussed at TMC meetings and communication also occurs via reports and memos.
• Public coordination occurs largely through TMC meeting comment periods and via letters and emails to the ED Office.
• The SAB is largely coordinated by the TRRP Science Coordinator (a USFWS employee).
• Most information contained on and communicated through the TRRP website.</td><td>Functional:
• The clarity of coordination between the TMC, advisory committees, work groups, and the ED/ED Office is mixed. Much of this mixed clarity stems from a lack of internal TRRP agreement on goals, objectives, and vision.
• An ED Office comprised of staff from two separate federal agencies without clear, coordinated ED oversight responsibilities for all staff creates internal staff tension and mixed messages to the TMC.
• Advisory committees/work groups seem to take on a larger role than just evaluating technical aspects of the TRRP and making recommendations to the TMC.
• The SAB is largely under-utilized and is largely divorced from interaction with the TMC, thus reducing its effectiveness in helping to provide the TMC with independent science review of Program implementation, analysis, and synthesis.
• Regular communication within the TRRP and among decision-making entities but that communication is not always effective.
• Poor communication between the TMC and the TAMWG. When functional, the TAMWG basically just sent letters to the TMC instead of having regular dialogue.
• Inconsistent communication between the TMC, TAMWG, and advisory committees/work groups.
• The TRRP website has recently been updated and provides a strong central repository of current and historical Program information.</td></tr>
<tr><td>Consequences of Failure</td><td colspan="2">• Lack of clear roles of TRRP authority (TMC makes decisions, ED responsible for implementation, technical committees evaluate data and provided recommendations to the TMC) will lead to TRRP stagnation and a lack of decisions and forward progress.</td></tr>
<tr><td>Consequence Rating (C)</td><td colspan="2">4</td></tr>
<tr><td>Likelihood of Failure</td><td colspan="2">• Coordination and communication within the TRRP are confused and tense. It is likely this aspect of governance will contribute to the TRRP stalling if issues are not resolved.</td></tr>
<tr><td>Likelihood Rating (L)</td><td colspan="2">4</td></tr>
<tr><td>Risk Rating (CxL)</td><td colspan="2">16</td></tr>
<tr><td>AG/AM Risk Typology "Fit"</td><td colspan="2">• AM will remain slow or stuck, or the TRRP will simply be conducting "trial and error", if this aspect of Program governance is not resolved.</td></tr>
<tr><td>Recommendations for Reform</td><td colspan="2">• Consider reorganization of TRRP away from model in Implementation Plan ("AEAM organization") and consider a more structured approach to information flow and management similar to the Platte River Recovery Implementation Program (TMC makes decisions, ED responsible for implementation, a unified ED Office staff, a small set of structured advisory committees, and better integration of the SAB).</td></tr>
</table>

Governance Component Structure/Capacity	Subcomponent Description:	
Subcomponent Scale (geography)	• *Definition* – Scale of Program represents manageable geography on the ground and is tied to relevance of key decision-makers. • The TRRP is focused on the area of the Trinity River between Lewiston Dam and the North Fork Trinity River in northern California. • This is only a segment of the mainstem Trinity, which continues below the North Fork until its confluence with the Klamath River and subsequent extension to the Pacific Ocean.	
Performance Assessment	Structural: • The TRRP does focus its on-the-ground work on the portion of the Trinity River between Lewiston Dam and the North Fork Trinity.	Functional: • While the TRRP focuses its work on the segment of the Trinity that is included in the ROD, the success/failure of the TRRP in terms of fisheries restoration is highly influenced by the fact that anadromous species move past the TRRP segment and are impacted by activities on the Trinity River outside the TRRP area, by activities on the Klamath River, and by ocean conditions and activities.
Consequences of Failure	• Without adjusting its goals and objectives accordingly, the TRRP may never be able to reach critical milestones.	
Consequence Rating (C)	**3**	
Likelihood of Failure	• The TRRP can be successful but its current set of goals and objectives are both not clear and likely not responsive to outside influences beyond the control of the TRRP.	
Likelihood Rating (L)	**3**	
Risk Rating (CxL)	**9**	
AG/AM Risk Typology "Fit"	• This subcomponent presents a challenge for AM in the TRRP because of the disconnect between what the TRRP can influence and achieve and the fisheries used as a measuring stick of Program success.	
Recommendations for Reform	• Adjust goals and objectives to adequately capture what the TRRP can control, and better identify what influence the Program can have on an anadromous fishery in the area where the TRRP can implement management actions.	

Governance Component Structure/Capacity Subcomponent Scale (time)	Subcomponent Description: • *Definition* – The Program is bound by a time scale that will allow tracking of progress toward milestones and achievement of goals/objectives. • The TRRP is not defined by a time increment, end date, or other time component in the Flow Study, Implementation Plan, ROD, or associated legislation.	
Performance Assessment	Structural: • The Program operates on an annual basis in terms of projects and funding but is not constrained by any identified time increment for achieving goals and objectives.	Functional: • The TRRP appears to operate under the premise that it will continue implementation if annual funding is provided.
Consequences of Failure	• Failure of this subcomponent will likely mean a continued lack of the TRRP being held accountable for progress toward its goals and objectives.	
Consequence Rating (C)	**4**	
Likelihood of Failure	• The TRRP may be able to continue for a long period of time under this arrangement but without an identified time increment tied to the ROD and legislative authority there is little incentive to show sustained progress toward achievable goals and objectives.	
Likelihood Rating (L)	**4**	
Risk Rating (CxL)	**16**	
AG/AM Risk Typology "Fit"	• While implementation of true AM at a large scale occurs best over a period long enough to see the results of implementation and species responses, the lack of a defined time increment for the TRRP has not provided the kind of direction necessary to ensure AM rigor.	
Recommendations for Reform	• Negotiate an acceptable time increment for the next stage of TRRP implementation and specify it in a new foundational document/agreement.	

Governance Component Structure/Capacity **Subcomponent** Stakeholders involved in decision-making	**Subcomponent Description:** • *Definition* – Stakeholders directly involved in Program decision-making. • The TMC is the decision-making body for the TRRP. Stakeholders are involved in the TRRP in an advisory capacity through the TAMWG.	
Performance Assessment	Structural: • The TMC is the decision-making body for the TRRP and is comprised of representatives of federal agencies, Tribes, and the State of California. • Stakeholders such as local landowners, river users, etc. are part of the TAMWG which is an advisory body. A TAMWG representative participates in TMC meetings but does not have an official vote.	Functional: • The TAMWG believes that it is routinely ignored by the TMC and that it does not have any influence on TRRP decision-making. • As of April 2018, the Department of Interior has rendered the TAMWG "administratively inactive" and it no longer even is serving in an advisory capacity for the TRRP.
Consequences of Failure	• The consequence of keeping stakeholders out of the TRRP decision-making process will continue to be a lack of trust between the TRRP and stakeholders, complaints about management action, and possibly a lack of support for continuing the TRRP in the long run.	
Consequence Rating (C)	**5**	
Likelihood of Failure	• Based on experience with the PRRIP and other similar programs, unilateral decision-making by a single entity (agency) or a decision-making body comprised only of agency representatives will not foster the trust and procedures necessary to ensure consensus decision-making within a program and will be a key factor in program failure.	
Likelihood Rating (L)	**5**	
Risk Rating (CxL)	**25**	
AG/AM Risk Typology "Fit"	• AM can only be successful if science learning is fed back into a functioning decision-making process and Program governance structure. • Even if the TRRP can build and implement a true AM Plan, failure to address this subcomponent will likely stop any forward progress for the TRRP in terms as AM serving as an input to decision-making.	
Recommendations for Reform	• Re-constitute the TMC to include some level of direct stakeholder involvement. • Consider development of an organizational charter for the TMC that specifies voting entities, voting processes, and how decisions will reflect the larger TRRP community.	

Governance Component Structure/Capacity	Subcomponent Description: • *Definition* – Present and adequate within the Program to deliver information useful to decision-makers. • Program staff and the technical portions of the AEAM organization (RIG, TMAG, and associated advisory committees and work groups) are strong and provide detailed technical capacity for the TRRP.	
Subcomponent Technical capacity		
Performance Assessment	Structural: • Formal structure of ED, Program staff, advisory committees, work groups, and AEAM Team (RIG and TMAG) provide sound TRRP technical capacity. • SAB utilized to provide independent science review.	Functional: • The staff split between Reclamation and the Service in the ED Office confuses lines of communication and work between and among technical aspects of the TRRP. • Despite this, there is constant and strong work being done within technical committees and work groups that keep the TRRP well-positioned to act on science learning and data analysis and synthesis. • Some concern about leadership turnover in the TRRP, as well as staff and technical representative turnover.
Consequences of Failure	• Lack of technical capacity would prevent the TRRP from moving forward with AM. • This is not the case; lack of progress on AM is more a function of overall structure of the TRRP, lack of clear and agreed-upon goals and objectives, and lack of an AM Plan to focus the work of technical committees and work groups.	
Consequence Rating (C)	**4**	
Likelihood of Failure	• Generally low given the extent of TRRP technical capacity and commitment to the TRRP and to the work of the Program.	
Likelihood Rating (L)	**2**	
Risk Rating (CxL)	**8**	
AG/AM Risk Typology "Fit"	• High technical capacity within the TRRP ensures that true AM can be implemented.	
Recommendations for Reform	• Update the structure of TRRP technical capacity to develop a small set of standing advisory committees. • Create clear lines of communication and authority (through charters) for these committees to avoid redundancies and ensure a smooth flow of information to the TMC.	

Governance Component Decision-Making Process	Subcomponent Description: • *Definition* – Decision-making shared among management agencies and stakeholders. • Decisions are made at the TMC level, which includes a mix of federal, tribal, and state representatives but does not include stakeholders as official voting members.	
Subcomponent Shared decision-making		
Performance Assessment	Structural: • The TMC includes federal, tribal, and state agency representatives. • This representation is shared downward within the TRRP in the AEAM Team, advisory committees, work groups, etc. • Stakeholder groups are represented on the TAMWG. A TAMWG representative attends TMC meetings but does not have an official vote.	Functional: • Questions about relative balance between TMC members and the influence each entity has on TRRP decisions. • Confusion about roles of Reclamation and the Service, and what it means that the Hoopa Valley Tribe signed the ROD. • Much concern about issues of "conflict of interest", how TRRP money is distributed, and this influences decision-making and Program progress. • TMC does not really function as a Board of Directors for the TRRP.
Consequences of Failure	• The TMC will not make decisions that are supported even within the TRRP. • Continued feelings of mistrust among and between TMC entities. • Inability to act on TRRP science learning. • Continued public concern and isolation of stakeholders.	
Consequence Rating (C)	**5**	
Likelihood of Failure	• High. Decision-making is not shared, there is mis-trust among decision-making entities, and there is a lack of clarity about the bounds of TRRP decisions (goals, objectives, vision for Program outcomes, etc.).	
Likelihood Rating (L)	**5**	
Risk Rating (CxL)	**25**	
AG/AM Risk Typology "Fit"	• Failing to fix this subcomponent will ensure AM remains stuck or that it is never truly implemented and utilized by the TRRP.	
Recommendations for Reform	• Re-constitute the TMC to include some level of direct stakeholder involvement. • Consider development of an organizational charter for the TMC that specifies voting entities, voting processes, and how decisions will reflect the larger TRRP community.	

Governance Component Decision-Making Process **Subcomponent** Fair and transparent	**Subcomponent Description:** • *Definition* – Decisions made openly and basis for decisions made available. • TMC decisions are recorded in meeting minutes that are made publicly available and TMC meetings are open to the public. The basis for TRRP decision-making is often not clear.	
Performance Assessment	Structural: • The TMC makes decisions for the TRRP. Those decisions are voted on in public meetings and recorded in meeting minutes posted on the TRRP web site.	Functional: • Lack of clarity in TRRP goals and objectives, mistrust among TMC entities, and lack of inclusion of stakeholders does not provide a clear basis for Program decisions. • "Fairness" is a concern, given issues related to conflicts of interest in TMC decision-making, how Program funds are allocated, and how the Program measures its progress.
Consequences of Failure	• Suspicion of Program decisions, lack of understanding about why decisions were made and how those decisions relate to science learning and progress toward Program milestones.	
Consequence Rating (C)	**4**	
Likelihood of Failure	• Mixed. Decisions are made publicly and recorded via meeting minutes but the basis for those decisions is not always well-understood.	
Likelihood Rating (L)	**3**	
Risk Rating (CxL)	**12**	
AG/AM Risk Typology "Fit"	• Important to ensure decisions are open and well-understood, providing clear linkages to science learning and how management actions are adjusted accordingly.	
Recommendations for Reform	• Re-constitute the TMC to include some level of direct stakeholder involvement. • Consider development of an organizational charter for the TMC that specifies voting entities, voting processes, and how decisions will reflect the larger TRRP community and how decisions are to be informed by AM.	

Governance Component Decision-Making Process	Subcomponent Description: • *Definition* – Program decisions are made by consensus of the decision-making body. • The TMC operates on a super-majority basis.	
Subcomponent Consensus		
Performance Assessment	Structural: • TMC decisions are formalized via voting through a super-majority process. Six out of eight votes are required to formalize a decision.	Functional: • A super-majority ensures that no one entity can always stop TMC decision-making. • However, this also can cause a situation where one or two TMC entities are repeatedly dissatisfied with the outcome of voting and decision-making. That dissatisfaction can then be used to disrupt TRRP functions. • There is also the belief among some TRRP entities that while the TMC makes decisions, ultimately the TMC is only advisory to the Secretary of the Interior and that DOI really makes final TRRP decisions. • Most decision-making appears to be focused on budget related matters.
Consequences of Failure	• Constantly disaffected parties can find other ways to disrupt TRRP functions and express their dissatisfaction.	
Consequence Rating (C)	**4**	
Likelihood of Failure	• Consensus is not required for a program to make decisions and move forward but it should at least be the goal of TMC decisions to ensure consistent and supported decision-making. TRRP super-majority rules can get decisions close to consensus but there remains the possibility that one or two entities will always find themselves on the wrong side of TMC decisions.	
Likelihood Rating (L)	**4**	
Risk Rating (CxL)	**16**	
AG/AM Risk Typology "Fit"	• The hard work required to reach consensus decisions in large-scale programs like the TRRP is the best way forward to ensure AM information is carefully considered and wisely used in decision-making.	
Recommendations for Reform	• Establish clear consensus-based decision-making procedures for the TMC.	

