RECLAMATION
Managing Water in the West

An Adaptive Management Workshop Manual to Assist in the Prevention, Management, and Resolution of Water Resource Conflicts

Managing Water Conflicts, UC Region and Denver TSC

prepared by

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Introduction

If you are reading this manual, you likely are involved in a water resource conflict or believe that you will be in the future, and you are seeking input on how to prevent or resolve the conflict. The probability of our assumption being correct is high because, particularly in the 17 western arid to semi-arid states serviced by the Bureau of Reclamation (Reclamation), uses of water are changing and water resource conflicts are emerging (Cortese 2003). Demands for water in many basins exceed available supply, even in years of normal precipitation (Bureau of Reclamation 2003, p. 3) and predictions emerge of a potential future crisis in water supply (Seager and others 2007, Barnett and others 2008). New strategies and institutional arrangements clearly are necessary for water managers to adequately address increasing risk and competition for water resources in this changing environment (Pahl-Wostl 2002, Pahl-Wostl and others 2007).

Adaptive management is a rigorous approach to managing complex natural systems by deliberately designing and conducting management actions as experiments to improve learning and reduce uncertainty so that decision makers have a scientific foundation to integrate with political considerations in determining whether or not to change management policies (Holling 1978, Walters 1986, Bormann and others 1999, Murray and Marmorek 2004). It is one of several related collaborative management methods that have been used to address complex natural resource issues (Blumenthal and Jannink 2000).

Adaptive management is not an end unto itself, but rather a means to reach better decisions that result in improved resource management (Williams and others 2009). The process grew out of a dissatisfaction by scientists with the products of assessments that were accomplished to satisfy the environmental laws passed in the U.S. during the late 1960s and early 1970s, e.g. National Environmental Policy Act of 1969, Clean Water Act of 1972, Endangered Species Act of 1973. Too often the outputs from these assessments were lengthy tomes that followed prescriptive formats and claimed to understand what the effects would be of actions proposed by federal agencies. They did not admit to the high uncertainty that scientists often attributed to their predictions or to the complexity of ecological interactions and resource responses to human actions. Also, monitoring of actual effects was too often not included when projects were implemented, because budgets were not provided to do so, and assessment conclusions were accepted on faith by managers as a necessary intrusion into the process of moving forward with the project (Holling 1978). These criticisms have persisted (National Research Council 1986) in the face of increasing complexity and severity of environmental problems.

The roots of adaptive management lie in the desires of scientists and managers to improve the decision making process for environmental resource management through interjection of science and stakeholder participation. (Holling 1978, Williams and others 2009). From the early stages of adaptive management development, this approach to renewable resource management has utilized the participation of a variety of people having different expertise and interests in a workshop environment at key points in the process (Holling 1978, p. xi). Three categories of participants—scientists, managers, and policy makers—were considered essential, and high emphasis was placed on constructing and testing simulation models for resource management in subject ecosystems (Walters 1986). Over the course of time, stakeholder participation has increased to engage political change in a process of social learning and problem solving (Lee 1993, p. 8, Williams and others 2009, Williams and Brown 2012). The increasing contribution of nongovernment stakeholders to decision making is manifested in the emergence of adaptive governance and adaptive co-management (Brunner and Steelman 2005, Folke and others 2005) in which authority held by government agencies is being shared through active public participation in decision making. Pahl-Wostl and others (2007) identified that this transition is part of a major paradigm shift in natural resources management, and particularly in water resources management.

Adaptive management often is portrayed as a six-step process or cycle (Figure 1). Step 1, assessing the problem, typically is accomplished through a series of workshops, such as are advocated in this manual, which include input from scientists, managers, and other stakeholders. Participants define the scope of the problem, bring together existing knowledge, and forecast potential outcomes of different management actions that might be taken. Design, in step 2, refers to the development of management and monitoring plans under which to take actions and measure their effects. In steps 3 and 4 the plans are implemented and observations are made on resource responses. Step 5 is the phase in which program participants compare what happened to what was forecast to happen. In step 6, adjustments are made based on knowledge gained to improve achievement of management objectives.

These six steps also can be divided into two phases: a setup phase and an iterative phase (Williams and others 2009, Williams and Brown 2012). In the set-up phase key components are developed, and in the iterative phase those components are linked together in a sequential decision process. The set-up phase has five structural elements, namely stakeholder involvement, management objectives, potential management actions, predictive models, and monitoring plans. The iterative phase uses these elements in an ongoing cycle of learning about system structure and function, and managing based on what is learned. To be effective, adaptive management requires a commitment to learn and then adjust based on what is learned. It is much less likely to be effective if participants enter the process with their minds made up leaving little opportunity for learning. Since one cannot learn from experience without measuring the consequences of actions taken, adequate resources for monitoring effects of actions also are necessary. Finally, decisions, actions and outcomes need to be documented and communicated to all involved in the process, so that knowledge gained is shared (Nyberg 1999).

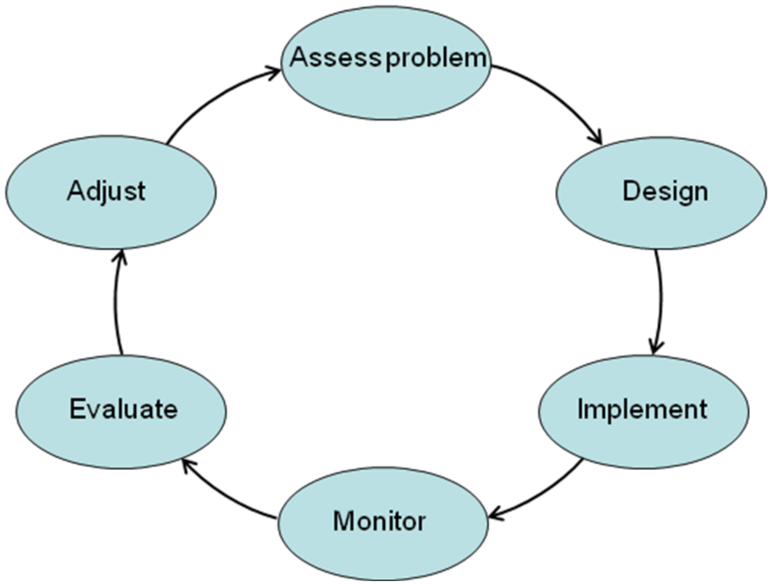

Figure 1. A diagrammatic framework for the adaptive management process of learning by doing (Nyberg 1999).

Workshops are considered a core activity in adaptive management projects and they can serve a valuable purpose in promoting dialogue, understanding, and trust in conflict resolution. Their principle use historically has been in the initial phase, assessing the problem, however they can occur anywhere in the process as a means of communication with and gaining responses from stakeholders.

A successful adaptive management workshop does not just happen. As Holling (1978) states, "…the best and quickest way to learn modes of successful operation of workshops is to build a body of experience by conducting some." There also is a good deal of work that must be done prior to convening a workshop, including ensuring that the right people and interests are present. Walkerden (2005), citing Wondolleck and Yaffe (2000), argues that successful collaborative decision making will involve four factors:

- early, often, ongoing active involvement by stakeholders in analysis, implementation, review, and decision making;
- real substantive involvement by all stakeholders;
- consensus decision making is desired, but widespread agreement may be suitable and;
- participation must be inclusive and representative, so key decision makers, interests, and opinion leaders must be involved.

Walkerden (2005) has concentrated on adaptive management workshops as part of a conflict resolution process and expanded their use beyond the initial phase of adaptive management. He noted that adaptive management includes planning processes that combine dialogue amongst stakeholders and resource experts with systems analysis and exploration of decision making in the face of uncertainty. Part of the process is carried out through multiparty, multidisciplinary workshops and simulation modeling to facilitate dialogue, negotiation, and planning, but these processes have been criticized for failure to provide adequate forums for the creation of shared understanding among stakeholders. Walkerden (2005) advocated that adaptive management processes be combined with processes derived from bargaining traditions such as principled negotiation (Fisher and others 1991) and sequenced negotiation (Susskind 1994) that engage conflict much more successfully than they do uncertainty.

The nature and scope of the conflict being addressed will play an important role in defining the process used to manage the conflict. People can disagree about many different aspects of a resource management issue, but these differences usually center on either facts related to cause and effect relationships or values directed at preferences for an outcome. Cardwell and others (2009) use an example of the relationship between stream flows and a recreational fishery to illustrate the difference. Participants in the dispute can disagree over technical questions (facts) such as whether a particular flow will affect a fishery. They can also disagree over what the flow should be based on their preference (values) for whether or not the fishery should even exist in the stream. Where the latter prevails, resolution of the dispute is not furthered by incorporation of additional scientific information and reduction of uncertainty. The influence of science in adaptive management will thus be stymied, leading to pathways that rely more on bargaining and compromise (Lee 1993).

This manual builds upon Walkerden's work and also extends from several previous Reclamation and Interior documents directed at adaptive management and decision making: *Review of Decision Making in Reclamation (Bureau of Reclamation 2004; abbreviated as RDMR), Adaptive Management: The U.S. Department of Interior Technical Guide (Williams and others 2009), Adaptive Management: The U.S. Department of the Interior Applications Guide (Williams and Brown 2012),* and *A Guide to Effective Solutions: Decision Process Guidebook (Bureau of Reclamation 2002; abbreviated as GED).* It also draws on the "shared vision planning" approach to collaborative water resource management practiced by the U.S. Army Corps of Engineers (Cardwell and others 2009, Creighton 2010).

Reclamation policy specifically promotes public involvement and thus serves as an inroad to this approach to conflict resolution:

> To ensure that whenever Reclamation actions may significantly affect individuals or groups, Reclamation will systematically

> provide opportunities for affected individuals, groups, and communities to be informed about the issues; as appropriate, participate in the definition of the problem, objectives, and possible solutions; and have their views documented and considered in Reclamation's decision-making processes. (see: http://www.usbr.gov/recman/cmp/cmp-p03.pdf)

This manual was written for managers, scientists, and mediators interested in using adaptive management workshops and processes as venues for preventing or managing water conflict. The primary steps in using adaptive management workshops as a forum for conflict management and decision-making are (a) pre-meeting project establishment efforts, (b) scoping workshop sessions, (c) structure workshop sessions, (d) dynamics workshop sessions, and (e) implementation (Walkerden, 2005).

Background: Water Scarcity and Water Conflict

As more people urbanize and increase the municipal and industrial use of water in the West, the amount available for historic uses serviced by Reclamation, including irrigated agriculture, is decreasing. In the Upper Colorado River Basin, total water use increased an average of approximately 26,000 acre-feet a year or a total of more than 1,000,000 acre-feet from 1971 through 2008, whereas agricultural use increased at a rate of 10,000 acre feet a year or about 460,000 acre-feet during the same period (Figure 2). Also, exports of water out of the basin grew by nearly 120,000 acre-feet in the same interval (Bureau of Reclamation 2004b, 2005, 2006, 2010). Agriculture is the largest user of water in the region (Solley and others 1998, Gollehon and Quinby 2000, Brown 2006), however the ratio of municipal and industrial water use to agricultural use has doubled from 5% to 10%. Water is increasingly being transferred away from agriculture to meet the needs of growing urban populations and instream uses, as there is little remaining unappropriated water (Platt 2004, Cortese 2003).

Even if you do not reside in the western United States, or even if you reside in a foreign land, the prospect remains that you may experience water resource conflict. The potential for conflict increases when political entities sharing a water resource have differing institutions for governing the resource (Jarvis and others 2005). Where the demand for water shared by neighboring nations approaches or meets available supply, international conflicts may increase (Postel and Wolf 2001). Throughout the world, competition for finite water resources is increasing as the population of humans and their demands on water resources grows (Jowit 2008). The demand for water also is inextricably tied to the demand for energy, which further complicates the human dilemma (Voinov and Cardwell 2009). Added to this dilemma is the prospect of new shortages and geographic redistribution of freshwater supplies due to the effects of global climate change (Carpenter and others 1992).

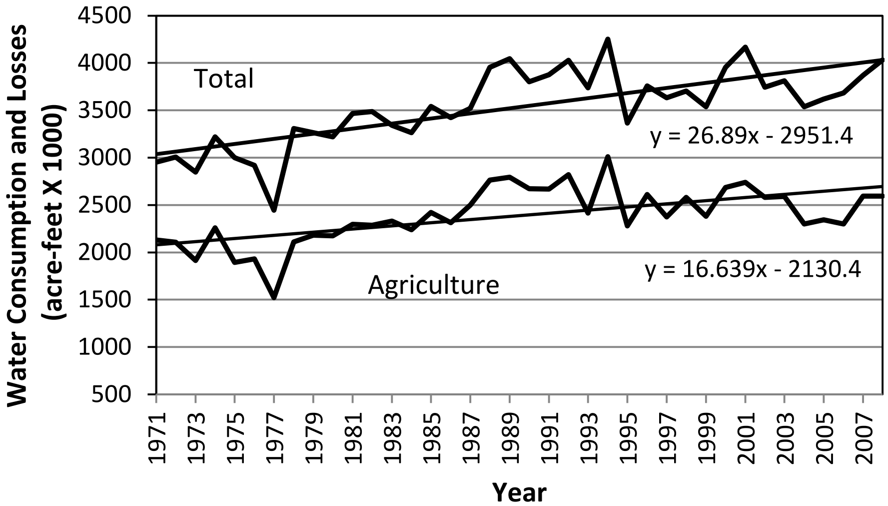

Figure 2. Total and agricultural consumptive uses and losses of water in the Upper Colorado Region of the Bureau of Reclamation from 1971 through 2008 (values for 2001 through 2008 are estimates). Values are in thousands of acre feet. Regression by least squares determination with intercept fixed at the value for 1971.