Governance Component Decision-Making Process **Subcomponent** Decisions linked to goals/objectives	**Subcomponent Description:** • *Definition* – Decisions tied to the processes described in the foundational document and linked to Program goals and objectives. • Given the lack of clarity on the overall TRRP goal and related objectives, and the lack of an AM Plan for the TRRP, TMC decisions are only loosely-based at best on TRRP goals/objectives.	
Performance Assessment	Structural: • TMC decisions are generally made based on recommendations from the ED and Program staff, as well as the AEAM Team and advisory committees/work groups.	Functional: • Most TMC decisions at the current time revolved around annual budgets and how to allocate funds to TRRP projects, "legacy" projects, and TRRP science.
Consequences of Failure	• Failure to meet agreed-upon TRRP goals and objectives.	
Consequence Rating (C)	**5**	
Likelihood of Failure	• High, given the lack of TRRP-wide agreement on the overall goal and related objectives of the Program.	
Likelihood Rating (L)	**5**	
Risk Rating (CxL)	**25**	
AG/AM Risk Typology "Fit"	• Critical step for successful AM. • AM must be built around TRRP goals and objectives. Until this subcomponent is resolved, AM will not be successfully implemented in the TRRP.	
Recommendations for Reform	• Develop agreed-upon goals and objectives for the TRRP. • Build a TRRP AM Plan based on these goals and objectives.	

<table>
<tr><td>Governance Component
Decision-Making Process

Subcomponent
Dispute resolution</td><td colspan="2">Subcomponent Description:
• Definition – There is a means for resolving disputes and decisions that do not reach consensus.
• The TRRP operates on a super-majority basis and does not have a formal means for dispute resolution.</td></tr>
<tr><td>Performance Assessment</td><td>Structural:
• TMC decisions are made via super-majority vote (6 out of 8 votes) with no formal means for reaching consensus or resolving disputes.</td><td>Functional:
• Disaffected parties exist from vote to vote (for example, the two Tribes are often on the opposite side of super-majority votes) and are left to express that dissatisfaction via other means.</td></tr>
<tr><td>Consequences of Failure</td><td colspan="2">• As happens currently in the TRRP, parties that do not support super-majority votes remain disgruntled and believe their concerns and ideas are not fully understood and addressed by the TMC.</td></tr>
<tr><td>Consequence Rating (C)</td><td colspan="2">3</td></tr>
<tr><td>Likelihood of Failure</td><td colspan="2">• This is an extension of the consensus and shared-decision-making subcomponents. This subcomponent can be resolved in the TRRP by addressing those other subcomponents and establishing a process to reach consensus decisions.</td></tr>
<tr><td>Likelihood Rating (L)</td><td colspan="2">3</td></tr>
<tr><td>Risk Rating (CxL)</td><td colspan="2">9</td></tr>
<tr><td>AG/AM Risk Typology “Fit”</td><td colspan="2">• The hard work required to reach consensus decisions in large-scale programs like the TRRP is the best way forward to ensure AM information is carefully considered and wisely used in decision-making.</td></tr>
<tr><td>Recommendations for Reform</td><td colspan="2">• Establish clear consensus-based decision-making procedures for the TMC. This is the best remedy for dispute resolution, short of engaging in formal dispute resolution proceedings.</td></tr>
</table>

Governance Component Decision-Making Process **Subcomponent** Adapt to surprises	**Subcomponent Description:** • *Definition* – Program can respond to change and surprise (uncertainty). • This relates to the ability of the TRRP to adapt to surprises that arise on the landscape or that influence application of AM on the Trinity River.	
Performance Assessment	Structural: • The ED Office, AEAM Team and advisory committees/work groups handle technical matters for the Program and make recommendations to the TMC. • Any surprises on the landscape or in response to management actions would bubble up to the TMC for decision-making purposes through this technical structure.	Functional: • TRRP science is proceeding but not under an official AM Plan. • Surprises in river or fisheries response are not necessarily being anticipated by the Program.
Consequences of Failure	• Important for the TRRP (and any program) to retain the learning and decision-making flexibility to respond to surprises so that results from Program implementation are responsive to new conditions.	
Consequence Rating (C)	**3**	
Likelihood of Failure	• Not necessarily a failure of the entire TRRP but certainly could prove challenging to interpretation of AM implementation results if no preparations are made to deal with surprises.	
Likelihood Rating (L)	**4**	
Risk Rating (CxL)	**12**	
AG/AM Risk Typology "Fit"	• Important for implementation of true AM. • Respond to surprises in how the Trinity River or fisheries respond to management actions, new features on the landscape (like phragmites on the central Platte River), etc.	
Recommendations for Reform	• Develop and implement an agreed-upon AM Plan within a revised TRRP governance and decision-making structure.	

Governance Component Decision-Making Process **Subcomponent** Ability to incorporate learning into decision-making	**Subcomponent Description:** • *Definition* – Program can incorporate learning from implementation into decision-making. • The TRRP does not operate under a formal AM Plan so does not have a formal process or set procedures for using Program science learning as an input in decision-making.	
Performance Assessment	Structural: • The TMC makes decisions on how to spend Program funds on science projects, data analysis, and data synthesis. • There is no agreed-upon AM Plan or set of Big Questions and priority hypotheses.	Functional: • Proposals for individual TRRP science projects, data analysis, data synthesis, etc. are developed through the technical aspects of the Program and work their way up to the TMC for final approval (largely through the annual TRRP budget process). • Results are presented to the TMC in the form of reports and/or presentations, but the lack of an AM Plan and a lack of clarity about Program goals and objectives do not regularly facilitate using this learning to help make TRRP decisions.
Consequences of Failure	• Inability to successfully implement true AM.	
Consequence Rating (C)	**3**	
Likelihood of Failure	• The Program can function without this subcomponent being resolved but this is a critical step the TRRP will need to focus on if AM is to be implemented successfully.	
Likelihood Rating (L)	**4**	
Risk Rating (CxL)	**12**	
AG/AM Risk Typology "Fit"	• This is a fundamental requirement of successful AM. Inability to incorporate science learning into decision-making means TRRP science will continue to add to the "science pile" without becoming a useful input to decision-making.	
Recommendations for Reform	• Requires both a re-structuring of TRRP decision-making processes and development of a Program AM Plan.	

AM Component Assess **Subcomponent** Problem definition and agreement	**Subcomponent Description:** • *Definition* – Program has clear goals and objectives, and there is an agreed-upon definition of AM. • There is a lack of clarity within the TRRP on the overall goals and objectives of the Program and there is not an agreed-upon definition of AM or an AM Plan.	
Performance Assessment	Structural: • There is no agreed-upon Program goal statement. • There are numeric fish population goals, but most consider those values outdated or unachievable. • The TRRP is not bound by a timeline for making decisions or achieving goals or objectives. • There is no single, unifying foundational TRRP document that spells out the Program goal.	Functional: • There is a lack of clarity among TRRP decision-makers as to the overall Program goal and objectives. • Decisions at the TMC level focus on annual budget line items, not on making management decisions/adjustments based on Program data analysis and synthesis.
Consequences of Failure	• The consequences of not having a negotiated goal statement and tiered objectives are likely to prevent the TRRP from moving forward. Decisions will continue to focus on issues related to annual budget instead of decisions related to adjusting management based on Program learning and based on Program goals/objectives.	
Consequence Rating (C)	**5**	
Likelihood of Failure	• High – the TRRP currently does not have a single, agreed-upon goal statement and related objectives, and there does not appear to be a process or intent to fix this issue.	
Likelihood Rating (L)	**5**	
Risk Rating (CxL)	**25**	
AG/AM Risk Typology "Fit"	• Without clear goals/objectives, and without a decision-making process tied to clear goals/objectives, the TRRP is not going to be able to implement true AM. Even though the Program claims to be implementing at least some degree of AM, the likelihood of failure of this subcomponent are high and the consequences mean the TRRP is either conducting trial and error or, at best, TRRP AM is stuck.	
Recommendations for Reform	• Negotiate an agreed-upon Program goal and related tiered objectives. • Negotiate a single, unifying Program document that includes these goals and objectives, an AM Plan, structural and functional guidance for decision-making, etc.	

<table>
<tr><td>AM Component
Assess</td><td colspan="2" rowspan="2">Subcomponent Description:
• Definition – Program has an AM Plan that is related back to overall goals and objectives and that specifies what the Program does not know but wants to learn (priority hypotheses, critical uncertainties).
• There is a lack of clarity within the TRRP on the overall goals and objectives of the Program and there is not a Program AM Plan.</td></tr>
<tr><td>Subcomponent
Roadmap of goals, objectives, hypotheses</td></tr>
<tr><td>Performance Assessment</td><td>Structural:
• There is no agreed-upon Program goal statement.
• There are numeric fish population goals, but most consider those values outdated or unachievable.
• The TRRP is not bound by a timeline for making decisions or achieving goals or objectives.
• No Program AM Plan.
• The foundational documents and the IAP contain language that could serve as priority hypotheses for a TRRP AM Plan.</td><td>Functional:
• There is a lack of clarity among TRRP decision-makers as to the overall Program goal and objectives.
• Decisions at the TMC level focus on annual budget line items, not on making management decisions/adjustments based on Program data analysis and synthesis.
• TRRP science activities often relate back to the IAP and guidance in the ROD and Implementation Plan, but there is no agreed-upon set of hypotheses for the Program.</td></tr>
<tr><td>Consequences of Failure</td><td colspan="2">• The roadmap is critical to forward progress with AM in the TRRP; without it, AM will not proceed.</td></tr>
<tr><td>Consequence Rating (C)</td><td colspan="2">4</td></tr>
<tr><td>Likelihood of Failure</td><td colspan="2">• High – there is currently no roadmap for the TRRP that clearly spells out goals, objectives, and hypotheses, but here is raw language in the IAP and the foundational documents that can be used to build this roadmap.</td></tr>
<tr><td>Likelihood Rating (L)</td><td colspan="2">3</td></tr>
<tr><td>Risk Rating (CxL)</td><td colspan="2">12</td></tr>
<tr><td>AG/AM Risk Typology "Fit"</td><td colspan="2">• The TRRP will not be able to implement AM without this roadmap. Science activities will be proceeding more in a trial and error format.</td></tr>
<tr><td>Recommendations for Reform</td><td colspan="2">• Negotiate an agreed-upon Program goal and related tiered objectives.
• Negotiate a single, unifying Program document that includes these goals and objectives, an AM Plan, structural and functional guidance for decision-making, etc.</td></tr>
</table>

<table>
<tr><td>AM Component
Assess</td><td colspan="2" rowspan="2">Subcomponent Description:
• Definition – Program decisions are affected by science learning through the application of AM.
• TRRP decisions are based largely on annual funding priorities and are not solidly linked back to a set of Program goals, objectives, and hypotheses.</td></tr>
<tr><td>Subcomponent
Decisions affected by information</td></tr>
<tr><td>Performance Assessment</td><td>Structural:
• The TMC makes decision for the TRRP.
• TMC decision-making receives various levels of input from the ED/EDO, advisory committees and work groups, the TAMWG, and the SAB.</td><td>Functional:
• Decisions at the TMC level focus on annual budget line items, not on making management decisions/adjustments based on Program data analysis and synthesis and linked to an AM Plan.</td></tr>
<tr><td>Consequences of Failure</td><td colspan="2">• The TRRP cannot really function as a true restoration program unless its decisions are at least informed by science learning from the Program itself.</td></tr>
<tr><td>Consequence Rating (C)</td><td colspan="2">4</td></tr>
<tr><td>Likelihood of Failure</td><td colspan="2">• Mixed – the TMC does take in information from the implementation of TRRP science activities, but it is not structured around an AM Plan.</td></tr>
<tr><td>Likelihood Rating (L)</td><td colspan="2">3</td></tr>
<tr><td>Risk Rating (CxL)</td><td colspan="2">12</td></tr>
<tr><td>AG/AM Risk Typology “Fit”</td><td colspan="2">• Clear linkages between decision-making and science learning need to be built and implemented in the TRRP to ensure the Program is actually implementing AM.</td></tr>
<tr><td>Recommendations for Reform</td><td colspan="2">• Negotiate an agreed-upon Program goal and related tiered objectives.
• Negotiate a single, unifying Program document that includes these goals and objectives, an AM Plan, structural and functional guidance for decision-making, etc.</td></tr>
</table>

<table>
<tr><td>AM Component
Assess</td><td rowspan="2">Subcomponent Description:
• Definition – Program has a collaborative process for developing an AM Plan, link it back to goals and objectives, and reach agreement on critical uncertainties, hypotheses, and related Big Questions.
• The TRRP has not initiated a collaborative process to develop a Program AM Plan and focus efforts to reach agreement on critical uncertainties and how to address them.</td></tr>
<tr><td>Subcomponent
Collaborative process to develop fundamental AM information.</td></tr>
<tr><td>Performance Assessment</td><td>Structural:
• The foundational documents and IAP provide much of the raw material necessary to build a TRRP AM Plan.

Functional:
• The foundational documents (TRFE, ROD, Implementation Plan) were not negotiated or built through a collaborative process of all key TRRP parties.
• The IAP was developed in a more collaborative manner but has never been formally adopted by the TMC.</td></tr>
<tr><td>Consequences of Failure</td><td>• Top-down development of the foundational documents and lack of agreement on the IAP will continue to serve as a significant roadblock to TRRP success.</td></tr>
<tr><td>Consequence Rating (C)</td><td>5</td></tr>
<tr><td>Likelihood of Failure</td><td>• High – there currently is not Program-wide buy-in on TRRP goals, objectives, hypotheses, or a path forward for AM.</td></tr>
<tr><td>Likelihood Rating (L)</td><td>5</td></tr>
<tr><td>Risk Rating (CxL)</td><td>25</td></tr>
<tr><td>AG/AM Risk Typology “Fit”</td><td>• AM will only work in a large-scale program like the TRRP if the AM Plan is developed collaboratively.</td></tr>
<tr><td>Recommendations for Reform</td><td>• Negotiate an agreed-upon Program goal and related tiered objectives.
• Negotiate a single, unifying Program document that includes these goals and objectives, an AM Plan, structural and functional guidance for decision-making, etc.</td></tr>
</table>

AM Component Design	**Subcomponent Description:** • *Definition* – Program has explicit management objectives that are measurable statements of outcomes the Program is trying to achieve that should facilitate evaluation of AM effectiveness. • Several TRRP documents includes language that could form specific management objectives (including the TRFE and the IAP) but this language needs to be unified and tied back to TRRP goals, objectives, and an AM Plan.	
Subcomponent Management objectives		
Performance Assessment	Structural: • The TRFE contains a set of what can be described as management objectives. • The IAP includes a set of six "primary objectives" that can be identified as management objectives for the TRRP.	Functional: • TRRP implementation at this point focuses more on three higher-order objectives from the foundational documents – annual flow regime, mechanical channel rehabilitation, and sediment management.
Consequences of Failure	• Implementation of AM or science activities without a clear measuring stick for progress or success, or for a pathway to serving as an input for decision-making.	
Consequence Rating (C)	**3**	
Likelihood of Failure	• Focus on the three higher-order objectives indicates a lack of agreement on an agreed-upon set of management objectives that can focus the work of evaluating the progress of AM in the TRRP.	
Likelihood Rating (L)	**3**	
Risk Rating (CxL)	**9**	
AG/AM Risk Typology "Fit"	• AM can function without management objectives, but it will be stuck or slow without some measure of progress and next steps.	
Recommendations for Reform	• Develop a clear set of management objectives as part of the collaborative development of a TRRP AM Plan.	

AM Component Design **Subcomponent** Management actions	**Subcomponent Description:** • *Definition* – Program has a set of management actions, has authority to implement those actions, and implementation is linked to science learning as an input in Program decision-making. • The ROD and Implementation Plan provide guidance on implementing an annual flow regime, mechanical channel rehabilitation, and sediment management as TRRP management actions, but those actions are not currently implemented against clear goals, objectives, and an AM Plan.	
Performance Assessment	Structural: • The ROD and Implementation Plan specify annual flow volumes, 47 project sites for channel rehabilitation and side-channel rehabilitation, and sediment introduction volumes.	Functional: • These actions are being implemented but not in the context of an AM Plan or against a clear set of TRRP goals and objectives.
Consequences of Failure	• Implementation without a measure of progress/success.	
Consequence Rating (C)	**2**	
Likelihood of Failure	• Specific management actions present for the TRRP, just need to be linked to an AM Plan, hypotheses, and an evaluation plan against TRRP goals and objectives.	
Likelihood Rating (L)	**2**	
Risk Rating (CxL)	**4**	
AG/AM Risk Typology "Fit"	• The specified management actions fit well within a general AM context; they just need to be implemented within the context of a TRRP AM Plan.	
Recommendations for Reform	• Develop a TRRP AM Plan.	

AM Component Design **Subcomponent** Monitoring/research protocols tailored to hypotheses and key questions from decision-makers	**Subcomponent Description:** • *Definition* – Program developed its own monitoring/research protocols that are designed to deliver information relative to key hypotheses and questions from decision-makers. • The TRRP does implement monitoring and research but not clearly in the context of agreed-upon goals, objectives, hypotheses, and Big Questions that relate to questions from the TMC important for decision-making.	
Performance Assessment	Structural: • The TRRP has a strong track record of project-specific and species monitoring and research. • Most monitoring is related to implementation of the major TRRP "management actions" – annual flow volumes, rehabilitation projects, and sediment introduction.	Functional: • Monitoring and research are implemented based on annual projects and their intended objectives, rather than being implemented to deliver information useful in decision-making related to TRRP goals, objectives, and hypotheses.
Consequences of Failure	• Monitoring data will fall into an ever-expanding "science pile" and will not be operationalized for TRRP decision-making.	
Consequence Rating (C)	**3**	
Likelihood of Failure	• The TRRP has high technical capacity and the funding necessary to implement appropriate monitoring/research; just need to link this data collection back to overall goals, objectives, and hypotheses.	
Likelihood Rating (L)	**3**	
Risk Rating (CxL)	**9**	
AG/AM Risk Typology "Fit"	• This is a common place where AM program get stuck – they conduct good science in the form of monitoring and research but fail to specify the "why" in advance so collected data is often not useful for decision-making.	
Recommendations for Reform	• Collaboratively develop a TRRP AM Plan, specify data needs for decision-maker questions, and develop or revise monitoring protocols to deliver this information.	

AM Component Implement	**Subcomponent Description:** • *Definition* – Program has a clear process for implementing management actions and monitoring. • The TRRP is proceeding with management actions and monitoring on the ground but that implementation is not linked back to an agreed-upon AM Plan.	
Subcomponent Plan for implementation of management actions and monitoring		
Performance Assessment	Structural: • The Implementation Plan provides the best information on Program structure and operation, including specifying roles for the ED/EDO and the AEAM Team.	Functional: • The guidance provided in the Implementation Plan has thus far not served to help build and operate a truly collaborative program that is functioning in a manner that can support implementation of an AM Plan and related TMC decision-making.
Consequences of Failure	• Implementation without decision-making, and without an ability for the TRRP to measure its progress toward achieving goals and objectives.	
Consequence Rating (C)	**3**	
Likelihood of Failure	• The Implementation Plan currently serves as the best statement of structure and function for the TRRP, and the Program has operated in this way for many years. That structure will have to be adjusted to accommodate development and implementation of a TRRP AM Plan and to better facilitate TMC decision-making.	
Likelihood Rating (L)	**3**	
Risk Rating (CxL)	**9**	
AG/AM Risk Typology "Fit"	• As with monitoring protocols, this is also a common place where AM program get stuck – they conduct good science in the form of monitoring and research but fail to specify the "why" in advance so collected data is not well-linked back to goals, objectives, and related decision-making.	
Recommendations for Reform	• Collaboratively develop a TRRP AM Plan, specify data needs for decision-maker questions, and develop an implementation plan to deliver this information to decision-makers.	

<table>
<tr><td>AM Component
Implement</td><td rowspan="2">Subcomponent Description:
• Definition – Program has clear lines of authority for implementation and oversight.
• In general, the ED and Program staff are responsible for day-to-day implementation of the TRRP, though several TMC entities are also involved in implementation and evaluation.</td><td></td></tr>
<tr><td>Subcomponent
Project oversight</td><td></td></tr>
<tr><td>Performance Assessment</td><td>Structural:
• The ED and EDO provide day-to-day oversight of TRRP implementation.
• Project-specific oversight of TRRP management actions are often overseen by a mix of EDO staff and TRRP partner staff.</td><td>Functional:
• There is tension within the EDO given the split of federal agency representation (Reclamation and Service) and the presence of TRRP partner staff.
• Project oversight seems to be handled on a case-by-case basis with different levels of oversight by and involvement of TRRP partner staff.</td></tr>
<tr><td>Consequences of Failure</td><td colspan="2">• Lengthening of time for implementation, time lags, incomplete or confused implementation, difficulty in collecting and analyzing data relative to Program goals, objectives, and hypotheses.</td></tr>
<tr><td>Consequence Rating (C)</td><td colspan="2">4</td></tr>
<tr><td>Likelihood of Failure</td><td colspan="2">• Relatively high because the management model for the TRRP does not seem to revolve around a strong and unified ED and Program staff.</td></tr>
<tr><td>Likelihood Rating (L)</td><td colspan="2">4</td></tr>
<tr><td>Risk Rating (CxL)</td><td colspan="2">16</td></tr>
<tr><td>AG/AM Risk Typology “Fit”</td><td colspan="2">• AM is hard work for a long time. It requires a dedicated staff to ensure that the right questions are being addressed, the right work is being implemented, and the right data are collected and analyzed.</td></tr>
<tr><td>Recommendations for Reform</td><td colspan="2">• Revise the ED and EDO structure of the TRRP to ensure unified implementation and oversight of all Program activities in an “honest broker” manner.
• Revise the involvement of TRRP partners to decision-making on the TMC and advisory through standing committees, not as participants in TRRP implementation and oversight.</td></tr>
</table>

AM Component Monitor	**Subcomponent Description:**
Subcomponent Implementation, effectiveness, and validation monitoring	• *Definition* – Implementation monitoring: designed to evaluate if a project/management action is implemented as intended; effectiveness monitoring: designed to evaluate how successful a project or management action is at achieving desired or expected outcomes; validation monitoring: designed to evaluate the response of species or river/form function to implementation of management actions. • The TRRP conducts implementation and effectiveness monitoring but does not conduct clear validation monitoring due to lack of clarity in overall goals and objectives and lack of an AM Plan that links science learning back to goals, objectives, hypotheses, Big Questions, and decision-making.
Performance Assessment	Structural: • The TRRP has a strong track record of project-specific and species monitoring and research. • Most monitoring is related to implementation of the major TRRP "management actions" – annual flow volumes, rehabilitation projects, and sediment introduction. Functional: • Monitoring and research are implemented based on annual projects and their intended objectives (implementation and effectiveness), rather than being implemented to deliver information useful in decision-making related to TRRP goals, objectives, and hypotheses (validation).
Consequences of Failure	• The consequences of not having a negotiated goal statement and tiered objectives are likely to prevent the TRRP from moving forward. Decisions will continue to focus on issues related to annual budget instead of decisions related to adjusting management based on Program learning and based on Program goals/objectives.
Consequence Rating (C)	**4**
Likelihood of Failure	• The TRRP has high technical capacity and the funding necessary to implement appropriate monitoring/research; just need to link this data collection back to overall goals, objectives, and hypotheses.
Likelihood Rating (L)	**4**
Risk Rating (CxL)	**16**
AG/AM Risk Typology "Fit"	• Without validation monitoring, the TRRP will struggle to use Program data to help make decisions and evaluate progress against agreed-upon goals and objectives.
Recommendations for Reform	• Collaboratively develop an AM Plan that provides clear linkages between Program science and decision-making.

AM Component Evaluate **Subcomponent** Data analysis	**Subcomponent Description:** • *Definition* – Analysis and reporting of Program monitoring data. • The TRRP conducts rigorous science and has conducted a good amount of data analysis to date.	
Performance Assessment	Structural: • Strong collection and analysis of implementation and effectiveness monitoring data.	Functional: • Some analysis of validation monitoring data, but there is a lack of consensus about data collection and analysis methods for key metrics such as fish population numbers.
Consequences of Failure	• Disconnect between implementation and decision-making. • Failure of this subcomponent creates a critical missing link between AM steps.	
Consequence Rating (C)	**2**	
Likelihood of Failure	• Low, in general this is a strong suit of the TRRP; just need to focus some attention on analysis of fish-related metrics.	
Likelihood Rating (L)	**2**	
Risk Rating (CxL)	**4**	
AG/AM Risk Typology "Fit"	• Needs to be strong to ensure Program data is being operationalized for implementation of AM.	
Recommendations for Reform	• Collaboratively develop an AM Plan that links data analysis to evaluation of hypotheses and ultimately decision-making.	

AM Component Evaluate	Subcomponent Description:	
Subcomponent Data synthesis	• *Definition* – Telling the "story" of AM. Stitching together multiple lines of evidence to provide an evaluation of the overall effects and outcomes of Program implementation. • In 2017, the TRRP began to tackle data synthesis efforts though it remains unclear how, or if, these efforts unifying multiple lines of Program evidence and the results of data synthesis will be reported to the TMC and used in decision-making.	
Performance Assessment	Structural: • The TRRP began the process of developing several data synthesis reports in 2017.	Functional: • It is not clear how the TRRP synthesis reports now in development fit together to tell a full "story" of AM implementation, and how the conclusions of these efforts will link to TMC decision-making.
Consequences of Failure	• Inability to effectively use Program science learning in the decision-making process – without synthesis, the TRRP cannot link the results of management actions and collected monitoring data to goals, objectives, Big Questions, and hypotheses.	
Consequence Rating (C)	**4**	
Likelihood of Failure	• The TRRP is aware of the need for data synthesis and has begun the effort, but the purpose and objectives of the ongoing synthesis effort needs attention as it relates to TRRP goals, objectives, and hypotheses.	
Likelihood Rating (L)	**4**	
Risk Rating (CxL)	**16**	
AG/AM Risk Typology "Fit"	• A critical step in AM – large programs collect multiple lines of evidence and stitching these multiple lines of evidence into an AM "story" is the only way to complete all six steps of AM, particularly the Adjust stage which is depending on decision-making informed by AM science learning.	
Recommendations for Reform	• Collaboratively develop an AM Plan that links data analysis to evaluation of hypotheses and ultimately decision-making.	

AM Component Evaluate	**Subcomponent Description:** • *Definition* – Integration of independent science review (science panel, peer review, publication) into the process of Program data analysis and synthesis. • The SAB provides independent science review for the TRRP, and there is also project-by-project peer review of TRRP work proposals. Linkages to the TMC and the utility of this review as a factor in TMC decision-making are not robust or well-understood.	
Subcomponent Independent science review		
Performance Assessment	Structural: • The TRRP has a standing independent science review panel in the form of the SAB. • Independent peer review is utilized at least at the project review level when the Program is attempting to prioritize annual work and budgets. • The TRRP has successfully published on topics such as sediment introduction.	Functional: • The SAB is underutilized, and no clear linkages exist between the SAB and the TMC. • SAB work is conducted at the request of the Science Coordinator but does not seem to operate under a specific TRRP charter or an annual work plan approved by the TMC. • Peer review is utilized at the project review/planning stage but does not seem to be regularly used to evaluate TRRP data analysis and/or synthesis reports.
Consequences of Failure	• Even when a program like the TRRP has strong internal technical capacity, the lack of functioning independent science review reduces the robustness and certainty of conclusions and decisions related to Program data analysis and synthesis.	
Consequence Rating (C)	**4**	
Likelihood of Failure	• Independent science review is being utilized by the TRRP, but it is not being made effective as an input into TMC decision-making.	
Likelihood Rating (L)	**4**	
Risk Rating (CxL)	**16**	
AG/AM Risk Typology "Fit"	• An important step in functioning AM – ensures more robust and valid conclusions and thus related decisions.	
Recommendations for Reform	• As part of a negotiated Program document, develop a charter for the SAB that includes its relationship to the TMC. • Develop TRRP peer review guidelines and empower the ED and Program staff to implement peer review with TMC approval.	

AM Component Adjust	**Subcomponent Description:** • *Definition* – Information from data synthesis and independent science review are communicated to decision-makers as an input into Program decision-making, with the result being clear management decisions that include science learning as an important input. • This subcomponent is in limbo for the TRRP unless and until an AM Plan is developed and a process is determined for synthesizing Program data, communicating it to the TMC, and having the TMC make decisions with this information as an input.	
Subcomponent AM results communicated to decision-makers and used in decision-making		
Performance Assessment	Structural: • AM is not really being implemented in the TRRP, so science learning communicated to the TMC comes in the form of individual project reports.	Functional: • Without TRRP clarity on overall goals and objectives, and without an AM Plan that specifies priority hypotheses and addresses scientific and technical Big Questions of relevance to the TMC, this subcomponent remains largely non-functional.
Consequences of Failure	• AM will continue to not be implemented, or if earlier steps are not implemented the TRRP will not be able to reach the "Adjust" step.	
Consequence Rating (C)	**5**	
Likelihood of Failure	• This subcomponent will remain in failure until the TRRP addresses its larger structural problems and develops an agreed-upon AM Plan.	
Likelihood Rating (L)	**5**	
Risk Rating (CxL)	**25**	
AG/AM Risk Typology "Fit"	• True AM can only be successfully implemented if a program can adjust based at least in part on its science learning.	
Recommendations for Reform	• Negotiate an agreed-upon Program goal and related tiered objectives. • Negotiate a single, unifying Program document that includes these goals and objectives, an AM Plan, structural and functional guidance for decision-making, etc.	