On a more positive note, research on water conflicts among nations has produced the unexpected result that, given the appropriate agreements and understandings of shared needs for water resources, human beings seldom engage in armed conflict in response to water shortages and even cooperate to endure these hardships (Wolf 1998, Yoffe and others 2003). Also, Fesler (2007) found that in the state of Oregon, as in international river basins, cooperation is often more common than conflict. What appears to be lacking where conflict surpasses competition is the institutional capacity of governments and citizen groups to respond to rapid change that accompanies or foments conflict (Wolf and others 2003). This brings forward the need for development of tools and processes that can be integrated into and build up the institutional capacity to facilitate collaboration over conflict.

A 2002 survey of Reclamation managers to determine their perspectives on causes of water resource conflict produced 33 different causes. Of the 33, the top 13 accounted for 79% of all responses (Figure 3). Leading the list was endangered species conflicts, followed by human population growth (including migration) and Indian water rights. If the totality of water resource conflicts was vested in even this short list of causes, there likely would be requirements for Reclamation managers to engage, at a minimum, stakeholders from other federal agencies, state agencies, recreation groups, environmental groups, agricultural interests, county and city governments, and American Indian tribes.

When combined with the vagaries of climate, economic conditions, changing political landscapes, and other uncertainties with which managers must contend, the extended list exemplifies the reality that water resource problems are among the set of "wicked problems" (Rittel and Webber 1973) or "second-order collective action conflicts" (Scholz and Stiftel 2005) whose solutions cannot be addressed by traditional methods historically used by agencies. These problems lead to conflicts that are producing new challenges for water resource managers in the 21st century including: (1) increasing complexity of both the problems and the social arena in which they are resolved; (2) increasing conflict over disputes of fact and of values among stakeholders; (3) limited knowledge and uncertain wants that change during the course of conflict resolution, and; (4) an inherent lack of trust among stakeholders that is difficult to overcome and can greatly affect the persistence of favorable outcome. (Cardwell and others 2009). It is not difficult to see, therefore, that the challenges for Reclamation managers in the 17 western states to resolve these conflicts and facilitate cooperation among potential contestants are both increasing and diversifying. Adaptive management has increasingly been used to inform water resource decisions using sound science and we believe that the process, with its attendant workshops as forums for discovery, discussion and decision making, offers a natural framework for managing those conflicts.

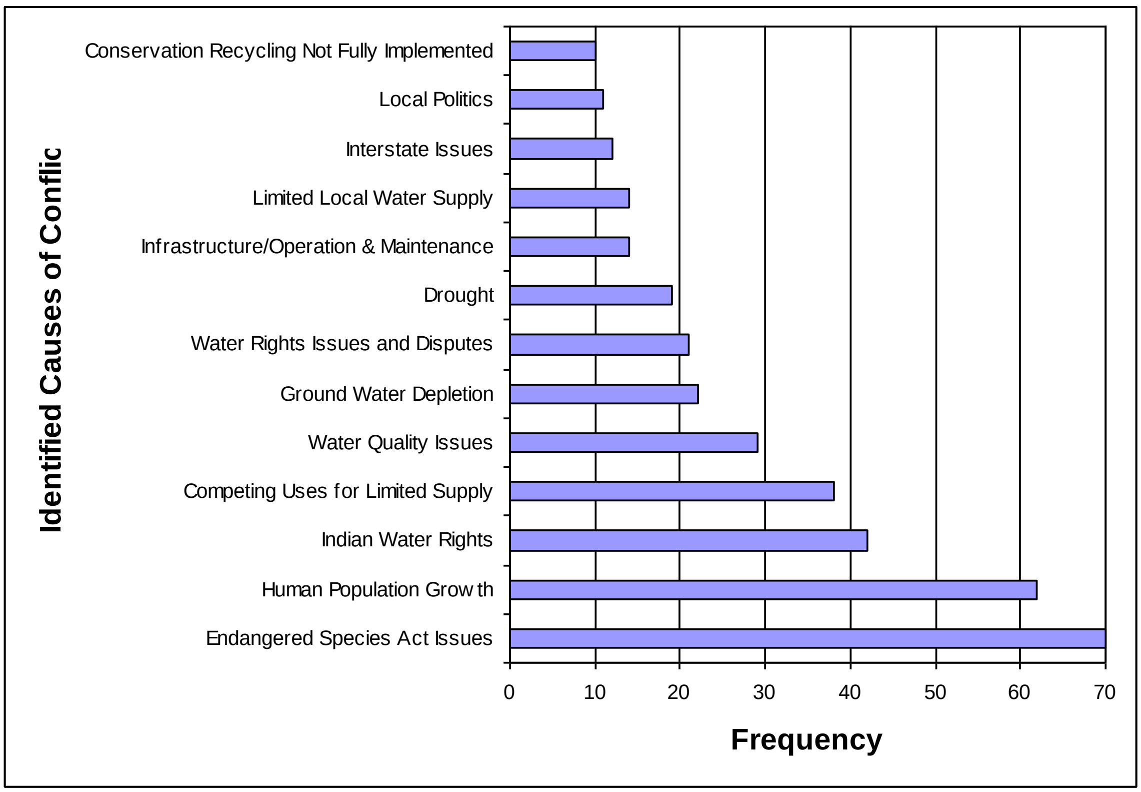

Figure 3. Causes of water resource conflicts in the 17 western states serviced by the Bureau of Reclamation as identified by agency managers.

Integrating Adaptive Management and Conflict Resolution

In many areas of human endeavor where individuals disagree, resolution is achieved without aggression or violence by facilitation, mediation, communication, and compromise. The end point of success can be an agreement reached by the people engaged in the process, with little attention paid to those people or resources who are not involved and do not have a voice in the process. Where natural resource management is the subject of disagreement, and particularly where regional or larger scale issues are at stake, the satisfaction of the group in resolving conflict may miss or avoid much larger issues. Thus, collaboration among humans can be viewed as successful in outcome, because group members are pleased with their efforts at achieving consensus, yet they may leave behind unresolved issues and disaffected resources not considered in the scope of the collaborative process.

Wondolleck and Yaffe (2000) address this concern under the umbrella of ensuring accountability by positing that a successful collaborative process should have three defining features: (1) legitimate, i.e. founded in law, participated in by responsible officials, and open to public for comment; (2) fair, i.e. those who will be affected are represented, the process is open and transparent, and decisions are reached through consensus rather than capitulation, and; (3) wise, i.e. focused on the problem, open to creative solutions, rooted in current scientific understanding, cognizant of uncertainty, and open to learning.

Adaptive management brings to conflict resolution a process for commitment to an open forum with broad-based participation that allows a wide variety of positions to be heard in seeking solutions. It brings a commitment to an objective, science-based foundation for decision making that forces attention to fact finding and learning in the face of uncertainty. Participants agree to apply modeling as a means to achieve a better understanding of how resources may react to management actions and to allow comparisons of predicted outcomes, in full view of underlying assumptions and uncertainties. Monitoring of resources ensures that managers have feedback on whether their actions are having the desired effects. From these projected outcomes and empirical results, experiments can be designed to test the predictions and improve knowledge, or, if risks are acceptable to decision makers, policy changes can be implemented. Through this combination, the process has the potential to satisfy the needs for legitimacy, fairness and wisdom identified by Wondolleck and Yaffe (2000).

Walkerden (2005) asks how the adaptive management planning process can be adapted to work better as a conflict resolution process. In answer, he turns to processes that concentrate on bargaining traditions, like principled negotiation (Fisher and others 1991) and suggests that a hybridization of the two processes should produce fruitful outcomes. Principled negotiation offers procedures and techniques that are not commonly understood or utilized by water resource managers, but need to be for successful conflict resolution. Four principles not emphasized in adaptive management are of importance:

> (1) Separate the people from the problem, i.e. keeping the focus on problem solving and away from personal conflicts. To accomplish this task, good facilitators will have to know how to listen carefully, how to be assertive when emotions begin to dominate the conversation, and how to turn emotional statements into constructive dialogue directed at better understanding and joint learning.
>
> (2) Focus on interests, not positions. The forum of an adaptive management workshop allows all participants an equal advantage to express their interests. It also provides an opportunity for participants to understand the basic values of their group members and how they perceive the system and its resources. Where differences occur, they can be directed through questions to improving the communication to enhance learning, rather than taking positions that polarize the participants.
>
> (3) Invent options for mutual gain. As participants begin to understand one another better, and a level of trust is developed, they characteristically become more open to seeking options that might have mutual benefit. They also begin to realize that there are uncertainties in outcome associated with implementing the options and to appreciate the need for science as a mechanism for improving their common knowledge of the system and resources in dispute. Participants often are pleasantly surprised to discover that they have inadvertently taken the first steps to developing a conceptual model, a task that many find formidable when first described.
>
> (4) Insist on objective criteria. Evaluation of predicted outcomes is a critical part of the iterative adaptive management process. Value-driven participants often advocate for criteria that, in their estimation, point the way to their favored management options or resources being used. It is necessary for those who conduct workshops, particularly those who facilitate discussions, to ensure that the process is directed toward unbiased joint learning and that the selected criteria are capable of distinguishing among the management options.

Adaptive management cannot guarantee the success of conflict resolution, in part because it is a process that depends on undependable human interactions. Humans can be the most important link in successful implementation of adaptive management, or the link that breaks and leads to failure. It is well recognized that water resource conflict resolution must bring more than traditional science to bear on problem solving (Ozawa 2005). What adaptive management provides is science directed at and applied to improving knowledge and reducing uncertainty to pave the way to better management decisions, transparency through open, public processes, and diversity of viewpoints from a wide range of affected stakeholders to help construct a process that can work. It is up to those of us that believe so to make it work.

Objectives and Associated Tasks for Implementing Adaptive Management Workshops for Conflict Resolution

Overview

No conflict management professional would dream of going into a scoping meeting without doing the requisite homework, and the need for preparation and planning is no different for adaptive management workshops. Reclamation managers will have a variety of roles in the workshop process and it is imperative that due consideration be given beforehand to determining how their roles, and the roles of other stakeholders, will be carried out through the process. Even if Reclamation is clearly the agency with decision making authority and the individual or individuals with that authority are identified, there are many opportunities for confusion and consternation in multi-party processes undertaken to resolve complex and critical issues common to water resource disputes. Decision makers are seldom deeply and consistently involved in the workshop process, so Reclamation managers will often be tasked with communicating with the workshop group and with superiors who will need to be briefed on progress and problems on a regular basis. Also, because adaptive management is a sequential, iterative process, decisions will need to occur at a variety of places in the process, not just at a single point.

It is clear that the role of Reclamation managers in the conflict management process is complex and that, for many, new or improved skills are needed for successful outcomes (see Fraidenburg and Strever 2004 for examples). This need was recognized by the National Research Council (2006) report on Reclamation construction and infrastructure:

> Reclamation has traditionally been an engineering- and science-driven organization. As such, training has been heavily focused on basic technical competencies. The success of Reclamation's mission to manage water resources will more and more depend on the bureau's ability to solve problems through consensus, requiring an increased emphasis on training and the retention of staff with collaborative competencies at all levels of the organization.

In response to this finding, Reclamation (2008a) committed to expand and integrate training to improve the collaborative competency of staff bureauwide. This commitment was subsequently endorsed through Reclamation policy CPM P08 (Reclamation 2008b) and included in performance evaluations for agency personnel.

The Pre-workshop Process

There are several key steps for integrating adaptive management workshops into the conflict resolution process (Walkerden 2005). Each step has its own set of objectives and there is an associated set of tasks that must be performed to meet these objectives.

The overarching objective of the pre-workshop process is to give workshop organizers an opportunity to set the stage for subsequent steps by addressing the who, what, when, where, why, and how questions and prepare for the *scoping meeting*. As Lee (1993) puts it, the political task that precedes negotiation is to organize the contending parties so that each is able to deal with the others. Walkerden (2005) argues that adaptive management workshops should be set up as negotiation processes leading to formal agreements and we agree this is desirable where attainable. The pre-workshop process should (1) engage in the identification of problems, views, values and perceptions that are at the root of the particular water resource conflict, in essence, bounding the conflict geographically, politically, and scientifically; (2) explore the range of potential desired future conditions for the system under conflict; and (3) assess what is known of cause and effect relationships between diverse actions and resources that might be affected by proposed actions. The objectives of the pre-meeting should be to:

- Become informed: all organizers should achieve a common understanding of the process and issues.
- Assess the utility of adaptive management processes.
- Examine resources and constraints.
- Identify the level of need for facilitators and identify who will facilitate.
- Identify and invite stakeholder representatives and experts to participate in adaptive management workshops, in shuttle diplomacy, or informal mediation.
- Describe the geography.
    - Water system (hydrography) description.
    - Engineering modification of the water system.
- Describe the ecosystem.
- Develop a data management plan.

Become Informed

It is critically important that the conflict management team become thoroughly familiar with every facet of the management decision that must be made. To do this it will be essential to peruse previous related documentation and studies. In doing so, it is important to try to gauge what the *critical issues* are and what

Reclamation's role and authority are (GED, 61-69, 76ff). Investigative efforts should also include reconnaissance of previous modeling efforts. It might be prudent to have a modeling expert assess the quality of previous modeling. To the extent possible at this stage, determine if previous models are desirable for the present effort (possibly with new inputs), if additional modeling is needed, and/or if a new model is required.

It will also be essential to assemble a multidisciplinary core team of subject-matter experts: legal, scientific, modeling, public, political, and international as the initial problem scoping indicates (RDMR, p. 10ff). It will be necessary to clearly define the roles and responsibilities of each team member. Establishing a consistent team process to follow when an issue arises can help to prevent internal conflicts. More will be said about this below under objective 5.

Conduct extensive interviews with a broad range of stakeholders and other interested parties to get their assessment of what the critical issues are. Try to identify unique categories of perspective on the issues and at the same time ask respondents to estimate the spatial and temporal extent of the problem. Ask the parties what they see to be the water management problem(s) to be addressed and the important resources that could be impacted by management actions. How well known are the relationships between management actions and resources responses, i.e. what levels of uncertainty exist in these relationships. Prioritize the list. Determine to the extent possible the range of desired future conditions. Begin to assess the cause and effect relationships between actions and resources that might be affected by alternative management actions that could be undertaken.

Determine who the decision-makers are, at what level they are located, and communicate with them early and often. What decisions will be made and who will make them? Do not neglect the role of informal decision-makers, such as prominent farmers or business people. Explore and understand the roles and responsibilities of those involved in the decision process. Determine what will be proposed as recommendation or decision processes and whether they will allow for anyone to exercise a veto in the conflict management process.

Determine the type of decision to be made: command, consult, or consensus (see, GED, p. 12).

- **Command**: Authoritative order or direction without consideration of another's view
- **Consult**: Authoritative order or direction with consideration of another's point of view
- **Consensus**: General agreement by all parties.

Given that adaptive management workshops invite input from a variety of stakeholders as participants in a decision-making process, a command decision as defined here would not occur in the workshop. Also, modern water resource conflicts are complex and often involve multiple jurisdictions, so there is seldom a single decision maker. Unless workshop participants are empowered to make final decisions in the negotiated agreement, a recommendation from the group to decision makers is a more likely outcome. The range of input to decisions often will lie within the boundaries of consult and consensus. Just how much emphasis is placed on achieving consensus is an important decision that should be afforded a high level of consideration.

Identify constraints within Reclamation and outside the agency for making management decisions. What are the views of Reclamation senior management? What Reclamation policies impinge upon the management decision? Again, what authorities does Reclamation have in this matter? How much budget is Reclamation willing to commit to pursuing an adaptive management workshop process? What are the political and policy constraints that impinge upon other agencies that are involved with this management decision, such as the Fish and Wildlife Service, the Army Corps of Engineers, or the National Park Service? What legal constraints, if any, exist? Are there any flexibilities in the pertinent laws?

Get a sense of what the social and political contexts are for the management decision at hand. What are the alignments of various interests with various possible management alternatives? Determine the distribution of political power and influence.

Get the best assessment you can of what alternative courses of management action might be feasible (these will be thoroughly aired in the scoping meetings), what criteria might be used to evaluate them, and the data that will be needed to conduct an analysis.

Determine what documents must be produced. What are the guidelines for document preparation? Assign document oversight to one of your team members. Determine who will review and approve the documents. Are appraisal and feasibility reports required? Consider selecting a peer review oversight committee for quality assurance.

To the extent possible, attempt to determine what "success" will look like and what criteria will be used to assess success. Again, determine the range of desired future conditions for the system under conflict.

Assess the Utility of Adaptive Management Processes

Obviously, if conflict resolution in the context of adaptive management workshops is being contemplated, then it must be determined early on if adaptive management is the desired framework to be used or if some other process should be applied. Williams and others (2009) provide a series of questions that, if answered in the affirmative, can lead to a conclusion that adaptive management is appropriate for a decision-making process:

- Is there a mandate to take action in the face of uncertainty?
- Does institutional capacity and commitment exist to undertake and sustain an adaptive management program?
- Is some kind of management decision to be made?
- Can stakeholders be engaged?
- Can management objectives be stated explicitly?
- Is decision-making confounded by uncertainty about potential management impacts?
- Can resource relationships and management impacts be represented in models?
- Can monitoring be designed to inform decision-making?
- Can progress be measured in achieving management objectives?
- Can management actions be adjusted in response to what has been learned?
- Does the whole process fit within the appropriate legal framework?

Some of these questions go beyond the question of whether adaptive management workshops are appropriate, but they are important to consider in the event that a full-fledged adaptive management program be considered as an outgrowth of the workshop process. There should be a concerted effort to evaluate these questions both in the pre-meeting and scoping meeting sessions.

Examine Resources and Constraints

What resources are available in terms of funding, technical expertise, communications systems, personnel, equipment, materiel, data, access to study sites, etc.? What constraints exist in terms of the law and other regulations; authorities; existing policies, and the goals and objectives of various participants? Given these resources and constraints develop a sense of what level of effort is currently possible. Put together a budget.

Identify Facilitators

Identify facilitators or other conflict management professionals such as mediators, negotiators, and arbitrators, “that are capable of facilitating negotiations amongst stakeholders in ways that will help them explore their underlying interests, using multiparty, multi disciplinary analysis of socio-ecological systems as a vehicle for this” (Walkerden 2005). Expertise in adaptive management processes would, of course, be implied.

Identify and Invite Stakeholder Representatives and Experts to Participate in Adaptive Management Workshops, and in Shuttle Diplomacy, or Informal Mediation.

It goes without saying that it will be necessary to determine if there are mandated participants. After interviews have been conducted, the relevant scholarly literature has been perused, and the media documentation has been surveyed, one can start to build up a set of potential cooperators and partners. In the course of their interviews, the core team will learn of other potential cooperators and partners. Key players and opinion makers from the following groups should be considered.

- Reclamation
- Cooperating partners
- Other Federal agencies
- State and local governments
- Interested organizations: e.g. hunting groups, environmental groups, farming interests such as The Family Farm Alliance, etc.
- Individuals who have a stake or interest in the outcome
- Water districts
- Local associations
- Consultants
- Scholars who have done work in the study area
- Irrigators

Asking persons in each group to provide a list of others that they think will want to be involved or who have an interest in the outcome of the management decision to be made will help to fill out the list of invitees.

Survey instruments have also been used to identify potential participants. Media announcements and web sites can also be means for identifying potential participants.

How many people can effectively come together in a workshop environment? There is limited guidance on this subject, but it may be that group size limitations that apply to other collaborative endeavors apply equally well in adaptive management workshops. Holling (1978) envisioned workshops of up to twenty specialists. These specialists are often divided into subgroups that apply their expertise to different resource groups or management actions. Walkerden (2005) limits the number to 30 or 40 at most, and advocates that if group size must be larger, adaptive management planning should play a supporting role to other processes. As advocated by Holling, the full group can be divided along lines of interest or expertise in parts of the process and then brought together at strategic times where it is important to have all parties engaged in a common setting (see also Creighton 2010).

People are invited to the workshop because of their interests, their expertise, their positions, their influence, and their willingness to work together in resolving conflicts. The last of these is vitally important. Many endeavors to resolve conflict are stymied by gridlock if the people involved do not enter with a willingness to engage constructively and with respect for other viewpoints. The challenge is formidable to convene the right mix of interests, values, expertise, roles, authorities and responsibilities among the people who will participate in the workshop.

McLain and Lee (1996) point out that decisions about who participates in workshops will play a large role in determining outcomes. Raadgever and others (2008) advocate that involving all relevant stakeholders early in the process helps to ensure that participants will have a good overview of relevant technical knowledge, values, and interests. This familiarity will then lead to better experiments with less chance of degradation to the system of interest. Therefore, it is of vital importance that workshop organizers spend time identifying what features they are looking for in workshop participants.

Holling (1978, p. 13) gave reasons for including several groups of individuals. Policy people and managers were included to provide a balance to the scientist's desire for minute detail and high precision. Scientists were necessary to provide a concentration on rigor of the analysis and an understanding of fundamental physical, ecological, and economic forces. In addition to the scientists, managers, and policymakers identified by Holling (1978), Walkerden (2005) adds policy analysts, and industry and community representatives. Among them likely will be government natural resource managers, individuals from extractive industries, academicians, members of environmental groups, elected officials, recreationists, consultants, and bureaucrats. In situations where the scale of conflict is high and the discord among participants is highly demonstrable, the use of a professional facilitator is recommended. It is often difficult for a government representative, particularly from an agency that has authority for management of a resource involved in the conflict, to be viewed as a "neutral person".

Williams and others (2009) are clear that a first step in adaptive management is to engage "the appropriate stakeholders." Selection of stakeholders is mentioned, but there is limited guidance beyond using personal contacts, public announcements, formal consultations, or other means. In other forums directed at environmental problem solving, there is similar emphasis on getting the "right participation" and "getting the participation right," (National Research Council 1999, Chess and others 2000). How does a workshop organizer determine which stakeholders are likely necessary to achieve success? And what processes help to assure that the group will be effective in their attempt at problem solving? Within the latitude that managers charged with resolving conflicts have to make such decisions, we believe these questions deserve serious attention.

Stakeholders, defined as an individual or group influenced by–and with an ability to significantly impact (either directly or indirectly)–the topical area of interest (Glicken 2000), have become increasingly involved in recent years as the role of public participation has increased in importance. Mitchell and others (1997) provided insight into the theory of stakeholder identification and salience—the degree to which managers give priority to competing stakeholder claims. With regard to what kind of entity can qualify as a stakeholder, their treatment assumed that persons, groups, organizations, institutions, societies, and even natural environments can qualify as stakeholders.

To narrow the focus on who should qualify as stakeholders and how they should be perceived by managers, Mitchell and others (1997) argued that three stakeholder attributes deserve serious attention: (1) legitimacy, does the stakeholder have a legitimate claim, spanning the legal to the moral, to concern for the resource(s) of interest; (2) power, does the stakeholder have the power to influence the decision or outcome of the group process and; (3) urgency, a combination of the time-sensitive nature of the concern with the criticality of the decision to the stakeholder. A step-by-step process that provides exceptional detail on stakeholder selection to complement the categorical identification of Mitchell and others (1997) is provided by Bryson (2004) and is worthy of study by workshop organizers.

There are seven different combinations of stakeholders that are possible given the three attributes used by Mitchell and others (1997): (1) three low salience stakeholders who can only lay claim to one of the three attributes, termed *latent* stakeholders; (2) three moderate salience stakeholders that hold different combinations of two of the three attributes, termed *expectant* stakeholders and; (3) a single high salience stakeholder group, termed *definitive*, whose members have all three of the attributes in combination (Figure 4).

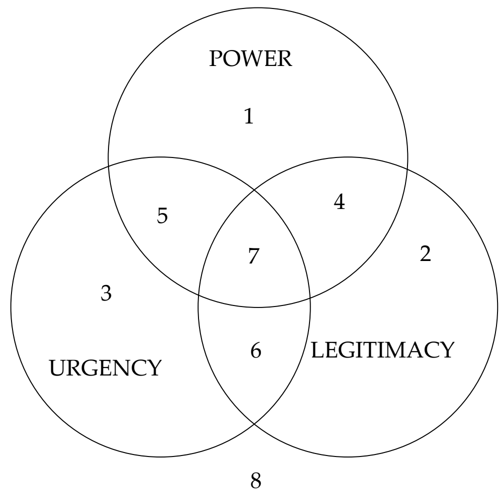

Figure 4. Illustration of different stakeholder categories in latent (1 = dormant, 2 = discretionary, and 3 = demanding); expectant (4 = dominant, 5 = dangerous, and 6 = dependent) and; 7 = definitive sets (from Mitchell and others 1997). The position of 8 is outside the stakeholder realm.

Mikalsen and Jentoft (2001) provided a method for stakeholder identification used in Norwegian fisheries management using the system of Mitchell and others (1997). They emphasized that stakeholder selection contains a need to decide who has a legitimate stake in the management of resources of interest, but that the diversity of involvement must be tempered with the necessity for efficient decision making. In their schema, all participants in the process are stakeholders, including managers, scientists, and decision makers in government agencies. Distinctions among stakeholders are made on the basis of scores (high, medium and low) assigned to three attributes (legitimacy, power and urgency), which places stakeholders in the latent, expectant, and definitive categories (see Table 1) identified by Mitchell and others (1997).

Table 1. Marine fisheries management stakeholders (Norway) from Mikalsen and Jentoft (2001).

Stakeholders	Urgency	Power	Legitimacy
Definitive	High	High	High
Fishers	High	High	High
Fish-processors	High	High	High
Bureaucrats	High	High	High
Enforcement agencies	High	High	High
Scientists	High	Medium	High
Fish workers	High	Medium	High
Expectant			
Indigenous peoples	High	Increasing	High
Environmental groups	Increasing	Increasing	Increasing
Local communities	Medium	Low	High
Latent			
Citizens	Increasing	Low	Increasing
Media	Increasing	Increasing	Low
Municipal authorities	Increasing	Medium	Increasing
Future generations	Low	Low	High
Banks	Low	High	Low
Consumers	Low	Low	Increasing
Equipment suppliers	Low	High	Medium
Tourist industries	Low	Medium	Low
Sports fishers	Low	Low	Increasing

Further definition of stakeholders and determination of their positions and interests was accomplished by Garin and others (2002) through semi-structured individual interviews. Stakeholders were selected to cover the full range of water uses and the geographic distribution of the conflict. The information collected through the interviews lead to (1) identification of key actors; (2) specification of decision rules for actions that had an impact on the hydrologic system; (3) identification of variables that determined the level of satisfaction of each stakeholder; and (4) identification of existing and anticipated conflicts over water use and conservation. Since workshops often are challenged by insufficient time for deliberation and discussion, such preliminary information seeking can be very valuable.

One of the first challenges of the workshop group is to determine the roles and responsibilities of the group, and of the individuals comprising the group, unless these prerequisites are identified to the group by a higher authority as a condition of participation. If the workshop is convened by a government agency, such as the Bureau of Reclamation, it is likely that the agency will have some authority for managing a portion of the resource base under consideration. In such situations, it is common for agencies to identify that they do not abrogate their authority for resource management by virtue of their participation in a group process. In practice, however, the amount of ownership and degree of active involvement in the decision-making process will be related to the willingness of participants to reach agreements and accept the final outcome (Pahl-Wostl and others 2007).

As set out in the above table, decision-makers are part of the group. It may be, however, that the ultimate decision maker, assuming the singular, is geographically dislocated from the group, hierarchically removed, or otherwise incapable of being actively involved in workshop deliberations. In such cases it is very important that there be delegation of authority to speak for the decision maker down to individuals involved in the conflict resolution process.