AM Component Adjust	**Subcomponent Description:** • *Definition* – Public reporting of the Program decision-making process, with clear and repeated reporting of how, or if, management actions and implementation are adjusted utilizing Program science learning through AM. • This subcomponent is in limbo for the TRRP unless and until an AM Plan is developed and a process is determined for synthesizing Program data, communicating it to the TMC, and having the TMC make decisions with this information as an input.	
Subcomponent Documentation of decision-making results		
Performance Assessment	Structural: • Decision-making results are reported largely in the form of TMC minutes. • There is TRRP reporting but it is focused on project-by-project results and does not yet come in the form of synthesis reports. • The TRRP began the process of some synthesis reporting in 2017.	Functional: • TMC decision-making at this point generally centers around annual budget priorities. • Though the TRRP has begun the process of synthesis reporting, it is not clear how those synthesis reports relate to TMC questions or decision-making.
Consequences of Failure	• Loss of TMC decision-making record, lack of transparency about how and why the TMC made management decisions.	
Consequence Rating (C)	**3**	
Likelihood of Failure	• The TRRP has the capacity for multiple levels of reporting. The TMC needs to be empowered to make management decisions under a revised structure that can then be memorialized in final reporting.	
Likelihood Rating (L)	**3**	
Risk Rating (CxL)	**9**	
AG/AM Risk Typology "Fit"	• Important to memorialize the results of full implementation of AM through the Adjust step.	
Recommendations for Reform	• As part of development of a TRRP AM Plan, specify Big Questions of relevance to the TMC and provide guidance on how implementation and data analysis/synthesis will be communicated to and used by the TMC.	

APPENDIX G. Restoration Program Evaluation Framework Data Output Tables for PRRIP AG and AM – Performance Assessment, Risk Assessment, Typology Fit, and Recommendations for Program Reform.

<table>
<tr><td>AG Component
Legitimacy</td><td colspan="2" rowspan="2">Subcomponent Description:
• Definition – Program is accountable and enabled with decision responsibility.
• The PRRIP is an official federal river restoration program that is legitimate and accountable as directed by the negotiated Final Program Document (with the Extension Addendum); Program Agreement signed by the Secretary of the Interior and the Governors of Colorado, Wyoming, and Nebraska; and Congressional legislation. The PRRIP is enabled with decision responsibility through the Program Document and related legislation.</td></tr>
<tr><td>AG Subcomponent
Accountability</td></tr>
<tr><td>Performance Assessment</td><td>Structural:
• The Final Program Document is the ultimate statement of PRRIP authority and was negotiated by the Program partners.
• PRRIP is implemented in 13-year increments. The First Increment is complete (2007-2019) and Congress approved a 13-year Extension of the First Increment in late 2019 keeping the PRRIP functional through 2032.
• Funding has been relatively stable over the years and tightly linked to the Program goal, First Increment Objectives, and management objectives in the AMP.</td><td>Functional:
• The PRRIP is being implemented, has a full independent Program staff, and has a decision-making body in the GC.
• Decisions at the GC level are made regarding budget priorities, management actions, land and water acquisition, direction of Program activities, and other priorities.
• Some lack of clarity on what “recovery” means. The PRRIP is an official endangered species Recovery Implementation Program (RIP), similar in nature to several other Bureau of Reclamation RIPs. But there is disagreement among GC members about the extent to which the Program is responsible for species recovery and what that means.</td></tr>
<tr><td>Consequences of Failure</td><td colspan="2">• Generally, very low because of the existence of the negotiated and agreed-to Program Document, Extension Addendum, and support of Program partners, Governors, the Secretary of the Interior, legislators, and the public.
• The issue of defining recovery</td></tr>
<tr><td>Consequence Rating (C)</td><td colspan="2">2</td></tr>
<tr><td>Likelihood of Failure</td><td colspan="2">• Very low. The PRRIP has clearly-established goals and objectives, a single, unifying foundational document (Final Program Document), and fully-functional decision-making body (GC), a fully-functional independent Executive Director’s Office, and a history of demonstrated success.
• While the issue of differing definitions of recovery is still present among GC members, it has not impeded program progress or success thus far and did not stop successful adoption of the 13-year Extension.</td></tr>
<tr><td>Likelihood Rating (L)</td><td colspan="2">1</td></tr>
<tr><td>Risk Rating (CxL)</td><td colspan="2">2</td></tr>
<tr><td>AG/AM Risk Typology “Fit”</td><td colspan="2">• Very low risk for this AG subcomponent. Given the clear legislative and administrative history of the PRRIP and support for the PRRIP, the presence of a single Program Document negotiated by the Program partners, and a fully-functioning decision-making body, independent staff, technical advisory committees, independent science review, and other functional and structural components of a strong restoration program, the PRRIP is an example of governance adaptation to the situational context that has enabled decision-making and AM to succeed.</td></tr>
<tr><td>Recommendations for Reform</td><td colspan="2">• Continue to implement the Program Document and Extension Addendum. A model program for consideration by other restoration programs in linking AG and AM.
• Some attention should be paid to the issue of what “recovery” means for the Program, whether the Program will be held accountable for meeting certain metrics of species recovery, and if so how to set those metrics.</td></tr>
</table>

<table>
<tr><td>Governance Component
Legitimacy</td><td colspan="2" rowspan="2">Subcomponent Description:
Definition – Program is responsive to constituencies both above and below the level of the decision-making body.
The PRRIP is a public program affecting resources with direct links to local landowners in Nebraska, water users, and communities. The Program is authorized and funded through state and federal legislation and is managed by a collaborative decision-making body (GC) that includes stakeholders (waters users and environmental entities) at the decision-making table with federal and state agency representatives.</td></tr>
<tr><td>Subcomponent
Responsiveness to constituencies</td></tr>
<tr><td>Performance Assessment</td><td>Structural:
The PRRIP decision-making body is the Governance Committee (GC) which is comprised of federal and state agencies, waters users, and environmental entities.
Below the GC, technical advisory committees are also structured in a similar collaborative manner.
Landowners in Nebraska are part of the Land Advisory Committee.</td><td>Functional:
All meetings of the GC and technical advisory committees are open to the public. All information (meeting agendas, meeting documents, etc.) are made widely available on the Program's web site.
Annual funding (primarily federal funds, with some funding from Colorado and Wyoming) remains consistent. The GC approves the annual budget in December of each year following extensive discussion of draft budget priorities at open public meetings of the technical advisory committees.
River landowners in Nebraska are part of the Land Advisory Committee.
The Program acquires land in fee title and pays market rates based on appraisal. The Program pays taxes on all land holdings like any private landowner.
The Platte River Recreation Access Program opens up Program land to outdoor recreation activities such as hunting and fishing to the public.</td></tr>
<tr><td>Consequences of Failure</td><td colspan="2">The current structure and function of the PRRIP keep the consequence risk of this AG subcomponent causing the Program to slow or fail very low.
Program entities remain open to considering changes in structure or adding additional partners depending if and when necessary.</td></tr>
<tr><td>Consequence Rating (C)</td><td colspan="2">2</td></tr>
<tr><td>Likelihood of Failure</td><td colspan="2">Very low because constituencies like water users, environmental entities, and landowners are part of the decision-making and deliberative structure and function of the PRRIP. The PRRIP operates as a member of the community on the central Platte River in terms of land acquisition and management.
Given current openness to exploring the addition of partners if necessary, low likelihood of failure due to any constituency being left out.</td></tr>
<tr><td>Likelihood Rating (L)</td><td colspan="2">1</td></tr>
<tr><td>Risk Rating (CxL)</td><td colspan="2">2</td></tr>
<tr><td>AG/AM Risk Typology "Fit"</td><td colspan="2">Very low risk for this AG subcomponent. Public involvement in all aspects of the Program and shared decision-making help to keep this aspect of AG in the PRRIP strong.</td></tr>
<tr><td>Recommendations for Reform</td><td colspan="2">Continue to operate as an open, collaborative restoration program.
Keep an eye on the need for potential changes in representation on the GC and/or advisory committees over time.</td></tr>
</table>

<table>
<tr><td>Governance Component
Structure/Capacity

Subcomponent
Polycentric</td><td colspan="2">Subcomponent Description:
• Definition – Polycentric organizational structure with a centralized decision-making body but with explicit support from advisory committees and appropriate levels of authority.
• PRRIP decisions are made on a consensus basis by the GC. The GC receives input from the Technical Advisory Committee (TAC), Water Advisory Committee (WAC), Land Advisory Committee (LAC), and Independent Scientific Advisory Committee (ISAC). The Program is guided by an independent Executive Director and staff.</td></tr>
<tr><td>Performance Assessment</td><td>Structural:
• The GC is the decision-making body for the PRRIP.
• The “Signatories” include the two Department of the Interior agencies (Bureau of Reclamation and U.S. Fish and Wildlife Service) and the three states (CO, WY, and NE). One “no” vote from a Signatory can stop a decision from moving forward but that has not occurred in the Program’s 13-year history so far. All decisions at the GC level are successfully made on a consensus basis.
• All GC entities operate under a charter that describes how GC members are to be selected, who they represent, and provide guidance to Program entities for coordination and communication to occur within those entities.
• The PRRIP chose to hire an independent Executive Director (not an employee of any PRRIP entity) who then created a small consulting company (Headwaters) to bring on Program staff.
• The PRRIP is an official restoration program but because of its unique structure and collaborative nature does not identify as a typical federal restoration program.</td><td>Functional:
• The GC is inclusive of key federal and state agencies but also includes stakeholders (water users, environmental entities) at the decision-making table.
• The Executive Director’s Office remains independent from all Program entities and operates in an “honest broker” role. This is a unique feature of the PRRIP not replicated in any other major restoration program in the U.S.
• Decision-making in the PRRIP has been delegated down to representatives who are closest to the resource but who also have the authority and responsibility to make binding decisions.
• Some concern about (but openness to) the need to always consider whether all constituencies are being fairly represented (river landowners, conservation groups from CO and WY, lower Platte River entities, etc.).</td></tr>
<tr><td>Consequences of Failure</td><td colspan="2">• While the PRRIP may not completely represent the ideals of polycentrism as first identified by Elinor Ostrom, its structure and function have been adapted to fit the resource and the social capital of the entities involved.</td></tr>
<tr><td>Consequence Rating (C)</td><td colspan="2">2</td></tr>
<tr><td>Likelihood of Failure</td><td colspan="2">• Very low risk of failure. The current structure and function of the PRRIP represent a strong approximation of what polycentrism can look like in a major U.S. restoration program.</td></tr>
<tr><td>Likelihood Rating (L)</td><td colspan="2">1</td></tr>
<tr><td>Risk Rating (CxL)</td><td colspan="2">2</td></tr>
<tr><td>AG/AM Risk Typology “Fit”</td><td colspan="2">• The structure and function of the PRRIP relative to this subcomponent would suggest that AM, if structured and managed correctly, could succeed at this large scale.</td></tr>
<tr><td>Recommendations for Reform</td><td colspan="2">• Consider adding or changing partnership representation over time, as necessary.</td></tr>
</table>

Governance Component Structure/Capacity	Subcomponent Description:	
Subcomponent Coordination and Communication	• *Definition* – Clear and regular coordination and communication among and between governance levels within the Program. • The ED and staff are responsible for most coordination and communication within the PRRIP. This includes coordinating upward to the GC from technical advisory committees and independent science review processes, and downward from the GC to technical advisory committees and the public.	
Performance Assessment	Structural: • The coordination (and communication) of the PRRIP is specified in the Final Program Document. • The GC is the decision-making body and the ED and staff implement the Program on behalf of the GC. • The ED Office (EDO) is comprised of independent staff hired and managed by the Executive Director. • All meetings are open to the public (GC and advisory committees) and all meeting agendas, minutes, and supporting documents are publicly-available via the Program's web site. • The ED Office coordinates public outreach and communications and represents the Program at numerous conferences, public events, and educational opportunities throughout the year.	Functional: • Strong communication within and between the EDO, GC, advisory committees, and the public. • The advisory committees have maintained their role of discussing the more technical aspects of land management, water management, and habitat management and science, reporting up to the GC with recommendations based on that technical expertise. The advisory committees operate under charters contained in the Final Program Document that provide guidance on membership, operations, and issues. • The ISAC reports to the GC annually on issues related to implementation and review of AM. • There is regular communication between and coordination among GC entities before and between meetings to discuss issues of significance. • The PRRIP has maintained its own website since 2007 and it was updated in 2018 to provide a more useful central repository of Program events and current and historical Program information. • General feeling within the Program that communication processes and structures are strong and working well. • Need to be mindful of complacency – letting the EDO do too much, making sure all advisory committees are engaged and providing input to the GC, etc.
Consequences of Failure	• No significant concerns raised about the structure and function of communication and coordination within the Program.	
Consequence Rating (C)	**2**	
Likelihood of Failure	• Very low risk of failure. Open communication at all levels.	
Likelihood Rating (L)	**1**	
Risk Rating (CxL)	**2**	
AG/AM Risk Typology "Fit"	• Low risk for this AG subcomponent, important part of facilitating successful AM.	
Recommendations for Reform	• Continue to operate as described in the Program Document and according to processes developed and implemented during the First Increment. • Watch for complacency and make sure all advisory committees are engaged and functioning.	