Working with the core team, it is important to develop a set of roles and responsibilities for prospective participants. Participants must understand their roles and responsibilities at the outset. Confusion quickly leads to dissatisfaction and opens opportunities for the less dedicated to challenge the process. In most situations there will be individuals for whom change likely will have negative consequences and for whom conflict resolution may not be wholly desirable.

Describe the Geography

Workshop organizers should interview technical experts close to the problem inside and outside Reclamation. From them attempt to get at the scale of the problem: national, state, local?

Interview local persons close to the problem. Once again, ask them to estimate the scale of the problem: national, state, local? Note that the people closest to the problem often have the best sense of what are the true geographic and time scales, but they also may be unaware of larger geographical, ecological, and political connections.

Put together an initial GIS application showing the basin(s) in question. This will also help to define the water system. Possible data layers might include: topography, wetlands, land use and cover, hydrography (including irrigation systems), Federal lands (including Reclamation lands), other land ownership, climate and meteorological data, geologic data (including soils), PLSS boundaries, ground water data, water quality data, political boundaries, demographic data, and transportation corridors. Many of these data layers are readily available through the Reclamation capability called the BORGIS DataSpace Console. A list of DataSpace layers is provided in Appendix I.

To set up DataSpace in a Reclamation office where it does not currently exist, contact the BORGIS System Management Team:

Kurt Wille: 303-445-2285
Bruce Whitesell: 303-445-3387
Greg Gault: 208-378-5325

Other data layers will be available from state, local, university, water district, and utility sources. Part of your pre-meeting responsibilities will be to track these data sources down.

Describe the Ecosystem

Make an initial exploration of the structure and patterns of cause and effect that shape outcomes in the problem area by studying the scientific and gray literature, by interviewing technical experts, and by talking with locals. Gathering existing relevant GIS data layers will also help you to do this. Put together a preliminary graphic representation or model of the problem. (No ecosystem is complete until social and economic elements have also been identified). A map of the various users within the basin is useful for conveying the spectrum of its constituencies.

A "hot-spot" map is often useful when mapping the problem-shed. For instance, where water quality is concerned, it might be useful to gather measurements throughout the watershed and map them. If endangered or invasive species are present, maps or aerial photography of their distributions can be provided. If they exist, vegetation maps are frequently useful in mapping the system's ecology. Sources include National Land Cover Database (http://www.mrlc.gov/), LandFire Data (http://www.landfire.gov/), and the USGS Gap Analysis Program (http://biology.usgs.gov/bio/gap.html). Obviously, localities may have more recent and higher resolution land use/land cover data.

Develop a Data Management Plan

Water conflict management studies frequently generate substantial volumes of data. Some of the data will be collected on the ground and some of them will be collected from previously published sources. Since these data will be used to support important decisions that could end up in litigation, they should be managed in a rational manner. Therefore, a plan defining how the acquisition, evaluation, maintenance, access, analysis, reporting, and disposition of the data will be managed is essential to a successful adaptive management and conflict management effort.

The Scoping Meeting Process

Scoping meetings will be held as part of the adaptive management workshop process. These will be used to introduce the parties to one another and begin articulation and discussion of the issues relevant to the conflict management resolution process. Specifically, the objectives of the scoping meetings are as follows:

- Exploring the participants’ expectations/concerns.
- Explaining and discussing the rationale for using adaptive management processes.
- Training in conflict management skills.
- Determining what management problems need to be addressed.
- Defining the scope of the management problem.
- Defining measureable management objectives.
- Identifying key indicators for each objective.
- Developing a conceptual model.

Explore the Participants’ Expectations/Concerns

According to Walkerden (2005) the scoping workshop should be set up explicitly as a facilitated negotiation. He adds that it should be organized in such a way as to allow for shuttle diplomacy, should it be deemed necessary.

Exploring the participants’ expectations for the workshops is one of the first important tasks. A general set of common concerns addressed in an impact assessment were identified by the National Research Council (1986, see Table 2). These can be used as a starting point. This list does not contain concerns for services or products that are realized from Reclamation activities, and those should be included. Two major considerations, which we have added under economic concerns, are water delivery to consumptive uses and hydropower production.

As part of this exercise, organizers should consider techniques and aids to visualization that will assist participants. Since we are concentrating on water resource conflicts involving the Bureau of Reclamation, the geographic focus of the problem can be clarified through the identification of involved water bodies, river reaches, sub-watersheds, watersheds or basins. By looking at the watersheds at several different scales in a Geographic Information System and adding themes related to resource concerns, organizers can begin to link the geographic setting to resource issues and proposed actions that are the focus of adaptive management. Participants can then be invited to provide input on where they perceive the boundaries of the problem lying in the landscape and why they subscribe to those limits.

Table 2. Common concerns addressed in impact assessment.

Legal requirements	**Aesthetic values**	**Economic concerns**	**Environmental values and concerns**
Air/water quality standards	Landscape appeal	Species or habitats of recreational or commercial interest	Ecosystem rarity or uniqueness
Public health	Attractive communities	Ecosystem components	Sensitivity of species or ecosystems to stress
Rare, threatened, and endangered species	Appealing species	Water delivery to consumptive uses	Ecosystem "naturalness"
Protected areas or habitats, including critical habitat	Species at higher trophic levels	Hydropower production	Genetic resources
			Ecosystem services
			Recovery potential of ecosystems
			"Keystone" species
			Effects on global climate change

This is one of the first places in the discussion where value-driven and fact-driven positions will emerge among participants. It is important for the workshop facilitator to engage all positions and to equally air them with the group in a process of joint fact-finding. Geographic scale differences will also emerge with participants differing on the boundaries that should be included in the discussion. Some portions of the differences that will emerge are simply the result of the world view held by participants. Local individuals often have a different view of the extent of the problem than someone who arrives from outside the geographic area in which the conflict occurs.

Any gathering of people in which opinions are put forward on the explanation of a phenomenon or a means of achieving an objective will have within it a full range of ideas on how certain the explanation for the phenomenon is understood or which approach is most likely to achieve the objective. In like manner, there will be, in the same group, a wide range of tolerance for risk in making decisions that will affect the futures of the members and the environment on which they depend for their livelihood.

Participants are expected to enter the workshop with open minds and with a willingness to work together to identify problems and engage in problem solving. There is no presumed correct or perfect solution; no one is wrong in order for someone else to be right. A desired outcome is that participants will better understand and appreciate one another's views, while at the same time jointly improving their scientific understanding of the structure and function of the ecosystem that is the focus of their conflict. The improvement in scientific understanding is arrived at through the development of the conceptual model of the ecosystem, determination of management goals and objectives, identification of resources that can serve as indicators of responses to management actions, projection of indicator responses to management actions as hypotheses, and identification of the uncertainty in those hypotheses.

In a brain-storming session of the participants, document their views as to the intent of the project. Document the proceedings with lists, tables, and tree diagrams   Model careful and open minded listening. Strive to incorporate intense emotions into the overall dialogue. Focus on building up an overall context, but ask for specifics, then ask how specifics inform the context Work to help each stakeholder see the point of view of the others. Work to understand the range of issues and document them (Walkerden, 2005).

Explaining and Discussing the Rationale for Using Adaptive Management Processes.

The rationale for using adaptive management as a conflict resolution forum must be explained to the workshop participants. Prerequisites for consideration of adaptive management will include, quite obviously, that a resource management decision will be made. In addition, management objectives pursuant to that decision are capable of being stated explicitly. Both the management decision to be made and the management objectives should be spelled out to the participants to begin the discussion as to their acceptability.

Water resource conflicts can evolve from changes in societal values, resource declines under ongoing management, or from proposed changes in management that lead to the fear of negative impacts on some resources or segments of the human population. In any case, it is necessary for workshop facilitators to help participants to reach agreement on their interpretations of what is being proposed, the range of potential positive, neutral and negative effects, the geography in space and time of the issues being considered, alternative actions that could be undertaken to reduce or mitigate the negative effects, and what indicators would provide adequate measures of success or failure for the assessment.

To further explain the appropriateness of adaptive management to address the problem at hand, please follow the guidelines in Williams listed above in the pre-meeting section, entitled *Assess the Utility of Adaptive Management Processes* (Williams and others 2009).

Training in Conflict Management Skills

Professor Aaron Wolf of Oregon State University, working with his colleague, Julia Doerman, has compiled a training manual for managing water conflict (Doerman and Wolf 2012). It contains training modules designed to build institutional capacity to avoid conflict before it occurs and manage it when it does occur.

Building on the work of Rothman (1997), the OSU approach teaches participants about the various stages of a water conflict: adversarial, reflexive, integrative, and action. Each of these levels requires a corresponding set of skills. Trust-building and a deepened understanding of conflict must occur in the adversarial stage. Listening skills and the ability to identify positions, needs, and interests is appropriate for the reflexive stage. Consensus building and relationship building skills are appropriate to the integrative stage. And, capacity and community building skills are appropriate for the action stage.

If time and funding permits, it is recommended that the participants receive training in these skill sets. As the conflict management process progresses, additional, in-depth skills-building training may become necessary.

Determine what Management Problems need to be Addressed

Determining what management problems should be addressed is a follow-up exercise from the initial exploration of participant expectations. Use the charts and other documentation from the first scoping exercise to prompt participants to give their assessment of what the management problems are. Walkerden (2005) stresses the importance of framing each issue as a search for objective criteria, and further asks that in documenting these two tasks, the facilitators should try to gauge what *interests* are at play as opposed to positions. The process should be a joint exploration. He points out that the unappreciated complexity and uncertainty generated here can be used to turn the effort into a joint search for the truth. As before, document the process with lists, tables, and tree-diagrams. This documentation should show that the social and ecological outcomes or consequences are a collective product.

One related issue that must be addressed is determining if there are *additional data requirements* or do the existing data meet the needs of the project? The beginnings of a data management plan should be discussed. Relevant questions are, "What decision(s) must be made that address the management problem? What data will be required to address these decisions? What data gaps exist? What levels of detail are required?"

The scope of the management problem must also be bounded in time and in space. Present the GIS data that were acquired in the pre-meeting activities to discuss these boundaries. Gathering this information could be seen as a set of narrowing tasks.

- Are the issues really a global in scope? Which? Why or why not?
- Are the issues national in scope? Which? Why or why not?
- Are the issues regional in scope? Which? Why or why not?
- Are the issues restricted to a single state? Which? Why or why not?
- Are the issues restricted to a single locality? Which? Why or why not?
- What watersheds are steeped in these issues? Which? Why or why not?
- When did these issues first come to the fore?
- What have been the key events in this history of these issues?
- What were the key triggers or turning points?
- Who were the key persons in the history of these events?

One final question remains, "What data analyses remain to be conducted, if any?"

Define Measureable Management Objectives

Can the group agree on a purpose or objective or range of them? Can a set of measureable goals be set forth? What are the associated milestones, deadlines, required resources and constraints (internal and external). Try to develop a project objective aligned with each need and action. Estimate the level of effort to meet each objective. Are the objectives attainable with the available resources? The decision-makers may want to limit the number of objectives. Determine what documents must be produced. Who will review them?

Prior to the knowledge assessment, workshop participants will have identified such a range of management objectives, the management actions that are thought to have high potential for achieving those objectives, and the important resources that could be affected both positively and negatively by the management actions. Proposed actions and affected resources are placed in a matrix and workshop participants, based on professional judgment, findings from the scientific literature, and discussions among themselves, provide evidence for cause and effect relationships, including the magnitude, direction, and uncertainty of those relationships. Matrix metrics used to indicate relationships and uncertainty can vary according to needs of the group. An example of decision matrix metrics used for assessing learning from management actions undertaken to determine the effects of Glen Canyon Dam on downstream resources (Melis and others 2006) is illustrated in Tables 3 and 4.

Table 3. Summary of definitions used to rank uncertainty of predictions in the decision matrix.

	Very Certain	Certain	Uncertain	Very Uncertain
Prediction	Direction and magnitude of response	Direction only	Direction only	Cannot predict direction
Supported by Data from Colorado River Ecosystem	Peer reviewed, likely involving a model. Little debate on interpretation of predictions	Peer-reviewed results, no model	Limited data, data without peer review, and likely debatable inference	No or very limited data
Data from Other Reference Systems	Validated prediction in other system that is considered a good model for CRE	Validated prediction in other system that is a weaker model for CRE	Weaker prediction from other system that is a weak model for CRE	No or very limited data in other systems. Other systems are not good model of CRE
General Theory / Conventional Wisdom	Very Strong	Good	Moderate	Low
Probability that the Prediction is Correct	90-100%	70-90%	50-70%	<50%

Knowledge assessments are an important part of the workshop process that serve as precursors to the development of conceptual models, and as a mechanism for joint learning by scientists, managers, stakeholders and decision makers about the structure and function of the ecosystem involved in the water resource conflict. The key findings of knowledge assessments are: (1) determination of the level of understanding of relationships between proposed actions and resource responses to those actions; (2) the diversity of opinion and consequent uncertainty that surrounds that understanding and; (3) the set of questions that identify key learning needed to arrive at decisions on resource management and that will drive resource monitoring to achieve that learning.

In the matrix, rows are resources that act as performance measures in responding to different management actions or treatments. A prediction of the direction of response of each performance measure [decline (-), no change (0), improvement (+)] to each action was made along with a ranking of the uncertainty of the predictions. If the direction of response could not be determined the prediction was defined as highly uncertain and colored RED. If a prediction of the direction of response could be made, but was based on limited data and there was a relatively low probability that the predicted direction of response was correct (50–70%), the prediction was considered uncertain and colored YELLOW. If the prediction was based on more data and there was a higher probability that the direction was correct (70–90%), the prediction was considered relatively certain and was colored LIGHT GREEN. If a quantitative prediction about the magnitude of response could be made, which required substantial data integrated into a model or stock assessment procedure, the prediction was considered very certain and colored GREEN. Specific objectives of the knowledge assessment are to (1) evaluate the uncertainties that persist regarding individual resource attribute responses of the ecosystem to the various management actions (2) develop strategic science questions that would need to be addressed to further reduce the uncertainties associated with the various treatments, and (3) identify research and monitoring strategies that might need to be undertaken to answer the science questions identified.

Table 4. Example matrix of resource performance measures and potential management actions containing potential direction of response except for highly uncertain relationships.

	Action 1	Action 2	Action 3	Action 4
Resource 1	+,0,-		+,0,-	+,0,-
Resource 2		+,0,-	+,0,-	+,0,-
Resource 3	+,0,-		+,0,-	
Resource 4	+,0,-	+,0,-	+,0,-	

This exercise can result in a categorization of the state of existing knowledge into three broad categories: (1) existing knowledge about a given resource was sufficient to determine both general trends and to quantify the rate and amount of change, (2) knowledge sufficient to determine general trends, but not to quantify rate or amount of change, and (3) knowledge not sufficient to reliably determine even general trends in condition/status. The knowledge assessment can highlight crucial gaps in existing monitoring and research programs, prompting further analysis and consideration of how to fill those knowledge gaps through future monitoring and research efforts.

Identify Key Indicators for each Objective

What indicators would measure success or failure in solving the problems? Ask the participants what indicators of system states should the group focus on as it explores alternatives. Frame each identified issue as a joint search for objective criteria.

Again, reason and be open to reason. Ask which standards are most appropriate and how they should be applied. Options will be evaluated in the light of indicators that reflect what participating stakeholders value, i.e. their needs and interests. Ask if there are some more creative ways in which the collective body could serve each stakeholder's interest, including the interests of biota located in places at risk of ecological harm (Walkerden 2005).

Develop a Conceptual Model

Building on the information collected in the pre-meeting efforts, it is appropriate to begin development of a plausible representation of the dynamic natural system. Model building lies at the heart of adaptive management as portrayed by Holling (1978) and Walters (1986). Williams and others (2009) also ascribe a high level of importance to models and, in one of the key questions in their guidebook, require that models be used to predict resource relationships and management impacts for successful use of adaptive management. There are two main reasons identified by Holling (1978) and Walters (1986) for development of models. First, the process of building an explicit numerical model requires a clear statement of what is known and what is assumed about the system being modeled. In so doing broad gaps in data and understanding are exposed that are otherwise easily overlooked. Second, even crude models can help to screen management options and eliminate those that are inappropriate for further consideration. We would add that engaging stakeholders in a joint learning process helps to diffuse differences of opinion and to build trust among the participants.

Conceptual models (CMs) provide a visual framework or graphical representation (Figure 4) of the proposed relationships among major factors affecting the system being evaluated. The CM identifies major management actions or natural system inputs, system processes, system responses, and major resources of concern that likely would be affected by changes in the system. CMs are also used to identify competing hypotheses and research questions to be addressed by management, monitoring and research. Workshop participants are encouraged to provide their perceptions of "how the system works" as a precursor to building hypotheses that can be tested if the group decides to apply adaptive management as a process for determining what the real, rather than hypothetical, relationships are among the system components, management actions, and natural drivers.

The CM allows for characterization of the system changes through time. It lists key components of the natural system and describes resource changes in terms of processes (for example, reproduction, mortality, spatial movement) that are thought to be directly influenced by alternative management actions. Fluctuating environmental conditions can be incorporated as needed to characterize resource dynamics. Management impacts are described in terms of costs, benefits, and influences on resource components or processes that are highlighted in the model. Models are calibrated with available data and knowledge, to ensure compatibility with current understanding about resource structures and functions.

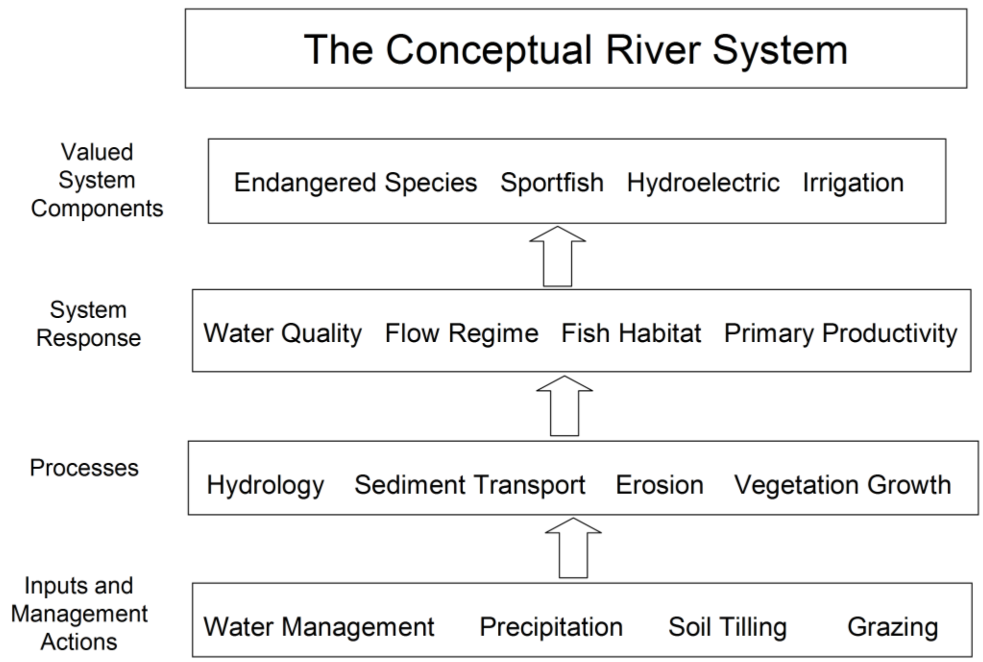

Figure 4. A conceptualized river system illustrating inputs and management actions, system processes, system responses, and valued system components.

The conceptual model:

- Specifies resource relationships and responses to projected actions, i.e. the potential impacts of management decisions
- Allows for the evaluation of various management objectives and alternatives
- Allows collaborators to compare and contrast management alternatives in terms of their costs, benefits, and resource consequences.
- Allows for the evaluation of contrasting hypotheses (possibly from stakeholders) about the impacts of various management actions.
- Allows for the capture of key uncertainties
- Make explicit predictions about responses of the indicators to management actions.
- Allows for the exploration of alternative scenarios

It is, of course, important to conduct sensitivity analysis on model parameters to test and validate the model.

Hypotheses and Resource Impact (X-Y) Graphs

An initial step in the development of priority hypotheses is accomplished by describing broad relationships among functional components of each CM. These broad hypotheses are further refined by the development of specific hypotheses based on the relationship among functional components of the system as illustrated in x-y graphs. The x-y graphs (Figure 5) illustrate the key relationships upon which hypotheses are based. They allow workshop participants to identify and discover differences among the resource relationships and among their perceptions of what these relationships are. In this way competing hypotheses can be generated. Collaboratively drawing impact hypothesis diagrams for given groups of actions and indicators can help to evaluate and screen alternative management actions.

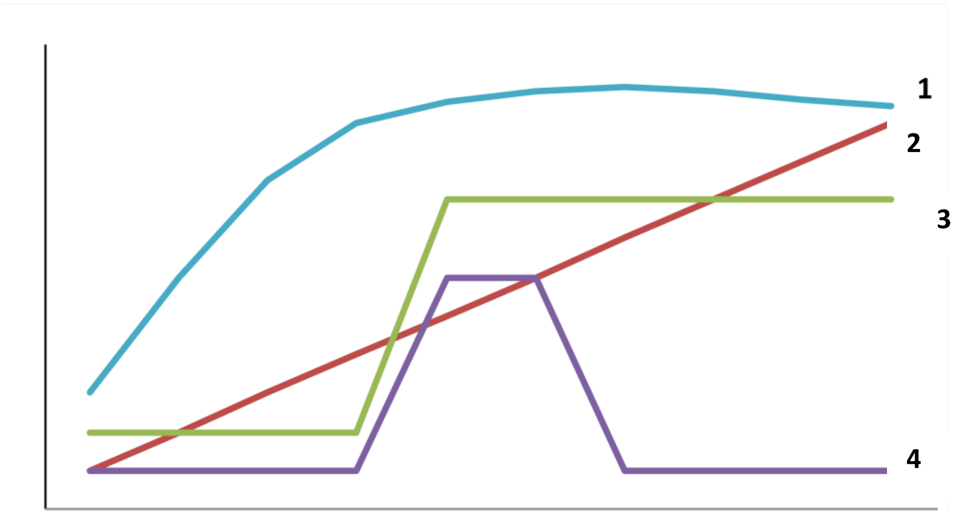

Figure 5. Hypothetical responses of resources to management actions.
1 = curvilinear; 2 = linear; 3 = threshold; and 4 = window.

Joint specification of elements and characteristics of conceptual model(s) also serves to build trust amongst the participants. Conceptual models present a characterization of the system changes through time. They describe resource changes in terms of processes (for example, reproduction, mortality, spatial movement) that are thought to be directly influenced by alternative management actions. Fluctuating environmental conditions are incorporated as needed to characterize resource dynamics. Management impacts are described in terms of costs, benefits, and influences on resource components or processes that are highlighted in the model. Models are calibrated with available data and knowledge, to ensure compatibility with current understanding about resource structures and functions.

Structure Workshop Sessions

The overarching objective of the structure session is to understand the basin's systems and sub-systems.

- Identify the major subsystems
- Describe interfaces between them.
- Review subsystem descriptions in light of stakeholders' interests.
- If a quantitative model is being built, describe processes quantitatively using equations that describe how outputs are derived from inputs.

Identify the Major Subsystems

Having obtained an overview of the water system in the scoping sessions, it is now time to look in detail at the underlying structures and dynamics of the ecological and socio-economic subsystems. The ecological-biophysical subsystems can be analyzed using a variety of tools:

- Consultation with local subject matter experts
- Local soils, geological, hydrological, biological, and climatological reports and handbooks.
- Harvesting GIS layers of soils, geological, hydrological, and climatological data. In addition, capturing aerial photography, topographic information, and other GIS data.
- If necessary, acquiring and processing satellite imagery.

The goal is to learn how each of the bio-physical processes at work in the natural system behaves. Specifically, how are its outputs derived from its inputs? (Walkerden 2005). What rules govern the deriving of outputs from inputs? What areas of uncertainty, complication, and constraint can be documented? Understanding these input/output relations and associated uncertainties can contribute information in the search for creative solutions and can help to clarify what additional science may be required. It is important to determine what underlying bio-physical processes are at work in the natural system. (Make extensive use of the subject matter experts, maps, aerial photos, and GIS capabilities). It is important to identify:

- Gaps in data library
- The level of detail required to undertake the conflict management process
- Existing sources of information
- What additional information needs to be collected in the field.
- What analytic procedures should be used to process the data.

In addition, as this process proceeds, it is essential to document the areas of scientific disagreement.

What are the underlying structures and dynamics of the socio-economic systems that impinge upon the biophysical system? Make extensive use of subject matter experts, scientific literature, newspapers, and interviews with locals to determine what underlying social, economic, cultural, and political processes are at work in the human-natural system interface.

Model the behavior of each process. Specifically, again, focusing on how outputs derived from inputs. What rules govern the deriving outputs from inputs? Document areas of uncertainty, constraint, and complication. Doing these things can contribute to the search for creative solutions. Identify and select data inputs. Carefully document areas of scientific disagreement (Walkerden 2005).

Describe Interfaces between them.

Next, use flow diagrams or a more detailed interaction matrix to portray interfaces *between* subsystems. How are the major shaping factors of the subsystems inter-related and connected? Model the interfaces.

Review Subsystem Descriptions in Light of Stakeholders' Interests.

Examine how each subsystem impacts stakeholder interests. Catalog these impacts. Having done that, once again, ask, "Are there other creative ways in which we could look after stakeholders' interests, including interests of other kinds of organisms that should be included?" (Walkerden 2005).

If a Quantitative Model is being Built, Describe Processes Quantitatively using Equations that Describe how Outputs are Derived from inputs.

What logical relationships and equations describe the social, economic, cultural, political, and bio-physical processes? Are there competing descriptions of the relationships and parameter values? Use these as guides to help sort out critical assumptions. Develop output graphs that show what the workshop participants assumptions about cause and effect imply (Walkerden 2005).

Use discussions and model outputs to understand how competing management strategies and policy environments can affect outcomes in the basin. This analysis can be used to examine strengths and weaknesses of policy alternatives. Shared learning exercises such as this can be used to discover new alternatives. It can also help foster better mutual understanding amongst participants, which can move the stakeholders towards consensus. This helps build insights into how in the midst of uncertainties the system could be managed to sustain resilience and support learning.

The model should be inclusive. Each interest, including the biota, should be present in the model. If a quantitative model is being built, build it incrementally, dialoguing frequently with stakeholders about what will add the most value to their investigations and negotiations. The structure and dynamics phases of the process can be interleaved if that is helpful. Ask again, "Are there some more creative ways in which we could look after each of the stakeholders' interests, including the interests of the organisms located in the place at risk of ecological harm?" (Walkerden 2005).

Dynamics Workshops Sessions

The overarching objective of the dynamics workshop sessions is to reach consensus and formalize an agreement. More explicitly, according to Walkerden (2005), it is necessary to:

- Explore the dynamics, and specifically, the effects of alternative assumptions and alternative management choices.
- Negotiate the path ahead.
- Formalize an agreement.

Explore the Dynamics, and Specifically the Effects of Alternative Assumptions and Alternative Management Choices.