<table>
<tr><td>Governance Component
Structure/Capacity</td><td colspan="2" rowspan="2">Subcomponent Description:
• Definition – Scale of Program represents manageable geography on the ground and is tied to relevance of key decision-makers.
• PRRIP management actions are focused on a 90-mile reach in central Nebraska. This area, called the Associated Habitat Reach (AHR), is the focal area because of its historic use by and administrative designation as critical habitat by the target bird species – whooping crane, interior least tern, piping plover.
• The scale matches the bioregion in terms of species use/occurrence and contribution of water to the Platte River – Platte water is largely snowmelt from the Rocky Mountains that originates in Colorado and then flows through the eastern plains of Colorado and through a system of federal reservoirs in Wyoming into Nebraska.
• A reach of the lower Platte River between the confluence with the Elkhorn River and the mouth at the Missouri River is also considered part of the AHR because of the presence of the fourth Program target species, the pallid sturgeon.</td></tr>
<tr><td>Subcomponent
Scale (geography)</td></tr>
<tr><td>Performance Assessment</td><td>Structural:
• The focus of PRRIP habitat and land acquisition and management is the 90-mile stretch of river in central Nebraska between Lexington and Chapman.</td><td>Functional:
• While the PRRIP focuses its work on the AHR in central Nebraska, the Program's success/failure in terms of contributions to the recovery of the target species is highly influenced by the fact that all three bird species are migratory and are impacted by the condition of wintering grounds, actions along the migratory pathway, weather events, climate change, etc.
• The Program continues to struggle with how to incorporate the pallid sturgeon into the actions of the Program and as written, the Program Document does not contemplate direct management activity outside of the AHR in central Nebraska, including on the AHR reach on the lower Platte.</td></tr>
<tr><td>Consequences of Failure</td><td colspan="2">• Generally low rise, as strong linkages have been built between the bioregion of the Program, the AG structure and function, and the use/occurrence of the three target bird species.
• Key point of potential risk is ongoing failure of PRRIP to address pallid sturgeon as target species in a meaningfully similar way as it has addressed the target bird species.</td></tr>
<tr><td>Consequence Rating (C)</td><td colspan="2">3</td></tr>
<tr><td>Likelihood of Failure</td><td colspan="2">• Moderate risk that pallid sturgeon issues will be unresolved during the Extension which may pose a challenge for the PRRIP in terms of its evaluation against the Service's Biological Opinion (BO).</td></tr>
<tr><td>Likelihood Rating (L)</td><td colspan="2">3</td></tr>
<tr><td>Risk Rating (CxL)</td><td colspan="2">9</td></tr>
<tr><td>AG/AM Risk Typology "Fit"</td><td colspan="2">• Generally, a positive example of the admonition to match the AG structure to the bioregion in question. Pallid sturgeon uncertainty adds some measure of risk to the typology evaluation for this subcomponent.</td></tr>
<tr><td>Recommendations for Reform</td><td colspan="2">• General bioregional AG match.
• Continued effort to identify if and how to better integrate pallid sturgeon into the PRRIP as a target species in the way that the whooping crane, tern, and plover have been addressed through the AMP.</td></tr>
</table>

<table>
<tr><td>Governance Component
Structure/Capacity</td><td colspan="2" rowspan="2">Subcomponent Description:
• Definition – The Program is bound by a time scale that will allow tracking of progress toward milestones and achievement of goals/objectives.
• The PRRIP was negotiated to operate in a series of 13-year increments. The First Increment was 2007-2019 and in 2019 Congress approved a 13-year Extension of the First Increment through the year 2032.</td></tr>
<tr><td>Subcomponent
Scale (time)</td></tr>
<tr><td>Performance Assessment</td><td>Structural:
• The length of the time increments (13 years) was negotiated by Program participants. That increment is roughly one-third of the time of the 40-year FERC license for Kingsley Dam on the North Platte River in western Nebraska (the relicensing process for Kingsley Dam was the impetus for the Program).
• The PRRIP operates on an annual basis in terms of projects and funding.
• Reclamation provides annual appropriations, if approved by Congress, through its agency budget.
• Colorado and Wyoming provide some Program funding that is not tied to an annual appropriation.</td><td>Functional:
• The PRRIP has established budgeting, policy, and AM procedures that ensure timely decisions are made relative to evaluating Program performance against goals and objectives.
• The time increment is not biological in nature (for example, tied to some kind of reproductive success timeline for one of the target bird species) but so far has proven long enough to provide meaningful data to help the Program address critical uncertainties through AM.</td></tr>
<tr><td>Consequences of Failure</td><td colspan="2">• Low risk of failure, the time increments used by the Program are negotiated and have been successfully used to organize Program science and policy decision-making.</td></tr>
<tr><td>Consequence Rating (C)</td><td colspan="2">1</td></tr>
<tr><td>Likelihood of Failure</td><td colspan="2">• Low likelihood of failure, the 13-year time increment has worked well for Program decision-making and has been affirmed twice by Congressional legislation and high-level administrative policy.</td></tr>
<tr><td>Likelihood Rating (L)</td><td colspan="2">1</td></tr>
<tr><td>Risk Rating (CxL)</td><td colspan="2">1</td></tr>
<tr><td>AG/AM Risk Typology “Fit”</td><td colspan="2">• Program seems to have found a “sweet spot” between a negotiated time increment based on policy that is substantial enough to provide biologically meaningful data for use as inputs in GC decision-making.</td></tr>
<tr><td>Recommendations for Reform</td><td colspan="2">• None. During implementation of the Extension, watch the relationship between critical uncertainties and the time expectation for delivering useful information for decision-making purposes.</td></tr>
</table>

<table>
<tr><td>Governance Component
Structure/Capacity</td><td colspan="2" rowspan="2">Subcomponent Description:
• Definition – Stakeholders directly involved in Program decision-making.
• The GC is the decision-making body for the PRRIP and includes stakeholders such as water users from all three states and environmental entities. Those stakeholders helped negotiate and design the Program. River landowners hold seats on the Land Advisory Committee (LAC).</td></tr>
<tr><td>Subcomponent
Stakeholders involved in decision-making</td></tr>
<tr><td>Performance Assessment</td><td>Structural:
• The GC is the decision-making body for the PRRIP and is comprised of representatives of federal agencies, state agencies (CO, WY, and NE), water users from all three states, and environmental entities. There are 11 members with 10 votes.
• Environmental entities have three representatives and two votes on the GC.
• There are five Signatories – Bureau of Reclamation, U.S. Fish and Wildlife Service, Colorado, Wyoming, and Nebraska.
• All of these Program partners operate under a charter negotiated as part of the Program Document that establishes guidelines for membership and procedures.
• River landowners in Nebraska hold seats on the Program's LAC since that is where Program management actions take place and where the Program acquires interest in land.</td><td>Functional:
• The GC operates through consensus decision-making. While one Signatory can stop further progress on a decision, that has not happened in 13 years of implementation. All GC decisions since 2007 have been resolved by consensus.
• As such, there is a general feeling of trust among Program parties which enables consensus decision-making and careful consideration of options and outcomes.
• Some indication that attention should be paid to the potential need to consider other parties being represented within the Program (environmental entities from Colorado and Wyoming, lower Platte River stakeholders, more representation for landowners, etc.).
• Concern that turnover within Program, especially at the GC level, will lead to loss of significant institutional knowledge at an important time. Need to develop procedures for better integrating new representatives into the Program.</td></tr>
<tr><td>Consequences of Failure</td><td colspan="2">• Very strong structural component of this program that can serve as a model for other programs so consequence risk low given that shared decision-making is purposeful and routinely cultivated. Trust is high among participants, but loss of individuals to retirement and job changes is a concern in terms of losing momentum and institutional knowledge.</td></tr>
<tr><td>Consequence Rating (C)</td><td colspan="2">2</td></tr>
<tr><td>Likelihood of Failure</td><td colspan="2">• Shared decision-making is a hallmark of the PRRIP and all indications are this aspect of Program decision-making will receive careful attention if concerns arise.</td></tr>
<tr><td>Likelihood Rating (L)</td><td colspan="2">2</td></tr>
<tr><td>Risk Rating (CxL)</td><td colspan="2">4</td></tr>
<tr><td>AG/AM Risk Typology "Fit"</td><td colspan="2">• Important example relative to other restoration programs of involving key stakeholders in decision-making, including the development of the Program itself and related goals and objectives. This kind of collaborative decision-making with stakeholders suggests low risk for AG components and also should help to enable successful AM.</td></tr>
<tr><td>Recommendations for Reform</td><td colspan="2">• Maintain current structure and procedures for decision-making.
• Pay attention to participant turnover and make sure new participants, especially GC representatives, are educated on the history, current status, and direction (purpose) of the PRRIP.</td></tr>
</table>

Governance Component Structure/Capacity	**Subcomponent Description:** • *Definition* – Present and adequate within the Program to deliver information useful to decision-makers. • The EDO is the center of technical and implementation capacity for the PRRIP. Advisory committees, including the Technical Advisory Committee (TAC) and the Independent Scientific Advisory Committee (ISAC), provide the EDO and GC with detailed technical support relative to Program goals, objectives, management objectives, management actions, and overall implementation of the AMP.	
Subcomponent Technical capacity		
Performance Assessment	Structural: • Formal structure of EDO with Program staff, advisory committees, and special working groups when necessary provides the PRRIP with strong technical capacity. • Independent science review – ISAC for reporting to GC on overall implementation of AM; peer review process for important technical publications, reports, or studies; and publication of Program manuscripts.	Functional: • EDO provides a constant line of communication with the GC regarding key uncertainties and important scientific and technical questions. • Regular interaction with the TAC regarding AM implementation and associated analysis and synthesis, though some attention needs to be paid to more routine interaction in the Extension as the AMP is revised and as new members cycle onto the TAC. • Annual State of the Platte Report provides a roll-up of Program analysis and other synthesis reporting (like the Tern/Plover Synthesis Chapters and the Whooping Crane Synthesis Chapters). • ISAC used well during the First Increment, need to establish a better plan for more regular interaction with and input from the ISAC during the Extension. • Identified need to re-establish the Adaptive Management Working Group (AMWG) with a small number of technical experts to assist with revision of the AMP for the Extension.
Consequences of Failure	• Strong technical capacity within the PRRIP (EDO, TAC, ISAC) that has been used well to the Program's advantage during the First Increment. • Need to revitalize this technical capacity entering the Extension to ensure continued input of useful information to GC decision-making.	
Consequence Rating (C)	**3**	
Likelihood of Failure	• Generally low given the extent of PRRIP technical capacity and commitment to the PRRIP on the part of Program participants and overall, to the work of the Program.	
Likelihood Rating (L)	**2**	
Risk Rating (CxL)	**6**	
AG/AM Risk Typology "Fit"	• High technical capacity within the PRRIP coupled with independent science review ensures that true AM can be implemented.	
Recommendations for Reform	• Re-establish the AMWG in the same context as it was established prior to the initiation of the Program in 2007. • Tend to clear and regular lines of communication between the EDO, TAC, and ISAC for the Extension.	

<table>
<tr><td>Governance Component
Decision-Making Process</td><td rowspan="2" colspan="2">Subcomponent Description:
• Definition – Decision-making shared among management agencies and stakeholders.
• Decisions are made at the GC level, which includes not only federal and state agency representatives but also representatives of water user groups and environmental entities.</td></tr>
<tr><td>Subcomponent
Shared decision-making</td></tr>
<tr><td>Performance Assessment</td><td>Structural:
• The GC includes federal and state agency representatives and also representatives of water user groups and environmental entities.
• This representation is shared downward within the PRRIP on the advisory committees.
• 11 GC members, with 10 votes total.
• Environmental entities have three seats at the GC table but only two votes.
• River landowners have seats on the Land Advisory Committee (LAC) to represent the concerns of landowners along the central Platte River where Program management actions and land acquisition take place.</td><td>Functional:
• Stakeholders are integrated into decision-making through representation on the GC.
• Some commentary on the need to consider additional representation within the Program (environmental groups from CO and WY, lower Platte River interests, etc.).
• Five Signatories and if one votes no on an issue then progress is stopped. Stakeholders do not have this authority. However, in 13 years of implementation, this has never happened and all decisions have been made by consensus.</td></tr>
<tr><td>Consequences of Failure</td><td colspan="2">• Shared decision-making is a hallmark of the PRRIP and there is no evidence this will change during the 13-year Extension, so very low risk of failure.</td></tr>
<tr><td>Consequence Rating (C)</td><td colspan="2">2</td></tr>
<tr><td>Likelihood of Failure</td><td colspan="2">• Very low, the structure of the Program has been officially retained for the Extension so any changes that might occur will not be contemplated until the start of the official Second Increment in the year 2023.</td></tr>
<tr><td>Likelihood Rating (L)</td><td colspan="2">1</td></tr>
<tr><td>Risk Rating (CxL)</td><td colspan="2">2</td></tr>
<tr><td>AG/AM Risk Typology “Fit”</td><td colspan="2">• Very low risk to AG because of the unique shared decision-making structure within the PRRIP, a structure generally not shared by any other large-scale restoration program in the U.S. Should be key to enabling successful AM.</td></tr>
<tr><td>Recommendations for Reform</td><td colspan="2">• Continue the current decision-making structure and processes.
• Stay mindful of the need to incorporate more stakeholder interests over time if necessary.</td></tr>
</table>

<table>
<tr><td>Governance Component
Decision-Making Process</td><td colspan="2" rowspan="2">Subcomponent Description:
• Definition – Decisions made openly and basis for decisions made available.
• All GC meetings and all advisory committee meetings are open to the public. Meeting agendas, supporting documents, and final minutes are posted on the Program's website. All Program documents and reports deemed final by the GC are posted for public consumption on the Program's website. The EDO is independent from all Program entities (no federal agency employees, for example).</td></tr>
<tr><td>Subcomponent
Fair and transparent</td></tr>
<tr><td>Performance Assessment</td><td>Structural:
• The GC makes decisions for the PRRIP. Those decisions are voted on in open session during public meetings and recorded in meeting minutes posted on the PRRIP website.
• The EDO is independent from all Program entities.</td><td>Functional:
• GC decision-making is linked to Program goals and objectives and all motions are voted on during open public meetings.
• These motions and subsequent decisions relate to expenditure of Program funds, management actions, land and water acquisition, implementation of AM, and general Program management.
• The independent EDO and staff approach their roles in an "honest broker" format attempting to present information fairly and without entity bias for the purposes of GC decision-making.
• Given that the EDO now has the great command of Program data and analysis and also is integral to implementation on behalf of the GC, need to make sure this independence is maintained.</td></tr>
<tr><td>Consequences of Failure</td><td colspan="2">• Modest risk, primarily related to independent implementation over time. Could have negative consequences for the PRRIP if the EDO loses sight of honest broker role and pierces bubble of independence (i.e., becomes advocate for one entity's position over another).</td></tr>
<tr><td>Consequence Rating (C)</td><td colspan="2">3</td></tr>
<tr><td>Likelihood of Failure</td><td colspan="2">• Not a strong risk, PRRIP likely to maintain open and transparent decision-making and tight oversight of EDO to ensure independence.</td></tr>
<tr><td>Likelihood Rating (L)</td><td colspan="2">3</td></tr>
<tr><td>Risk Rating (CxL)</td><td colspan="2">9</td></tr>
<tr><td>AG/AM Risk Typology "Fit"</td><td colspan="2">• As a model Program, this subcomponent is an important example of the value of open process and having an independent Executive Director and staff. This makes it a low-risk subcomponent for the typology.</td></tr>
<tr><td>Recommendations for Reform</td><td colspan="2">• Maintain the current process of GC decision-making being conducted in the sunlight.
• Continue the "experiment" with an independent ED and staff, monitor through GC oversight to ensure the EDO maintains its honest broker role.</td></tr>
</table>

Governance Component Decision-Making Process **Subcomponent** Consensus	**Subcomponent Description:** • *Definition* – Program decisions are made by consensus of the decision-making body. • The GC operates on a consensus basis and all GC decisions since the Program began in 2007 have been decided with a consensus vote.	
Performance Assessment	Structural: • The GC attempts to reach consensus on all motions and votes during each year.	Functional: • Since the Program began in 2007, all GC decisions have been made via consensus. • Signatories can individually stop a decision but that has not happened within the PRRIP during its existence. • The consensus process can be slow, with some issues needing to spill over into future meetings to give more time for issues to be resolved. • The successful consensus approach has engendered a high level of trust among GC members and within the Program as a whole, which has led to Program success during the First Increment. • The long term of Program function and success has led to a fairly smooth decision-making process within the GC. • Lack of clarity on some objectives such as how to handle pallid sturgeon, what recovery means for the Program, etc. remain challenges to Program function but have not stopped forward progress thus far.
Consequences of Failure	• No risk – the use of consensus decision-making within the PRRIP has led to a stronger program and is codified through the Program Document and through the 13-year Extension.	
Consequence Rating (C)	**1**	
Likelihood of Failure	• Consensus decision-making is a hallmark of the PRRIP and there is no evidence changes in that approach are at all likely.	
Likelihood Rating (L)	**1**	
Risk Rating (CxL)	**1**	
AG/AM Risk Typology "Fit"	• Consensus decision-making is difficult and time-consuming but the PRRIP has proved its worth and its ability to succeed within the AG structure of a large-scale restoration Program. A low-risk AG subcomponent for the PRRIP.	
Recommendations for Reform	• Continue consensus decision-making.	