Using a "scenario gaming" environment, conceptual models, and/or quantitative models, explore the consequences of various assumptions and alternate management practices. Scenario gaming is a modeling system used to envision and test various management actions within an adaptive management framework. Construction of the model is based upon highly studied cause and effect relationships, relevant data attributes, expert knowledge, and discussions amongst scientists, managers, and stakeholders. The gaming dimension of the interactive model is designed to spur discussion as to the nature of the bio-physical system, the social and economic system that impinges upon it, and the values systems of various users. Uncertainties are discussed and documented. System elements (cattle, farmers, tourists, wildlife etc.) expressed as nouns, processes that act upon them expressed as verbs, and relevant data attributes expressed as adjectives are assembled and put into the collaboratively constructed model. After model construction, interested parties interact with it to better comprehend the nature of the problem, stimulate discussion about potential management actions, and witness potential outcomes resulting from these actions. The hope is that over many iterations a convergence amongst the parties will occur as to what the proper management actions should be-- as various actions are tested interactively and their outcomes displayed (see, for instance, Kiker, et al., 2006).

Other tools (see Appendix I) are also available. Among these are:

- The Four R's framework
- Participatory Mapping
- Scenario Based Methods
- Discoursed base-valuation

For a discussion of these and other tools, please see Lynam, et al, 2007.

Negotiate the Path Ahead.

The number of negotiation processes is practically without number, of course. Walkerden (2005) suggests using gaming processes to facilitate negotiation. Doerman and Wolf (2012) propose removing the boundaries of the problem-shed and looking system-wide at the allocation of assets and liabilities as one of the first steps. How can system-wide assets be allocated in ways to serve the needs of all participants? He suggests developing performance criteria for measuring success. Then the boundaries can be replaced. Walkerden (2005) proposes using gaming processes to facilitate the negotiating processes to reach consensus.

Formalize an Agreement.

With a system-wide perspective, problems can sometimes be reframed, new governance capacities developed, and cooperative networks established to empower participants to come to consensus and formalize an agreement (Doerman and Wolf 2012).

Implementation

Implementation of the agreement reached through previous steps would most often be accomplished by government agencies, but having built a high level of association in the development of management actions, other stakeholders likely will wish to remain involved in the implementation of actions agreed to in the workshop process and in the review of accomplishments under any agreements reached. This is a key step in the adaptive management cycle as the process moves from the set-up phase to the iterative phase as described by Williams and others (2009). This presumes that the appropriate stakeholders have been engaged in articulating the scope and nature of the resource issue, that management objectives and alternatives have been identified, that models have been developed to predict impacts of management actions on resources, that the uncertainty of these forecasts has been ascertained, and that a monitoring effort has been designed to empirically measure resource responses with emphasis on appropriate attributes needed for learning, evaluation, and decision making. If the adaptive management process is to be followed, the undertaking of this phase logically commits the group to a decision-making process that incorporates knowledge gained through implementation of management actions and monitoring their effects on important resources.

Since adaptive management is an iterative learning process, new knowledge gained from implementation also may well result in a circling back to revisit assumptions that led to decisions on original management actions. Any refinements or changes will benefit greatly from learning and from the trust built among participants in the workshop process. When the time comes for review of the initial agreement, incorporation of knowledge gained, and negotiation of any further agreement, an adaptive management workshop would be a logical forum in which to exchange ideas and make progress toward reaching the new agreement.

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Appendix I: Tools in Support of Adaptive Management Conflict Management Processes

<u>Name</u>: Geographic Information Systems

Geographic information systems are the hardware and software operated by trained geospatial analysts for maintaining, viewing, and processing spatial data in digital form. These data can be readily updated, modeled, and analyzed to produce products that decision-makers can use. Successful use depends upon data accuracy, precision, currency, and the skill of the GIS analyst.

Geographic information systems require scientists trained in their use. Understanding of the principles of cartography, geodesy, statistical analysis, data management, earth science, and programming are essential for successful use. For advanced usage modeling skills are essential. Obviously, quality data are essential for a successful project. Data imported from external sources should always be evaluated for positional and thematic accuracy.

GIS combines graphical representations of earth features with a relational database. Each graphic entity, therefore, can have attached to it a set of relational attributes. For instance a census tract will contain tabular data about population, income, housing, and educational attainment.

Combining various data layers allows for decision analysis. For instance, overlaying a modeled flood boundary over various social and economic data layers can allow the GIS analyst to estimate population and critical infrastructure at risk. GIS has an enormous number of analytical capabilities (Berry 1993, 1996; Morain 1999). Among these are:

- Basic and advanced mathematical operations: addition, subtraction, multiplication, division, along with trigonometric, power, and root functions.
- Descriptive statistics: mean, median, mode, variance, deviance, frequency, diversity, deviation, count.
- Comparative statistics: cross-tabs, t-tests, chi-square, F-tests, etc.
- Distance measures: simple distance, least cost distance (effort, time, cost), proximity, narrowness, buffering.
- Neighborhood characterization: surface configuration (slope, aspect, grade, curvature), roving windows summaries (summarizing values within a specific vicinity along with associated descriptive statistics), interpolation (computing predicted values for each map location), diversity, interspersion, deviation.
- Distributional analysis. Clustering or evenly spaced (lattice) patterns can indicate that some underlying process accounts for the spatial distribution, while a random distribution may not.

- Visual exposure: view-shed delineation (all locations ‘within sight’ of a place), exposure density (determines how often each location is ‘within sight’ of a linear or areal entity)
- Spatial correlations or associations. For instance, it can detect the relation of fauna to vegetation to soils to parent materials. For example, is there a connection between a particular endangered bird species distribution and the distribution of an exotic plant? Spatial correlation can provide quantitative evidence.
- Surface generation based on autocorrelation: topography, pollution concentrations, temperature surfaces, etc.
- Shape characterization: convexity and concavity, complexity, integrity, contiguity, inter-feature distance, regularity and irregularity. Some animals and plants require habitat of various shapes, extents, and regularity in order to thrive.
- Homogeneity and heterogeneity. Is a landscape composed of homogeneous elements or is it characterized by a high degree varied elements? Knowledge of this could help identify, for instance, encroachment of new species.
- Segregation and integration. e.g. are certain species sub-populations separated from one another or are they found together on a regular basis?
- Connectivity: tests if places are accessible by some means with one another or are they islands. For instance, endangered species in different locations need access to one another for continued propagation.
- Modeling. GIS has extensive modeling capabilities. Descriptive, explanatory, static, deterministic, and stochastic modeling can be done with GIS.

Thus, GIS provides the ability to combine many layers of information to yield an accurate and up-to-date understanding of a place. The results of these analyses can provide essential spatial data to provide essential information to planners and decision-makers. It is also useful for monitoring activities. For instance, river restoration activities can be monitored with GIS to determine if endangered species habitat really is expanding over time.   GIS is useful for scenario planning. For instance, in planning processes one can monitor how various development projects will impact the magnitude and speed of precipitation runoff.

Some significant limitations apply to the use of geographic information systems. GIS requires trained staff for successful implementation and use, the software can be expensive to acquire, and output is only as good as the input data.   To repeat, data must be gathered carefully, quality checked, and maintained with care

An abundance of GIS data relevant to water management is available for immediate download from sources such as the EPA, the USGS, the NRCS, FEMA, and the Census Bureau. The list below is a partial catalog of cost-free, downloadable data themes:

- Water Flow
- Water Level in Wells
- Water Quality
- Aquifers
- Water Use
- Precipitation
- Digital Elevation Models
- Digital Raster Graphic
- Topography Sheets
- Soils
- HUCs: Basin Boundaries
- Orthophoto Quads
- National Agricultural Imagery Program Photography
- National Land Cover Dataset
- Annual and Monthly Precipitation
- Annual and Monthly Temp
- Census of Agriculture
- Census Data
- FEMA Establishment Data
- Hydrography
- Precipitation
- Temperature

The above data sets and numerous others can be obtained from various national and state GIS data warehouses:

The GIS Data Depot: http://data.geocomm.com/
Environmental Systems Research Institute: http://www.esri.com/data/free-data/
Geospatial One Stop: http://www.data.gov/
National Atlas of the U.S.: http://nationalatlas.gov/
National Historic Geographic Information System: http://www.nhgis.org/
The USGS National Map Seamless Server: http://seamless.usgs.gov/index.php
The USDA Geospatial Data Gateway: http://datagateway.nrcs.usda.gov/
Census Data: http://www.census.gov/geo/www/tiger/
FEMA Data: http://www.lib.ncsu.edu/gis/hazus.html and
http://www.lib.ncsu.edu/gis/data.html
The USGS: http://waterdata.usgs.gov/nwis/rt; http://nhd.usgs.gov/;
http://water.usgs.gov/watuse/; among others.
EPA: http://www.epa.gov/waterscience/ftp/basins/gis_data/

These and other spatial data from local sources can be readily combined by a GIS analyst for water resource management projects. In doing so, an overall view of the entire water system can be readily produced for the first adaptive management meeting. Then, as time goes on, other data can be collected and added.

In addition to the above citations, Reclamation maintains a data library called DataSpace, which puts a large variety of basic geographic data at users' finger tips. Figures 1-6 show what data layers are available. A detailed description of the DataSpace capability can be found at: https://borsp/corp/GIS/DataStewardship/Forms/AllItems.aspx.

A related advanced application has also been developed called Tessel8: https://borsp/corp/GIS/BORGIS/SitePages/Web%20Maps.aspx.

A GIS application developed for the Gunnison River shows the kinds of data layers that are readily available for those seeking to make stakeholders aware of the complexities of an entire river basin. A demonstration GIS application for the Gunnison Basin has been prepared for distribution. For a copy, please contact the authors: Dennis Kubly (801-524-3715) or Douglas Clark (303-445-2271).

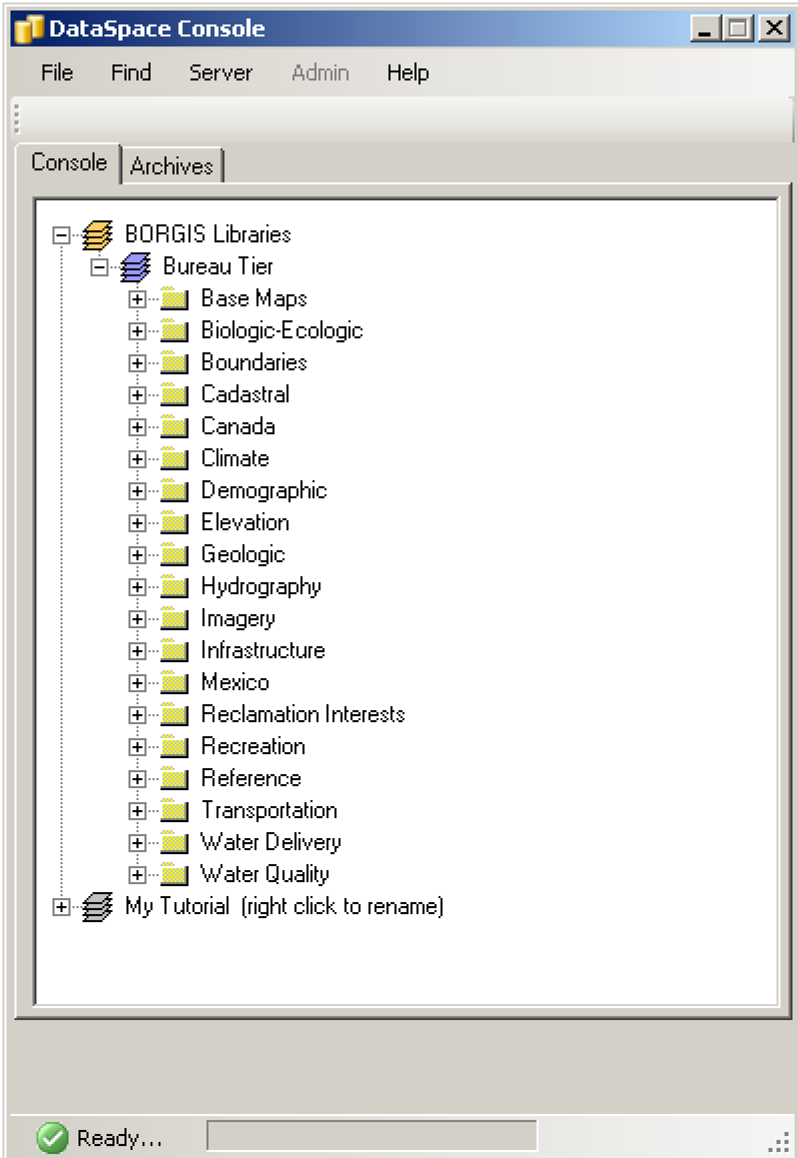

Figure 1: DataSpace Overview

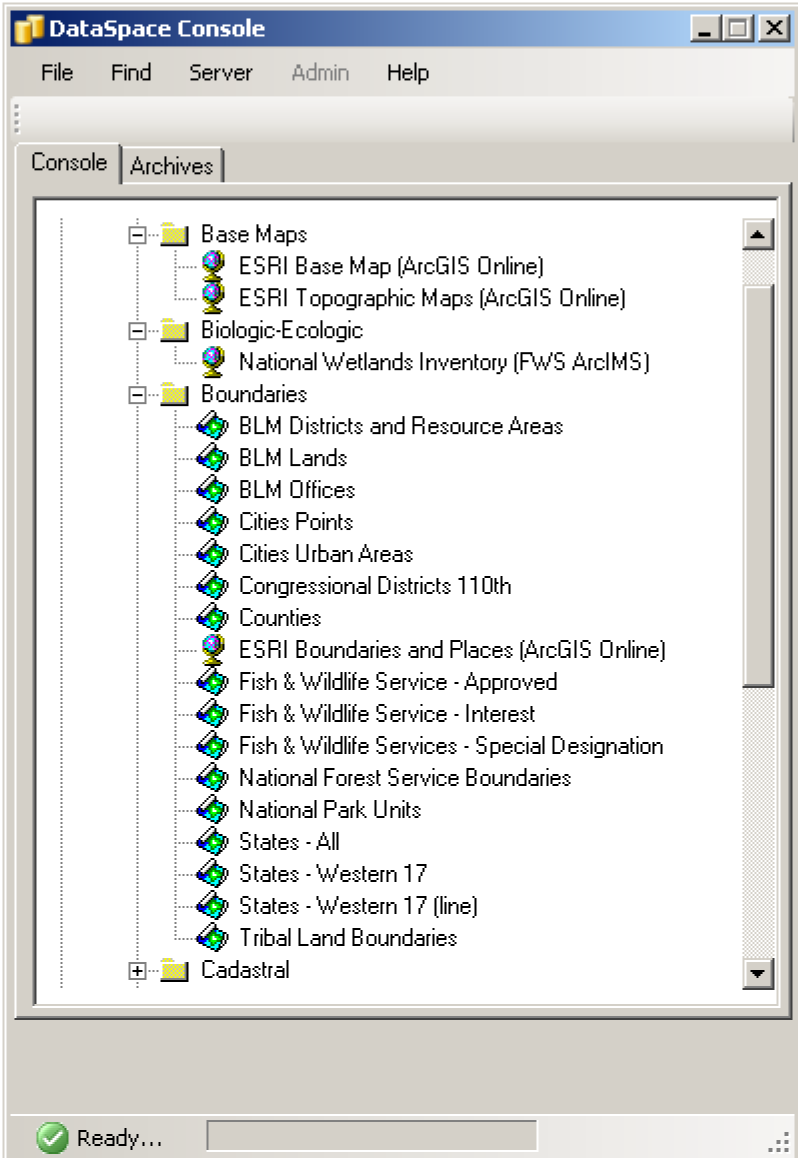

Figure 2: DataSpace base maps, biologic data, and boundaries data.

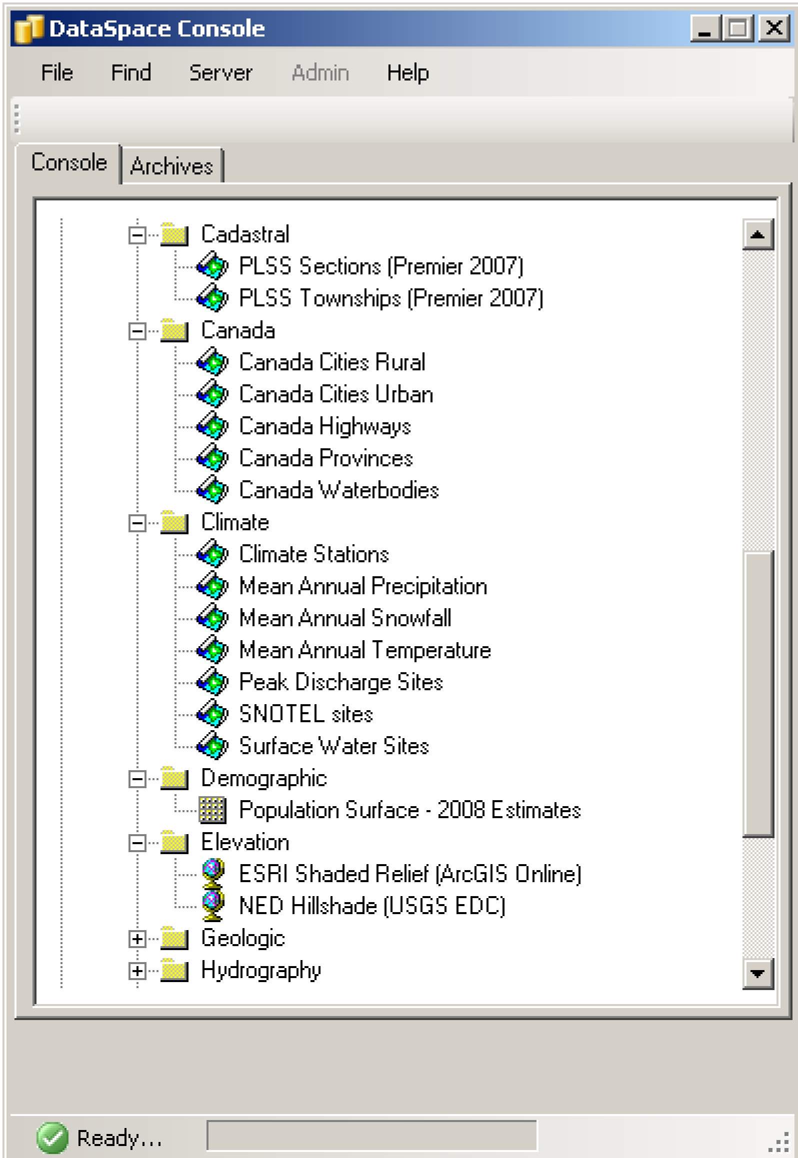

Figure 3: DataSpace: Cadastral, Canadian, and climate data

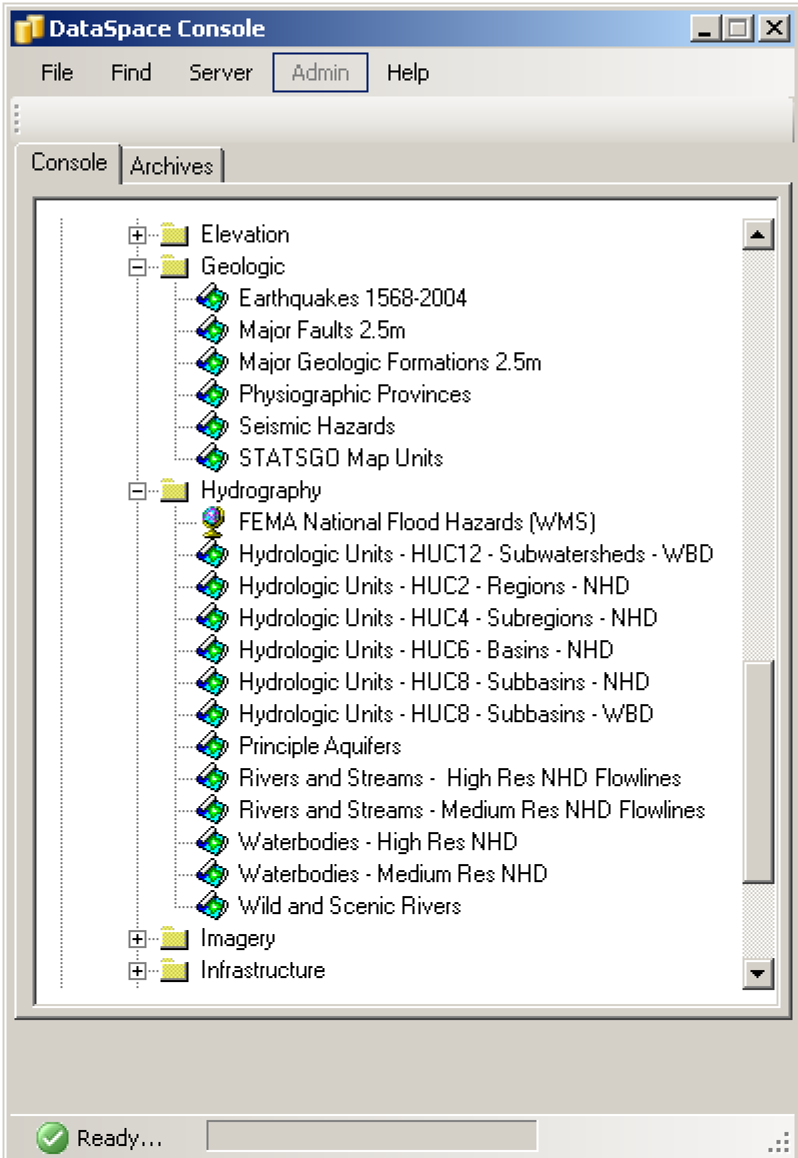

Figure 4: DataSpace: Geologic data and hydrography data

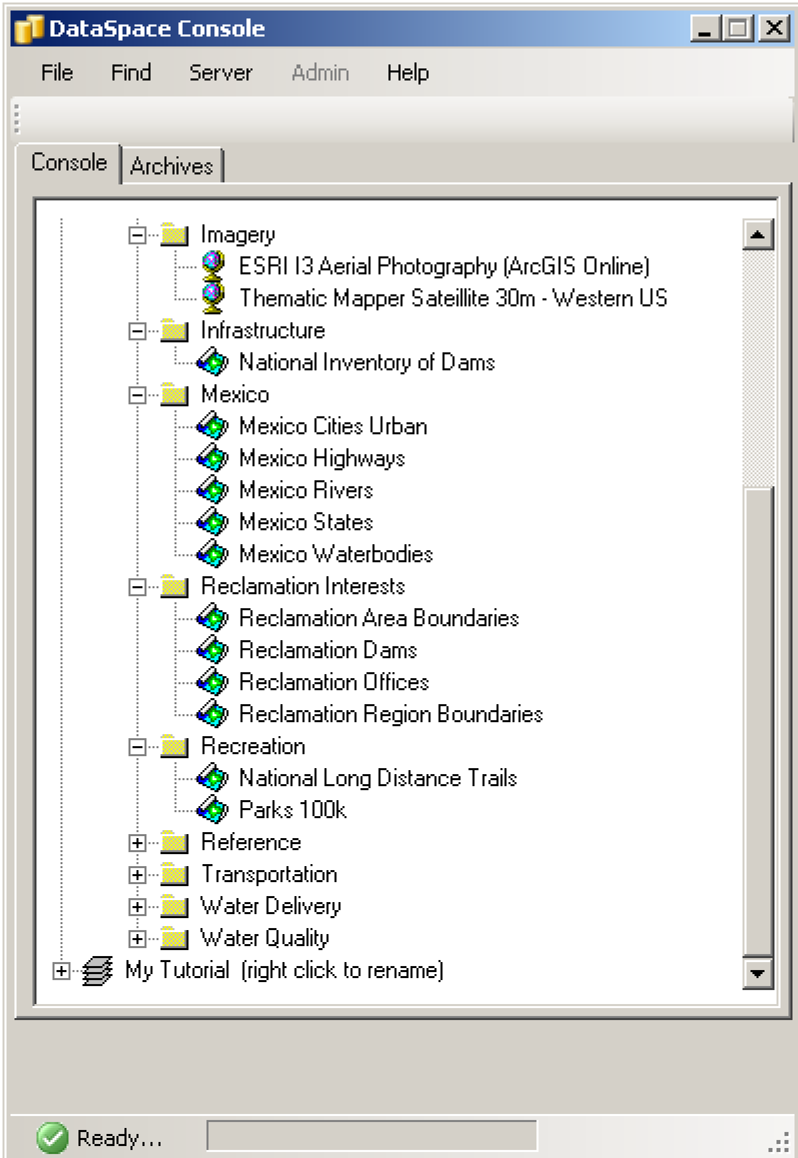

Figure 5: DataSpace: Imagery, infrastructure, Mexican, Reclamation interests, and recreation data

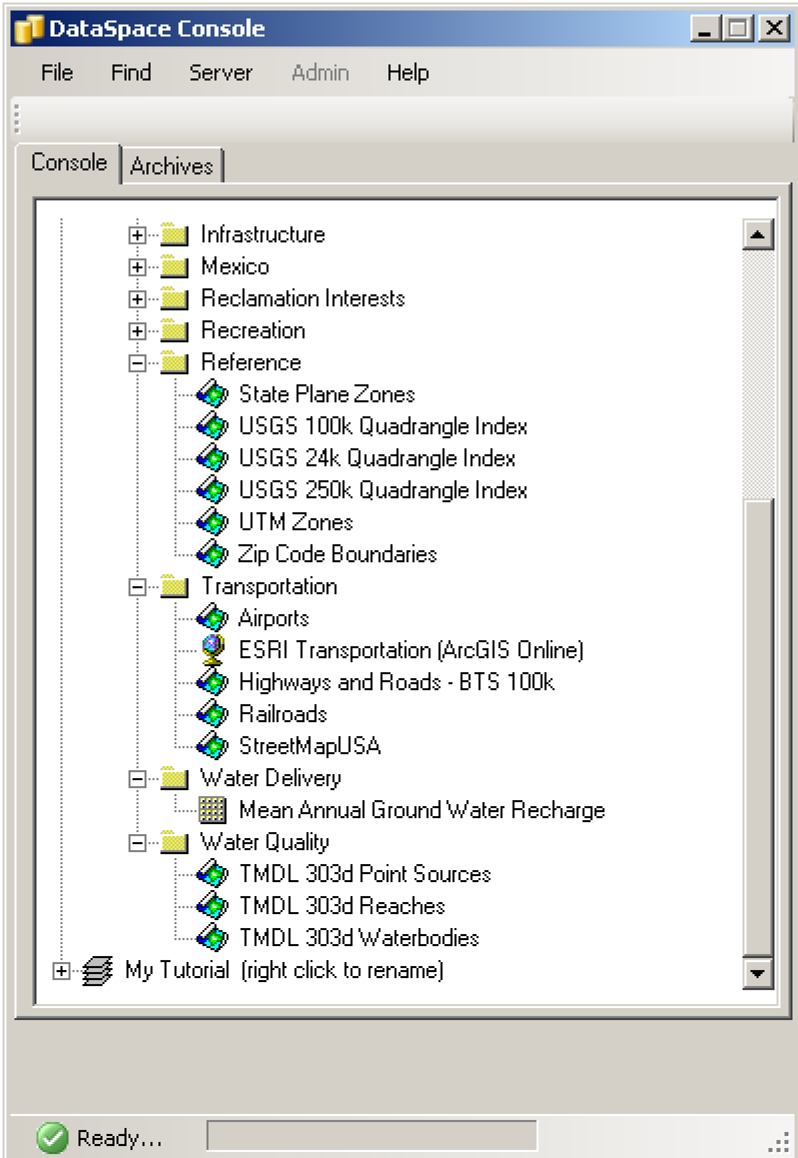

Figure 6: DataSpace: Reference, transporation, water delivery and water quality data.