Governance Component Decision-Making Process	**Subcomponent Description:** • *Definition* – Decisions tied to the processes described in the foundational document and linked to Program goals and objectives. • The Program Document clearly specifies the Program purpose, goals, objectives, and management objectives for the AMP. All goals and objectives are consistently referenced when developing annual budgets, plans for management actions, science synthesis reports like the annual State of the Platte Report, etc.	
Subcomponent Decisions linked to goals/objectives		
Performance Assessment	Structural: • Program goals and objectives clearly spelled out in the Program Document and referenced by nearly all survey respondents as being the organizing principles of the PRRIP. • This includes a set of 10 Milestones (land, water, depletions plans, AMP implementation, etc.) that are referenced by policy-makers within the GC as measures of success.	Functional: • PRRIP decisions have all largely centered around the First Increment Objectives of land (10,000 acres) and water (130,000-150,000 acre/feet year of reductions to flow shortages). • This also includes a focus on learning through AM during the First Increment. • General concern among respondents about resolving issues related to pallid sturgeon, trying to determine what it means to "recover" the target species (or what the Program is on the hook for relative to recovery), and how to sustain the Program in the near-term and long-term if AMP management objectives are being met.
Consequences of Failure	• Structurally sound and organized around clear and agreed-upon goals and objectives. But some underlying concern about the issue of measuring success (especially related to "recovery"), pallid sturgeon, target flows, and how to approach AM in the Extension. These need to be sorted out to avoid a serious risk to the PRRIP in the long term.	
Consequence Rating (C)	**4**	
Likelihood of Failure	• The PRRIP has its marching orders for the Extension but a note of concern here to make sure the Program attends to issues related to clarification of issues surround target flows, recovery, and pallid sturgeon, in particular, to ensure no large issues are left unresolved or at least unplanned toward the end of the Extension.	
Likelihood Rating (L)	**3**	
Risk Rating (CxL)	**12**	
AG/AM Risk Typology "Fit"	• The PRRIP is a model in terms of have clear purpose, goal, and objective language negotiated in the Program Document and understood by all. Some looming policy-related issues tied to target flows, recovery, and pallid sturgeon need to be addressed early in the Extension and pose a little higher AG risk for the typology.	
Recommendations for Reform	• Continue clear communication on and decision-making related to the PRRIP's stated goals, objectives, and management objectives. • Investtime now in more difficult policy issues (target flows, recovery, pallid sturgeon) to avoid policy traps late in the Extension.	

<table>
<tr><td>Governance Component
Decision-Making Process</td><td colspan="2" rowspan="2">Subcomponent Description:
• Definition – There is a means for resolving disputes and decisions that do not reach consensus.
• The GC operates on a consensus basis but does not have a formal process for dispute resolution, other than a Signatory being able to stop forward progress on an issue.</td></tr>
<tr><td>Subcomponent
Dispute resolution</td></tr>
<tr><td>Performance Assessment</td><td>Structural:
• GC decision-making occurs through a consensus-based process. This is not a formal dispute resolution process but rather a well-worn approach dating back to the 10-plus years of negotiation to build the PRRIP.
• In terms of decision, 11 members of the GC have 10 votes (environmental entities have three GC seats but two votes).
• 5 Signatories = Bureau of Reclamation, U.S. Fish & Wildlife Service, Colorado, Wyoming, and Nebraska.</td><td>Functional:
• All GC decisions since the Program began in 2007 have been via consensus.
• One Signatory “no” vote can stop a decision but that has not happened during Program implementation thus far.
• Unlikely that all decisions by the GC will achieve consensus forever, so consider developing a more formal dispute resolution process for when that happens.</td></tr>
<tr><td>Consequences of Failure</td><td colspan="2">• Strong decision-making functionality thus far suggests little risk of failure. The only concern is to consider establishing a more formal dispute resolution process for if/when the GC reaches an issues that cannot be resolved through the typical consensus channels.</td></tr>
<tr><td>Consequence Rating (C)</td><td colspan="2">3</td></tr>
<tr><td>Likelihood of Failure</td><td colspan="2">• No evidence the PRRIP will move away from consensus-based decision-making.</td></tr>
<tr><td>Likelihood Rating (L)</td><td colspan="2">2</td></tr>
<tr><td>Risk Rating (CxL)</td><td colspan="2">6</td></tr>
<tr><td>AG/AM Risk Typology “Fit”</td><td colspan="2">• Strong example of a large-scale restoration program successfully using consensus as the organizing principle for decision-making, so generally low AG risk. Risk level would be lower still if the PRRIP developed a more formal dispute resolution process for challenging issues that may lie ahead.</td></tr>
<tr><td>Recommendations for Reform</td><td colspan="2">• Develop formal dispute resolution process for difficult issues when they arise.</td></tr>
</table>

<table>
<tr><td>Governance Component
Decision-Making Process</td><td colspan="2" rowspan="2">Subcomponent Description:
• Definition – Program can respond to change and surprise (uncertainty).
• The Program has had to deal with surprises such as the influx of the invasive plant Phragmites and the onset of both drought conditions and exceptionally wet conditions.</td></tr>
<tr><td>Subcomponent
Adapt to surprises</td></tr>
<tr><td>Performance Assessment</td><td>Structural:
• The general structure of the PRRIP and the openness to learning and incorporating that learning into decision-making suggest the ability to be flexible and respond to surprises.</td><td>Functional:
• Consensus decision-making has been an important tool for the PRRIP, but it is slower and more deliberative thus making it harder to respond to surprises.
• Similarly, shared decision-making with stakeholder involvement has been an important tool for the PRRIP, but the multitude of interests represented on the GC and the differences of opinion that exist on key issues like target flows, recovery (species benefits), and pallid sturgeon suggest difficulty lies ahead if more surprises face the PRRIP.
• No real planning for the onset of a major drought, or if the PRRIP would be implemented during a long period of consistently less water or more flashy events like floods exacerbated by climate change.</td></tr>
<tr><td>Consequences of Failure</td><td colspan="2">• Could be very high if another major surprise appears or if Program water acquisition and management plans are thrown off by climate events.</td></tr>
<tr><td>Consequence Rating (C)</td><td colspan="2">4</td></tr>
<tr><td>Likelihood of Failure</td><td colspan="2">• It is likely that water conditions over the next 13 years will be different than forecasted and that other surprises will emerge that will test the resilience of the PRRIP and the Platte River system.</td></tr>
<tr><td>Likelihood Rating (L)</td><td colspan="2">5</td></tr>
<tr><td>Risk Rating (CxL)</td><td colspan="2">20</td></tr>
<tr><td>AG/AM Risk Typology "Fit"</td><td colspan="2">• Concerns were raised by some respondents that the PRRIP is structured well but that structure may be somewhat brittle because of how long ago it was negotiated and developed. A higher risk AG subcomponent for the PRRIP in the typology.</td></tr>
<tr><td>Recommendations for Reform</td><td colspan="2">• More formal and in-depth contingency planning for water availability and use.
• Forecast additional potential surprises to ensure the PRRIP is more resilient to change.</td></tr>
</table>

Governance Component Decision-Making Process **Subcomponent** Ability to incorporate learning into decision-making	**Subcomponent Description:** • *Definition* – Program can incorporate learning from implementation into decision-making. • The Program spent a good deal of time during the First Increment deciding how best to incorporate learning into decision-making and use that learning to enable the GC to make more informed decisions. Tools such as Structured Decision Making (SDM) have been employed to facilitate this effort.	
Performance Assessment	Structural: • The GC makes decisions on how to spend Program funds on science projects, data analysis, and data synthesis. • The AM Plan was negotiated as part of the Program Document. It is being revised for the Extension but during the First Increment contained the conceptual models, management objectives, hypotheses, monitoring protocols, and other critical components of true AM that have been the focus of implementation and evaluation since 2007.	Functional: • Proposals for PRRIP AM implementation, data analysis, data synthesis, etc. are developed through the technical aspects of the Program and work their way up to the TMC for final approval (largely through the annual PRRIP budget process). • This includes review by and discussion with the ISAC, peer reviewers when necessary, and other forms of independent science expertise. • Results are presented to the GC on a regular basis – quarterly meetings, annual AMP Reporting Session, periodic EDO updates. • The EDO generates an annual State of the Platte Report that rolls up Program learning (analysis and synthesis) to date and tracks learning relative to AMP management objectives against a set of Big Questions with underlying hypotheses. • The GC agreed to use an SDM process at the end of the AM cycle for one key issue (river flow, its ability to build and maintain tern/plover nesting habitat, and tern/plover productivity on such habitat). This led to a decision to change management actions and thus completion of one full cycle of the six AM steps. • Some concern about how this will proceed in the Extension now that several central critical uncertainties have been addressed during the First Increment.
Consequences of Failure	• Very low risk. This is a strength of the PRRIP. The process for using learning in decision-making may not be written down but the Program now has a pattern of behavior to serve as a guide for repeating the process.	
Consequence Rating (C)	**2**	
Likelihood of Failure	• Unlikely – the PRRIP developed an AG structure that has enabled AM and the process of integrating learning into GC decision-making.	
Likelihood Rating (L)	**1**	
Risk Rating (CxL)	**2**	
AG/AM Risk Typology "Fit"	• Another way in which the PRRIP is a model restoration program. The AG structure that emerged in negotiating a way forward was purpose-built to enable AM and integrate learning into decision-making. Very low risk AG subcomponent.	
Recommendations for Reform	• Repeat the process of completing a full AM cycle for other critical uncertainties during the Extension (likely related to whooping cranes).	

<table>
<tr><td>AM Component
Assess

Subcomponent
Problem definition and agreement</td><td colspan="2">Subcomponent Description:
• Definition – Program has clear goals and objectives, and there is an agreed-upon definition of AM.
• Clearly-stated and agreed-upon goals and objectives for the PRRIP in the Program Document. A negotiated and agreed-upon AMP that includes a definition of AM, management objectives, management strategies and actions, and a set of priority hypotheses to test.</td></tr>
<tr><td>Performance Assessment</td><td>Structural:
• There are agreed-upon Program goals and objectives that are written into the negotiated Program Document which is the single unifying foundational document for the PRRIP.
• GC focus on First Increment objectives for habitat (10,000 acres) and water (130,000-150,000 acre/feet per year in shortage reductions) informed by learning from the AMP.
• AM is defined in the AMP and provides a common understanding of AM for the PRRIP.
• AMP includes four management objectives tied to the target species, management strategies and actions, and a set of 47 priority hypotheses.</td><td>Functional:
• First Increment AMP implementation focused on prioritizing the hypotheses into a smaller set of Big Questions that served to focus AM implementation efforts but also as a means of communicating AM learning back to the GC for decision-making purposes.
• Biggest challenge for the PRRIP is to repeat the Assess step for the Extension – identify the next set of Big Questions and hypotheses, establish management actions, and specific what learning is expected and how it will be translated back to the GC for decision-making during the Extension and for negotiations for a Second Increment that would start in the year 2033.</td></tr>
<tr><td>Consequences of Failure</td><td colspan="2">• Very low risk of failure, the presences of a single, unifying foundational Program Document negotiated by Program parties that includes an AM Plan with a definition of AM, specific management objectives, management strategies and actions, and hypotheses has been a fundamental reason why the PRRIP has been successful so far.</td></tr>
<tr><td>Consequence Rating (C)</td><td colspan="2">2</td></tr>
<tr><td>Likelihood of Failure</td><td colspan="2">• Very low, requires hard thinking for the Extension in terms of how to re-focus AM implementation efforts but the PRRIP has the technical capacity in staff, technical representatives of GC members, and the use of independent science to build a revised AMP for the Extension.</td></tr>
<tr><td>Likelihood Rating (L)</td><td colspan="2">1</td></tr>
<tr><td>Risk Rating (CxL)</td><td colspan="2">2</td></tr>
<tr><td>AG/AM Risk Typology “Fit”</td><td colspan="2">• This subcomponent is a very low AM risk for the typology. The PRRIP is a good example of having a clear problem definition and AM definition up front, at the beginning of the Assess step of the AM cycle, to guide development and implementation of AM. This also creates a strong link to the AG structure of the PRRIP.</td></tr>
<tr><td>Recommendations for Reform</td><td colspan="2">• Continued effort to specify Big Questions, hypotheses, management actions, and the decision-making process relative to AM learning for the Extension.</td></tr>
</table>

<table>
<tr><td>AM Component
Assess</td><td colspan="2" rowspan="2">Subcomponent Description:
• Definition – Program has an AM Plan that is related back to overall goals and objectives and that specifies what the Program does not know but wants to learn (priority hypotheses, critical uncertainties).
• Negotiated AM Plan included as part of Program Document. AMP is linked back to Program goals and objectives through management objectives, management strategies and actions, and a set of priority hypotheses.</td></tr>
<tr><td>Subcomponent
Roadmap of goals, objectives, hypotheses</td></tr>
<tr><td>Performance Assessment</td><td>Structural:
• PRRIP has agreed-upon AMP with definition of AM and key components – management objectives, management strategies and actions, and priority hypotheses.
• PRRIP began using Big Questions during the First Increment to roll up several hypotheses into overarching questions of interest to GC decision-makers and that could help better link AM learning to decision-making.</td><td>Functional:
• Respondents generally agreed there is a common understanding of the purpose of the AMP and the hypotheses being tested.
• General agreement that the purpose of AM in the PRRIP is to learn, reduce uncertainty, and provide information to the GC for decision-making.
• Big Questions provide useful tool to communicate learning to the GC and show a more direct link between decisions the GC will make and AM learning.
• General agreement about the nature of uncertainties that need addressed for the PRRIP – water for species, long-term habitat and flow management, incremental benefits of water (how much water do we need?), and target flows.
• Concern about specifying how to address pallid sturgeon, how to relate species responses to management actions, and impacts of events outside the control of the PRRIP such as drought and climate change.
• Need to address these issues for Extension, develop a revised AMP that fills out the roadmap going forward.
• Consider developing a more formal process for integrating AM learning into GC decision-making – will SDM always be used in the Adjust step of the AM cycle? How does the GC functionally use AM learning as an input to decision-making about management actions, water acquisition, etc.?</td></tr>
<tr><td>Consequences of Failure</td><td colspan="2">• The PRRIP was successful during the First Increment implementing the existing AMP and feeding learning into decision-making. Key challenge now is revising the AMP and structuring learning for use in decision-making during the Extension. Failure to complete this work would significantly impede implementation of true AM during the Extension.</td></tr>
<tr><td>Consequence Rating (C)</td><td colspan="2">4</td></tr>
<tr><td>Likelihood of Failure</td><td colspan="2">• The PRRIP is actively working to revise the AMP and provide a roadmap for learning during the Extension, but critical issues such as pallid sturgeon and water availability (drought, climate change, water use) remain a challenge.</td></tr>
<tr><td>Likelihood Rating (L)</td><td colspan="2">3</td></tr>
<tr><td>Risk Rating (CxL)</td><td colspan="2">12</td></tr>
<tr><td>AG/AM Risk Typology “Fit”</td><td colspan="2">• Low AM risk and good typology fit when considering the results of implementation of the First Increment thus far. Risk moves upward slightly since the Extension has begun but the AMP has yet to be revised. The GC decided to keep the management objectives the same for the Extension so that provides a foundation to build on for AM.</td></tr>
<tr><td>Recommendations for Reform</td><td colspan="2">• Develop a revised AMP for the Extension, including Big Questions, hypotheses, and management actions.
• Develop a more repeatable process for integrating AM learning into GC decision-making.</td></tr>
</table>