Stakeholders 4Rs Framework: Rights, Responsibilities, Revenues/Returns (from the resource) and Relationships (Summarized from: Dubois, 1998).

The 4Rs Framework scrutinizes the balance or imbalance of the stakeholder *rights, responsibilities, returns (i.e. rewards or incentives),* and *relationships* (4Rs). It attempts to transform a disputed resource from a source of conflict to an equitably distributed asset, capable of meeting divergent needs. It identifies and builds upon existing technical and institutional resources to initiate and sustain positive change. And it also serves as a tool to help stakeholders to discuss and come to agreement about their respective responsibilities, rights, relationships, and returns as change proceeds.

4Rs assumes that what is called for in the particular dispute in question is a transition to more sustainable resource management practices that will ensure the security of resource-related goods and services at the household, local, regional, national, and even global levels. To work, this system depends upon the willingness of the disputing parties to engage in mutual learning, explore alternative solutions, and re-negotiate roles. Over the course of the workshops, participants must come to have a clear sense of what the new set of 4Rs of each stakeholder or party will be after the transformation.

The 4Rs process begins by assessing the current state of stakeholders' roles, rights, responsibilities, and returns-- both in the realm of policy and "on the ground". The attributes of a future desired state are explored, along with the measures to be taken along the way to realize this new desired reality.

As a prerequisite it will be necessary to assess and determine for the state, private sector, and local communities the relative capacities for learning, the capacities to explore options and achieve constructive negotiations, and the capacities to develop institutional environments where such processes can reasonably occur. Both technical and institutional capacities must be explored. Technical capacity is defined as both the supply of technical skills and the capacity to transfer those skills into new technologies, methods, and systems. Institutional capacity refers to the ability of institutions to make optimal use of the existing technical capacities and resources in a sustainable fashion. The 4Rs process requires the commitment of the leadership, local ownership, institutional legitimacy, transparency, accountability, and fair, enforceable rules.

During the 4Rs process, it is essential to diagram or map the various capacities and then identify what additional capacities need to be developed to manage the mutually agreed upon rule changes. It is also essential to map the distribution of power and ask upon what is it built, how does it affect relationships, and how and under what conditions can power relations change in the direction of equitability. At this point discussions can proceed as to how to move from the current set of rights, responsibilities, returns, and relationships to a future desired set.

4Rs has many advantages. It is effective in utilizing, fostering, and distributing capacities amongst constituencies. It has a reputation for building an effective network that can oversee future development. At a minimum it can deepen the understanding of benefit allocations and power structures. It has the salutary effect of taking into account stakeholders' wishes and needs at many scales and it encourages active involvement. (Actual negotiation can take place at any time in the 4Rs process.) It can both reduce the risks of unplanned outcomes and facilitate the identification of performance indicators. It facilitates policy analysis, helps to identify base issues and diagnose social/political problems in part by identifying imbalances in responsibilities, rights, and revenues/returns. It is useful for comparing policy strengths and weaknesses and assessing the quality of the relationships amongst stakeholders. It is simple to understand, makes the concept of stakeholders' roles more operational, helps in the transition from community participation to multi-stakeholder negotiation, and complements other tools in addressing the sources of conflict.

As might be expected, 4Rs also has limitations. For instance, empowering locals can sometimes lead to local despotism. In some cases there may be no legal recognition of local sustainability initiatives. It may disturb existing social structures and power relations. Finally, wrongly used, 4Rs can result in solutions that cannot be implemented.

Discourse Based Valuation (Summarized from Perkins, 2003 and Wilson and Howarth, 2002)

Discourse Based Valuation (DBV) assigns value to public goods using a process of free, open, wide-ranging public dialogue and debate (Perkins, 2003). Values *derived from this forum* can subsequently be used to guide environmental policy (Wilson and Howarth, 2002). In the course of the discussion/debate process, the interested parties learn about, organize, and articulate their preferences for alternative ecosystem goods and services. The parties are not asked to negotiate, but rather to engage in a deliberative process for making consensus-based judgments with the goal of reaching agreement on what should be valued by or on behalf of the public or society writ large (Wilson and Howarth, 2002).

DBV brings together persons or groups with a stake in a political decision about a natural resource. Descriptions of how an environmental good is valued by the various parties must be developed during discussions. By discussing multiple perspectives, a shared learning process takes place. The parties, as a result, (and, ultimately, the decision-makers) can come to have an appreciation of the environmental, social, economic, political and other factors that must be considered to lead to a course of action acceptable to all (Perkins, 2003). If the process succeeds, interested parties also come to understand what the alternatives are and their various tradeoffs (Perkins, 2003).

Prior to the discourse sessions, it is essential to make certain that decision bodies such as government officials and other public agencies are willing to commit to the implementation of the decisions and outcomes of the discourse process (Perkins, 2003). Once initiated, the process generally starts at a local level and builds from there. An understanding of local needs and priorities is essential (Perkins, 2003). DBV acknowledges that placing a value to environmental goods is frequently difficult. Given this fact, tradeoff analyses are also difficult and must be handled with care (Perkins, 2003).

Small groups of citizens can render informed judgments about public goods not simply in terms of their own personal utility, but also in terms of widely held social values (Wilson and Howarth, 2002). Because deliberations require citizens to go beyond private self-interest, the process has the potential to generate solutions characterized by social equity and political legitimacy (Wilson and Howarth, 2002). Socially fair outcomes are more likely if a fair deliberation is conducted. Providing forums for discussion and debate will encourage individual participants to engage in collective thinking about the common good (Wilson and Howarth, 2002). Deliberation and debate among respondents can lead to more durable and sustainable decisions (Wilson and Howarth, 2002).

Operationally, a free and fair system of discourse must include equal access to debate, the reigning in of powerful agenda setters, unrestrained access to raise and object to amendments, and the freedom of all participants to express their own attitudes, wishes, and needs (Wilson and Howarth, 2002). In instances where common goals are essential to move forward, they should be developed in an environment in which each person or interest is equitably represented (Wilson and Howarth, 2002). Assigning money values to public, non-marketed goods and services is sometimes required or informative. Examples include clean air, unpolluted and non-depleted aquifers, wilderness experiences, stable plant and animal populations, and biodiversity (Perkins, 2003).

Nevertheless, DBV can be a substitute or counterbalance for traditional economic valuation processes. "When economic studies purporting to show the "bottom line" are quickly overruled by political realities, and when economic rationales are brought in as justification for changes of plans made necessary by public pressure, it is time to pull away the veil, stop funding the economic studies, and acknowledge that costs and benefits are actually a black box affected more by political conditions and community satisfaction with government decisions than by "objective", individually-specified, or market-related conditions." (Perkins, 2003).

DBV works best in circumstances where there are well-developed political organizations on all sides and the issue is "wicked" or complex (Perkins, 2003). It works where traditional environmental valuations such as cost/benefit analyses have failed (Perkins, 2003). DBV has been successful in complex regulatory environments and in an environment where there are high levels of uncertainty (Perkins, 2003). Participants must be empowered to be explicit about the values that are important to them (Perkins, 2003). All constituencies must be identified and connected to the process.

In practice, DBV works best by making use of small groups (2-20). Citizen-stakeholders deliberate as to the value of a public good. The group should have a common purpose and the activities must be well-coordinated to be effective. Procedural rules should be developed and followed to foster a fair outcome. Each participant should be allowed to participate in the discourse, put issues on the agenda, and make his/her own assessment regarding the valuation of the environmental good. The environment for the discussion should be open and pressure-free. The goal of discourse is to reach a consensus set of valuations amongst all the participants. Debate is organized around the acceptability of alternative measures of what constitutes the common good. Participants are asked to avoid a narrow constituent-oriented point of view (Wilson and Howarth, 2002).

Participants are also asked to be responsive to demands that are argued for openly in reference to a conception of the common good for society (Wilson and Howarth, 2002). Each group is presented with alternative policy scenarios, each representing different combinations or amounts of a desired ecosystem good or service. Each will likely have an associated cost or benefit to society. Faced with this tradeoff, the group is then be asked whether they are willing to have society pay a specified amount of additional cost to provide for the specified amount of ecosystem good or service, provided in each scenario. The group would thus provide values not in terms of each member's willingness to pay, but rather in terms of the group's willingness to have society pay (Wilson and Howarth, 2002).

DBV techniques will likely expose participants to a wider range of points of view than would be possible for individuals left to their own devices. They evaluate ecosystem goods and services in a manner that involves fair treatment of competing groups (Wilson and Howarth, 2002). Small interdisciplinary discussion groups have been found to yield significantly more ecosystem services than individuals (Wilson and Howarth, 2002). Participants may have differences in training, background, and life experience, and thus different information about given alternatives. If group members effectively share their information, shared learning can occur, and the groups can make more informed policy choices than if the decision were left to a single individual (Wilson and Howarth, 2002).

The diversity of value-systems and personal views can create a fertile environment for coming to grips with the implications of various externalities and finding flexible, innovative resolutions (Perkins, 2003). DBV can reveal participants' unspoken views and preferences (Perkins, 2003). It has been successful in circumstances where there is potential for dissatisfied local people to sabotage the conflict management process (Perkins, 2003).

Like all methods, DBV also has certain limitations. Small discussion groups have sometimes been found less likely to disclose controversial information than private interview survey instruments (Wilson and Howarth, 2002). Secondly, as noted by Perkins, "From an ecological point of view, any valuations methodology is inevitably anthropocentric; even discourse-based valuation can only include intrinsic and existence values insofar as some humans represent their interests in those nonhuman-derived values." (Perkins, 2003). Finally, DBV may fail where secretive and covert deal-making and decision processes are going forward.

Name: Scenario-based Methods (Summarized from: Wallenberg, et al. 2000)

Scenario processes seek to stimulate creative ways of thinking about future conditions. Participants are encouraged to depart from the established ways of looking at their environments. They are asked to discuss the possibility of new courses of action that hold the potential of resulting better outcomes. Four kinds of scenarios are frequently used:

- *Vision* scenarios serve to elicit peoples' hopes and dreams
- *Projection* scenarios illustrate what respondents believe are the consequences of their current situation.
- *Pathway* scenarios create comparisons of the present and a desired future to foster strategies and processes for change.
- *Alternative* scenarios show a range of possible outcomes to help participants bound uncertainty.

Scenario representations can take many forms: pictures, photos, narratives, dramas, videos, dances, mathematical equations, GIS applications, maps, drawings, graphs, etc., or, indeed, combinations of these. They can be used to explore the various current mental maps of how things are perceived to work and what future conditions are desirable. This exercise can help individuals to better come to grips with the uncertainties surrounding the present and future, and also help them to begin to understand the potential consequences of various management actions in the short and long terms. Participants also explore myriad types of possible interactions and visions of alternative futures. Scenario process facilitators encourage interactions amongst divergent groups to stimulate creative learning, and discovery of ranges of outcomes-- along with the associated strengths and limitations of each.

The process requires inclusivity to succeed. For instance, even the views and interests of those lacking substantial political power, are, nonetheless relevant in and to the power structure. Thus, differences among groups must be accommodated. Operationally, this may mean that process organizers will have to work with different groups in a successive manner. They may have to segregate powerful and weak participants in early group sessions, since user's capacities, preferences, and resources determine the forms of the scenarios.

During scenario visioning processes, among the first required steps, obviously, is to define the purpose of the scenario. The next step is to determine what kind of data and information about the future are required to support the mutual learning process that will inform future decisions or management actions. Step three is to choose the appropriate type of scenario process. If a need exists to develop knowledge about participants' preferences about the future, *vision* approach is appropriate. If there is a need to have a shared understanding of the future to achieve some desired management action, the *projection* or *alternatives* approach may be chosen.

Selecting facilitators and settings follows. It is important to choose facilitators who are interested in empowering weaker parties. They must also display a capacity for objectivity, fairness, and maintaining an open and inclusive attitude. It is essential to choose styles of communication and meeting settings that show respect and fairness for the cultures and values of all participants.

It is important to determine the relevant groups to involve in the scenario process and establish how the interests of each should be represented. (Consulting local news outlets, interviewing key personnel, consulting local experts, and reading related literature can help identify these groups.) Understanding differences amongst groups in communication styles and modes of viewing the future is also essential. Determine the learning styles and capacities of each group. Assess group internal and external dependencies and interdependencies amongst groups and group members. It is also wise to determine what *persons* within the social hierarchy and what *agencies* will have access to and/or control over information. Finally, what knowledge set or information base does each group have as a domain?

Geographic information systems, maps, aerial photography, satellite imagery, and the like can be used to represent scenarios in ways that make them tangible to the chosen groups and to decision-makers. Scale the scenario methods to provide groups and decision-makers just enough information to allow them to construct plausible, distinct scenarios. Run the scenarios of choice using the methods appropriate to them.

Scenario planning has been demonstrated to have a variety of strengths. It is a basic tool for learning, particularly anticipatory or forward-looking learning. It helps to overcome strong tendencies for people to believe that the future will repeat the patterns of the recent past, something that can be a problem with monitoring-based learning. Where uncertainty and complexity exist, preparedness for the future can depend in part on the extent to which people have engaged in processes to anticipate the unexpected. In this regard, scenarios can waken people's critical thinking and stimulate new insights.

Scenarios can act as a springboard for building perceptions amongst stakeholders of the values and assumptions that underlay management of a natural resource. They can help to identify competing value systems and identify areas of interdependency. Scenarios are useful where complexity and uncertainty are high because they investigate the sources of these. They can help to view choices and alternatives in a new light. They have the potential to foster creative visions of the future. They can be used to introduce hypothetical possibilities. They can cause stakeholders to examine whether they have underestimated uncertainties, denied evidence contrary to their views, or overestimated their abilities to influence futures. Finally, they can promote social learning.

Scenarios can, however, also be an be costly in terms of time, money, and effort. Doing the front-end investigations, assembling the right mix of people, collecting technical information, and holding multiple meetings can consume substantial resources.