AM Component Assess **Subcomponent** Decisions affected by information	**Subcomponent Description:** • *Definition* – Program decisions are affected by science learning through the application of AM. • PRRIP has successfully completed one full cycle of the six AM steps regarding a key uncertainty (flow, sandbar habitat, and tern/plover nesting) and adjusted management activities as a result of Program learning.	
Performance Assessment	Structural: • The GC makes decision for the PRRIP. • For decision-making purposes, the GC receives various levels of input from the EDO, advisory committees and work groups, and independent science review (ISAC and peer review).	Functional: • The GC makes decisions on a consensus basis. • On a functional basis, most decisions at the GC level focus on annual budget line items, acquisition of land and water resources, and higher-level policy issues. • The intent of the First Increment was to be the "learning" increment focused on implementation of the AMP. • That resulted in prioritization of key uncertainties and hypotheses, development of the Big Questions, refinement of independent science review processes, and efforts to analyze and synthesis Program data through tools like the annual State of the Platte Report and the annual AMP Reporting Session. • The GC used Structured Decision Making (SDM) to help use Program learning in the Adjust step of AM. • Linkages between AM learning and decision-making are not specified in the AMP so some attention needs to be paid to developing a more formal process for GC decision-making in the Adjust step of AM (i.e. use of SDM, more clearly specific decisions that need to be/will be made, etc.)
Consequences of Failure	• The PRRIP has proven it can complete a full cycle of the six AM steps and has retained the structure and function of GC decision-making for the Extension that enabled that success. But some concern about repeating that process and developing a more formal linkage between AM learning and GC decision-making at the beginning of the Extension, including how to deal with challenges such as the links between water management actions and species responses, pallid sturgeon, target flows, and impacts of factors outside the control of the Program such as drought and climate change.	
Consequence Rating (C)	**3**	
Likelihood of Failure	• Low at the current time, given that the PRRIP is now engaged in a process to forecast decisions that need to be made to negotiate a Second Increment that would start in the year 2033 and to determine how best to address complex issues such as target flows and pallid sturgeon before getting too far into the Extension.	
Likelihood Rating (L)	**2**	
Risk Rating (CxL)	**6**	
AG/AM Risk Typology "Fit"	• Generally low AG/AM risk because of proven ability to use AM learning as an input in decision-making and adjust management actions as a result.	
Recommendations for Reform	• Develop a more formal, repeatable process for integrating AM learning with GC decision-making.	

AM Component Assess	Subcomponent Description:	
Subcomponent Collaborative process to develop fundamental AM information.	• *Definition* – Program has a collaborative process for developing an AM Plan, link it back to goals and objectives, and reach agreement on critical uncertainties, hypotheses, and related Big Questions. • Negotiated AMP is part of the Final Program Document and was specifically developed to guide Program learning in the First Increment as a collaborative means to address key uncertainties and disagreements about how to manage Program resources to benefit target species (e.g. use of flow versus use of mechanical means to create and maintain habitat).	
Performance Assessment	Structural: • The AMP includes key components such as conceptual models, management objectives, management strategies and actions, hypotheses, monitoring protocols, and direction on data analysis. • During the First Increment, the EDO and advisory committees developed Big Questions to help organize hypotheses and AM learning and the Big Questions were approved by the GC.	Functional: • The AMP was developed and negotiated as part of the process of finalizing the Program Document. • The GC intended the First Increment to be the "learning increment" through application of AM. • The PRRIP is built on a shared-decision making structure that engages stakeholders in GC decision-making and includes those stakeholders in all advisory committees and implementation of the AMP. • Collaborative process in place, PRRIP needs to continue work on developing Big Questions, hypotheses, and management actions for the Extension.
Consequences of Failure	• Low risk, given the current AMP was developed collaboratively and the PRRIP is now engaged in a collaborative process to revise the AMP for the Extension. Main challenge is to complete the process of collaboratively revising the AMP.	
Consequence Rating (C)	**2**	
Likelihood of Failure	• Process in place to revise the AMP for the Extension but a fairly high level of difficulty of key challenges that have to be resolved (target flows, pallid sturgeon) in order to move forward with that revision.	
Likelihood Rating (L)	**3**	
Risk Rating (CxL)	**6**	
AG/AM Risk Typology "Fit"	• Model program in terms of collaborative process, developing AMP as part of finalizing foundational document, and clear pattern of success in collaboratively implementing AM. Low AG/AM risk.	
Recommendations for Reform	• Complete process of revising AMP for the Extension, including Big Questions, hypotheses, and management actions.	

<table>
<tr><td>AM Component
Design

Subcomponent
Management objectives</td><td colspan="2">Subcomponent Description:
• Definition – Program has explicit management objectives that are measurable statements of outcomes the Program is trying to achieve that should facilitate evaluation of AM effectiveness.
• The PRRIP AMP includes four specific management objectives and AM learning is reported to the GC against those management objectives as a decision-making input.</td></tr>
<tr><td>Performance Assessment</td><td>Structural:
• The AMP includes four management objectives: three that are specific to the Program's target species (tern/plover, whooping crane, and pallid sturgeon) and a "catch-all" objective for other species of concern.
• These management objectives were retained unchanged for the Extension (2020-2032) by the GC.
• General agreement that management objectives have thus far not included specific species metrics because the bird species are migratory that are impacted by factors outside the control of the Program.
• Idea was to provide benefits for species rather than being tied to any range-wide recovery metrics.</td><td>Functional:
• The management objectives are used by the PRRIP to help organize and prioritize uncertainties and hypotheses to be addressed by AM implementation.
• The tern/plover and whooping crane management objectives do include metrics for assessing performance of the Program against the management objectives, but internal PRRIP discussion and review by the ISAC suggest those metrics are really proxies for true measurements of reproductive success (tern/plover) and river use (whooping crane).
• The pallid sturgeon management objective is written as a "do no harm" objective, meaning the current language directs the Program to "avoid adverse impacts" to pallid sturgeon and their habitat in the lower Platte River due to PRRIP management actions in the central Platte River.
• The PRRIP has not specified any metrics for measuring progress of the Program against the pallids sturgeon management objective.
• The PRRIP has not attempted to address the fourth management objective, which is to avoid ESA listing of additional species of concern.
• Liked the pallid sturgeon management objective, the species of concern objective includes no metrics for measurement of progress over time.
• The GC retained all four management objectives for the Extension.
• Internal PRRIP discussion and ISAC review suggest the need to re-consider the management objectives and the metrics used to measure progress toward achieving the objectives.</td></tr>
<tr><td>Consequences of Failure</td><td colspan="2">• Imperative for successful AM implementation since management objectives serve as the currency of discussion with the GC about AM learning. Current metrics for tern/plover and whooping crane management objective have been "met" in terms of identified proxies, but PRRIP needs to determine what this means in the long term. Pallid sturgeon management objective needs to include specific measures of progress.</td></tr>
<tr><td>Consequence Rating (C)</td><td colspan="2">4</td></tr>
<tr><td>Likelihood of Failure</td><td colspan="2">• The PRRIP is attempting to avoid failure of the AM subcomponent by addressing management objective metrics and the pallid sturgeon management objective as part of the AMP revision for the Extension.</td></tr>
<tr><td>Likelihood Rating (L)</td><td colspan="2">3</td></tr>
<tr><td>Risk Rating (CxL)</td><td colspan="2">12</td></tr>
<tr><td>AG/AM Risk Typology "Fit"</td><td colspan="2">• Probably the most structural and functional AM risk for the PRRIP. This is a specific aspect of AM that needs attention by the PRRIP at the beginning of the Extension.</td></tr>
<tr><td>Recommendations for Reform</td><td colspan="2">• Agree to a set of metrics for measuring progress against the tern/plover, whooping crane, and pallids sturgeon management objectives.
• Develop clearer linkages between the management objectives, measures of progress, and the communication and use of AM learning as an input to GC decision-making during the Extension.</td></tr>
</table>

<table>
<tr><td>AM Component
Design

Subcomponent
Management actions</td><td colspan="2">Subcomponent Description:
• Definition – Program has a set of management actions, has authority to implement those actions, and implementation is linked to science learning as an input in Program decision-making.
• Specific management actions identified in the AMP as tests of two possible management strategies (flow-related versus mechanical-related) that are linked to the priority hypotheses and AM implementation.</td></tr>
<tr><td>Performance Assessment</td><td>Structural:
• Two management strategies are identified in the AMP and intended to be implemented in parallel as possible to test two theories of how best the PRRIP can create and maintain habitat for the target species and expect positive outcomes – FSM (Flow-Sediment-Mechanical) and MCM (Mechanical Creation & Maintenance).
• The AMP includes specific management actions that comprise the two management strategies to be implemented by the PRRIP during the First Increment – flow releases, sediment augmentation, mechanical habitat restoration, and specific habitat development such as palustrine wetlands and off-channel sand and water habitat (nesting habitat for terns/plovers).</td><td>Functional:
• AMP management actions have been the subject of much of the implementation work and success of the PRRIP during the First Increment.
• Successful implementation of flow tests, on-channel habitat construction, off-channel habitat construction, channel width creation, etc.
• Research, monitoring, data analysis, and data synthesis during the First Increment has focused on the results of management action implementation and habitat, river, and species responses.
• The PRRIP took advantage of multiple high-flow events during the First Increment (2007-2020) to learn about the impact of high flows on habitat creation and maintenance and species responses and use, which allowed the Program to learn about the potential effects of a flow management action like short-duration high flow (SDHF) without full implementation of that management action.
• As of August 2020, somewhat unclear what the exact management actions will be during the Extension, though the PRRIP is actively engaged in a process to revised the AMP and specify management actions that can be implemented to provide AM learning useful for GC decision-making during the Extension and that can be useful in Second Increment negotiations toward the end of the Extension.
• General agreement that even with management actions specified, the GC retains a large amount of flexibility to adjust those actions or otherwise respond to learning when necessary to speed learning and help with decision-making.</td></tr>
<tr><td>Consequences of Failure</td><td colspan="2">• Low. The PRRIP negotiated a clear set of management actions for AM implementation during the First Increment and in most cases successfully implemented those actions. The PRRIP is actively engaged in a process of specifying management actions for the Extension linked to remaining critical uncertainties and hypotheses.</td></tr>
<tr><td>Consequence Rating (C)</td><td colspan="2">2</td></tr>
<tr><td>Likelihood of Failure</td><td colspan="2">• Very low, the PRRIP will specify Extension management actions in 2020 or 2021.</td></tr>
<tr><td>Likelihood Rating (L)</td><td colspan="2">2</td></tr>
<tr><td>Risk Rating (CxL)</td><td colspan="2">4</td></tr>
<tr><td>AG/AM Risk Typology “Fit”</td><td colspan="2">• The specified management actions fit well within a general AM context, are the main subject of AM implementation, and learning relative to implementation of these management actions has been used by the GC for decision-making purposes. Constraints are related to water and habitat/land availability, not to a failure of the PRRIP or weaknesses in the AMP.</td></tr>
<tr><td>Recommendations for Reform</td><td colspan="2">• Develop specific management actions for AM implementation during the Extension.</td></tr>
</table>

AM Component Design	Subcomponent Description:
Subcomponent Monitoring/research protocols tailored to hypotheses and key questions from decision-makers	• *Definition* – Program developed its own monitoring/research protocols that are designed to deliver information relative to key hypotheses and questions from decision-makers. • The AMP includes specific monitoring protocols related to the target species and developed additional monitoring and research protocols during the First Increment linked to the Program's agreed-upon goals, objectives, management objectives, hypotheses, and Big Questions.
Performance Assessment	Structural: • The PRRIP spent considerable time and effort prior to the beginning of the First Increment and during the First Increment to develop, implement, and refine sound and consistent monitoring protocols for the target bird species (tern/plover, whooping crane) and aspects of river geomorphology, sediment transport, etc. Functional: • Consistent monitoring throughout the First Increment has provided the PRRIP with a large dataset relative to target species use and reproductive success. • Long-term monitoring on river geomorphology, vegetation, and sediment transport instrumental in implementation and evaluation of the AMP. • Monitoring protocols have been refined over time to respond to learning relative to species' migratory patterns, critical information needs, use of new technology, etc. • Consistent annual funding for monitoring that is clearly tied to AM implementation, learning, and decision-making needs. • All monitoring protocols have been subjected to independent science review to ensure the use of sound methodology. • The PRRIP used directed research projects such as research on the ability of flow to remove vegetation such as phragmites to fill information gaps.
Consequences of Failure	• Very low. Demonstrated pattern of success of developing, implementing, refining, and funding consistent monitoring and research (when necessary) to provide long-term datasets.
Consequence Rating (C)	**2**
Likelihood of Failure	• Short of unanticipated budget constraints, very low likelihood of failure of this AM subcomponent.
Likelihood Rating (L)	**2**
Risk Rating (CxL)	**4**
AG/AM Risk Typology "Fit"	• Strong science effort within the PRRIP that is tied to collecting information important for AM learning and contributing to decision-making.
Recommendations for Reform	• Continue to refine monitoring protocols over time as AM learning demands. • Continue to justify and provide consistent annual funding for PRRIP monitoring.

AM Component Implement	**Subcomponent Description:** • *Definition* – Program has a clear process for implementing management actions and monitoring. • The AMP provides clear specification of management actions and monitoring protocols. The PRRIP developed a process for implementation during the course of the First Increment.	
Subcomponent Plan for implementation of management actions and monitoring		
Performance Assessment	Structural: • The AMP includes specific management actions and monitoring protocols but does not include a full implementation plan for those actions and monitoring. • The EDO developed an Implementation Plan during the First Increment and the PRRIP generally developed implementation approaches and priorities that were followed throughout the First Increment.	Functional: • The EDO, in collaboration with the Technical Advisory Committee (TAC) and Independent Scientific Advisory Committee (ISAC) developed an implementation plan for AM during the First Increment that included the design of actions, associated monitoring and research, and plans for data analysis. • During the course of the First Increment, the PRRIP developed general procedures and processes for implementing AM actions and associated monitoring. • The PRRIP needs to refine its implementation plan for AM for the Extension based on how the AMP is revised.
Consequences of Failure	• Necessary component of AM to avoid breakdown of links between AM and decision-making. The PRRIP developed this plan over time during the First Increment and is actively working to develop an implementation plan for the Extension. Chief concern is ensuring this work is completed and that it provides consistent and repeatable guidance.	
Consequence Rating (C)	**3**	
Likelihood of Failure	• Generally low since the PRRIP is actively working to develop this for the Extension as part of the revised AMP.	
Likelihood Rating (L)	**2**	
Risk Rating (CxL)	**6**	
AG/AM Risk Typology "Fit"	• Moderate risk in that the PRRIP started the First Increment without a clear implementation plan and developed it over time as the work of the Program was ongoing. Attempting to avoid repeating that by developing a formal implementation plan at the beginning of the Extension to better guide management actions and monitoring and provide a roadmap as to how learning will be communicated to the GC and used as an input in decision-making.	
Recommendations for Reform	• Collaboratively develop an implementation plan for the Extension as part of the process of revising the AMP.	

AM Component Implement	Subcomponent Description:	
Subcomponent Project oversight	• *Definition* – Program has clear lines of authority for implementation and oversight. • The PRRIP utilizes independent implementation, meaning the ED and Program staff (EDO) are not employees of any of the Program parties but are rather employees of a private natural resources consulting firm. The EDO is responsible for day-to-day implementation of the PRRIP on behalf of the GC.	
Performance Assessment	Structural: • The ED and Program staff (EDO) are employees of Headwaters Corporation, a private, for-profit natural resources consulting firm. • The ED and Program staff are not employees of any PRRIP entity and are thus independent. • The EDO is responsible for day-to-day implementation of the PRRIP as directed by the GC.	Functional: • The PRRIP decided to utilize independence implementation to build in independence, avoid agency bias, and overcome issues of trust and power dynamics. • The EDO acts as "honest brokers" for the GC, providing objectivity and independent assessment of Program learning. • General feeling this is the best approach to staffing a Program like the PRRIP. • Some concerns about it slowing down the process of implementation and decision-making, EDO staff size and costs over time, and also the need to ensure the EDO does not end up guiding the GC (instead of acting as honest brokers). • Question asked by respondent – the pros are so strong, why isn't this approach used more by restoration programs?
Consequences of Failure	• Little to no risk. Strong record of success with independent implementation during the First Increment.	
Consequence Rating (C)	**1**	
Likelihood of Failure	• Little to no risk. Independent implementation retained for the extension. Death of original ED (Jerry Kenny) was a jolt to the Program but Headwaters survived as a business and continues to provide the ED and staff for the PRRIP. Headwaters has committed to providing these services to the PRRIP at least throughout the Extension, assuming GC agreement.	
Likelihood Rating (L)	**1**	
Risk Rating (CxL)	**1**	
AG/AM Risk Typology "Fit"	• A unique model of independent implementation for other restoration programs to consider. May be adaptable in other programs depending on conditions.	
Recommendations for Reform	• Continue to use independent implementation. • Ensure the GC provides oversight of the EDO as honest brokers.	

AM Component Monitor	Subcomponent Description:	
Subcomponent Implementation, effectiveness, and validation monitoring	• *Definition* – Implementation monitoring: designed to evaluate if a project/management action is implemented as intended; effectiveness monitoring: designed to evaluate how successful a project or management action is at achieving desired or expected outcomes; validation monitoring: designed to evaluate the response of species or river/form function to implementation of management actions. • The PRRIPP conducts implementation, effectiveness, and validation monitoring linked to AMP implementation and the management objectives, hypotheses, Big Questions, and management actions.	
Performance Assessment	Structural: • The PRRIP has a strong track record of project-specific and species monitoring and research. • Most monitoring is related to implementation of the major PRRIP management actions including flow tests, habitat creation, sediment augmentation, etc.	Functional: • Monitoring and research are implemented primarily to deliver information useful in decision-making related to PRRIP goals, objectives, management actions, Big Questions, and hypotheses (validation). • Implementation and effectiveness monitoring of specific management actions and their impact on river form/function and target species habitat provide critical data inputs. • General agreement that PRRIP monitoring provides useful data to decision-makers.
Consequences of Failure	• Low, the PRRIP has a strong track record of all three phases of monitoring.	
Consequence Rating (C)	**2**	
Likelihood of Failure	• Low, the PRRIP is engaged in the process of revising the AMP for the Extension which includes attention to the need to refine existing monitoring protocols or develop new protocols as demanded by the direction of AM learning.	
Likelihood Rating (L)	**2**	
Risk Rating (CxL)	4	
AG/AM Risk Typology "Fit"	• Strong PRRIP science program with monitoring at all levels and use of monitoring data in decision-making.	
Recommendations for Reform	• Continue to implement, refine, and fund monitoring throughout the Extension. • Provide clear links between monitoring outputs and use of that learning as an input in GC decision-making.	

AM Component Evaluate	Subcomponent Description: • *Definition* – Analysis and reporting of Program monitoring data. • The PRRIP conducts rigorous science with extensive data analysis, peer review, and publication of results.	
Subcomponent Data analysis		
Performance Assessment	Structural: • Strong collection and analysis of research and monitoring data.	Functional: • Continued effort to discuss all data collaboratively within the EDO, TAC, and ISAC. • Continued use of internal peer review and publication of results to ensure rigor.
Consequences of Failure	• Low in the PRRIP because of history of development and implementation of rigorous approaches to data collection, analysis, and reporting.	
Consequence Rating (C)	**2**	
Likelihood of Failure	• Low, in general this is a strong suit of the PRRIP.	
Likelihood Rating (L)	**2**	
Risk Rating (CxL)	**4**	
AG/AM Risk Typology "Fit"	• Needs to be strong to ensure Program data is being operationalized for implementation of AM. Generally good history of that with the PRRIP.	
Recommendations for Reform	• Collaboratively develop revised AMP for the Extension that specifies management actions, Big Questions, and hypotheses to ensure a data analysis plan can be developed that will be useful in data synthesis efforts and help to answer questions the GC has regarding implementation of management actions and river and species responses.	

AM Component Evaluate	**Subcomponent Description:** • *Definition* – Telling the "story" of AM. Stitching together multiple lines of evidence to provide an evaluation of the overall effects and outcomes of Program implementation. • A strong suit of the PRRIP developed over time through the use of tools such as Big Questions, data synthesis chapters, the State of the Platte Report, and the annual AMP Reporting Session.	
Subcomponent Data synthesis		
Performance Assessment	Structural: • PRRIP uses Big Questions as a tool to roll up several underlying priority hypotheses and discuss strong inference of multiple lines of evidence with the GC. • EDO has developed two sets of synthesis chapters (tern/plover, whooping crane). • State of the Platte Report summarizes annual AM learning and learning over time for the GC. • Synthesis discussed during the annual AMP Reporting Session which includes the GC, TAC, ISAC, EDO, contractors, and other interested parties.	Functional: • General agreement this is a strong suit of the PRRIP. • Synthesis chapters on terns/plovers and whooping cranes have formed the basis of AM learning conclusions after several years of implementation. Most of the individual chapters have been published in refereed journals. • Annual State of the Platte Reports for the GC include EDO assessments (thumbs up, thumbs down, not certain) of the Big Questions giving the GC direction on what the Program has learned to date relative to those questions and the underlying hypotheses. • All synthesis, Big Question assessments, and general conclusions from learning are discussed in detail at the annual AMP Reporting Session. • Some concern raised as to making sure that the EDO and others do not jump to conclusions, let the data speak and make sure clear linkages exist to Big Questions and hypotheses.
Consequences of Failure	• Low risk, priority effort of the PRRIP. Need to specify Big Questions, hypotheses, and approaches to synthesis for the Extension.	
Consequence Rating (C)	2	
Likelihood of Failure	• Very low risk, this remains a priority of the PRRIP at all levels – GC, TAC, and EDO.	
Likelihood Rating (L)	1	
Risk Rating (CxL)	2	
AG/AM Risk Typology "Fit"	• A critical step in AM. The priority placed on this by the PRRIP makes it a very low AM risk factor.	
Recommendations for Reform	• Collaboratively develop Big Questions, hypotheses, management actions, and approaches to data analysis and synthesis for the Extension.	

AM Component Evaluate	**Subcomponent Description:** • *Definition* – Integration of independent science review (science panel, peer review, publication) into the process of Program data analysis and synthesis. • The ISAC provides independent science review on AM implementation to the GC. The PRRIP also utilizes peer review through its own peer review process for critical Program documents, monitoring protocols, reports, etc. and then seeks publication when warranted for additional peer review and to ensure scientific rigor.	
Subcomponent Independent science review		
Performance Assessment	Structural: • The PRRIP has a standing independent science review panel in the form of the ISAC that reports directly to the GC. • Independent peer review following the Program's internal peer review process is utilized, when directed by the GC, for particular Program reports, monitoring protocols, and other key documents. • The PRRIP has a proven track record of publication.	Functional: • The ISAC generates an annual report to the GC based on questions from the EDO, TAC, and GC directly; discussions and presentation at the annual AMP Reporting Session; drafts of the annual State of the Platte Report; and other webinars and discussions throughout the year. • The GC has asked the ISAC to weigh in on certain issues over time, including pallid sturgeon and the Platte River caddisfly. • Some feeling that the ISAC may be underutilized especially as the PRRIP pivots to the Extension, attention needs to be paid to ISAC structure and function for the Extension to ensure their continued utility. • The PRRIP has used peer review a few times during the First Increment as directed by the GC (for example, on the stage change study, monitoring protocols, etc.). That peer review follows a specific process collaboratively developed by PRRIP entities and the EDO. • To provide additional peer review and to seek additional independent science input, the PRRIP utilizes publication of manuscripts. For example, most of the tern/plover and whooping crane synthesis chapters have been published in established refereed journals.
Consequences of Failure	• A central feature of the Program's science structure. Need to ensure the ISAC is kept strong, functional, and useful to the GC during the Extension.	
Consequence Rating (C)	**3**	
Likelihood of Failure	• Low risk, a continued source of focus for the PRRIP.	
Likelihood Rating (L)	**2**	
Risk Rating (CxL)	**6**	
AG/AM Risk Typology "Fit"	• An important step in a functioning AM program – ensures more robust and valid conclusions and thus related decisions. Low risk for the PRRIP, generally a strong aspect of the Program.	
Recommendations for Reform	• Pay attention to the structure and function of the ISAC for the Extension, ensure it meets the needs of independent science review for and advice to the GC.	

<table>
<tr><td>AM Component
Adjust</td><td colspan="2" rowspan="2">Subcomponent Description:
• Definition – Information from data synthesis and independent science review are communicated to decision-makers as an input into Program decision-making, with the result being clear management decisions that include science learning as an important input.
• To date, the most successful example of this in the PRRIP is the use of Structure Decision Making (SDM) to help connect AM learning to GC decision-making.</td></tr>
<tr><td>Subcomponent
AM results communicated to decision-makers and used in decision-making</td></tr>
<tr><td>Performance Assessment</td><td>Structural:
• The EDO reports on AM learning to the GC at all quarterly GC meetings.
• Some members of the GC participate in the annual AMP Reporting Session.
• Workshops and GC Special Sessions are used to communicate and discuss AM learning and how that learning can be used to inform GC decisions.</td><td>Functional:
• The primary example of how the PRRIP has handled this issue is the use of SDM to provide the GC with decision-making context for considering management actions related to tern/plover nesting habitat.
• Tradeoffs, consequences, and expected outcomes were part of the SDM process which led to the GC deciding to adjust management actions related to flow management for terns and plovers and a focus on off-channel nesting habitat.
• General agreement that the GC found this to be a helpful and successful effort that should be repeated.
• Need to develop a more formal, repeatable process for linking AM learning to GC decision-making for the Extension.</td></tr>
<tr><td>Consequences of Failure</td><td colspan="2">• Generally, a critical subcomponent of AM; a fatal flaw if this subcomponent fails. For the PRRIP, low risk because this is seen as critically important for the Program.</td></tr>
<tr><td>Consequence Rating (C)</td><td colspan="2">2</td></tr>
<tr><td>Likelihood of Failure</td><td colspan="2">• Low risk, just need to ensure a more formal and repeatable process is established for the Extension.</td></tr>
<tr><td>Likelihood Rating (L)</td><td colspan="2">2</td></tr>
<tr><td>Risk Rating (CxL)</td><td colspan="2">4</td></tr>
<tr><td>AG/AM Risk Typology “Fit”</td><td colspan="2">• True AM can only be successfully implemented if a program can adjust based at least in part on its science learning. Successfully completed one full cycle of the six AM steps in the PRRIP, poised to do it again in the Extension so very low risk.</td></tr>
<tr><td>Recommendations for Reform</td><td colspan="2">• Collaboratively develop a more formal process (SDM and/or other tools as necessary) for linking AM learning to GC decision-making.</td></tr>
</table>

AM Component Adjust	**Subcomponent Description:**	
Subcomponent Documentation of decision-making results	• *Definition* – Public reporting of the Program decision-making process, with clear and repeated reporting of how, or if, management actions and implementation are adjusted utilizing Program science learning through AM. • GC decisions are clearly recorded in the minutes of all GC decisions, which are made public on the PRRIP website. Final reports from efforts like the tern/plover SDM process are also posted for public consumption on the PRRIP website. Changes in management actions or new approaches are also detailed in the annual PRRIP budget and work plan.	
Performance Assessment	Structural: • GC decisions all recorded in quarterly meeting minutes that are posted for public consumption on the PRRIP website. • Results of the tern/plover SDM process also posted on the PRRIP website in the form of a final report. • The PRRIP generates an annual work plan with its annual budget that details how money will be spent on management actions, monitoring, analysis, and synthesis in the coming year.	Functional: • All GC meetings are open to the public and all discussions are recorded in public minutes.
Consequences of Failure	• Very low risk, all GC decision-making related to AM, budgets, or any topic are recorded and made publicly available. Those decisions are made in open session at public meetings.	
Consequence Rating (C)	**1**	
Likelihood of Failure	• Very low risk, all documentation and reporting procedures are to be retained during the Extension.	
Likelihood Rating (L)	**1**	
Risk Rating (CxL)	**1**	
AG/AM Risk Typology "Fit"	• Important to memorialize the results of full implementation of AM through the Adjust step. The PRRIP has done this and will continue to do so during the Extension so low AM risk.	
Recommendations for Reform	• Continue to provide public documentation and reporting of all GC decision-making during the Extension.	