

June 30, 2016

To: Sandy White, Chair
Arkansas Basin Roundtable
sandyw@white-jankowski.com

Re: Summary of basin roundtable preference survey

Dear Sandy,

I'm please to deliver this brief summary from conducting a basin roundtable preference survey between February-May, 2016. Below are some sections of narrative describing the background, research agenda, results, and possible interpretation of the results of the project. I'm interested in the following feedback from the roundtable: Are you able to understand how the criteria were developed and the projects were categorized? Do my results (criteria ranking) make sense? Does my interpretation of the results make sense? Are there other ideas for interpreting these results? Do you agree with how these results could be used? Any additional feedback?

Background

Colorado's Water Plan (<http://coloradowaterplan.com/>) is a non-binding vision to address several major challenges to Colorado's water resources; they include:

- i) Minimizing the gap between strained water supplies and growing water demands,
- ii) Minimizing socio-economic impacts due to losses of irrigated agriculture,
- iii) Maximizing the integrity of aquatic ecosystems, valued fish species, and recreation,
and
- iv) Addressing climate change.

The basin roundtables have been tasked with assessing and recording all known water supplies and demands in the basins, and with designing projects that aim to provide resources for key consumptive (e.g., industrial, agricultural, and municipal water) and non-consumptive (e.g., biodiversity, recreation, and aesthetic values) water needs to address Colorado's water resource challenges.

In 2015, updated lists of projects were published in eight basin implementation plan (BIP) reports, which are available on the website for Colorado's Water Plan. The reports have been embraced by Colorado's Water Plan with anticipation that the projects be implemented over the next several decades to address the previously-described water resource challenges and to sustain Colorado's water future.

Approximately 1,002 projects were listed in the eight BIP reports reviewed, which include ongoing, planned, and completed projects. Descriptions for each project were independently written by various members of the basin roundtables and/or their partnering entities. The project descriptions included different underlying strategies to achieve a consumptive, non-consumptive, or multi-purpose outcome. A resounding message from the reports is to effectively implement those strategies to meet agricultural, municipal, industrial, environmental, and water

administration needs. Yet the approach was un-structured in that it was not influenced by any systematic or complementary tools for assessing projects across basins or statewide.

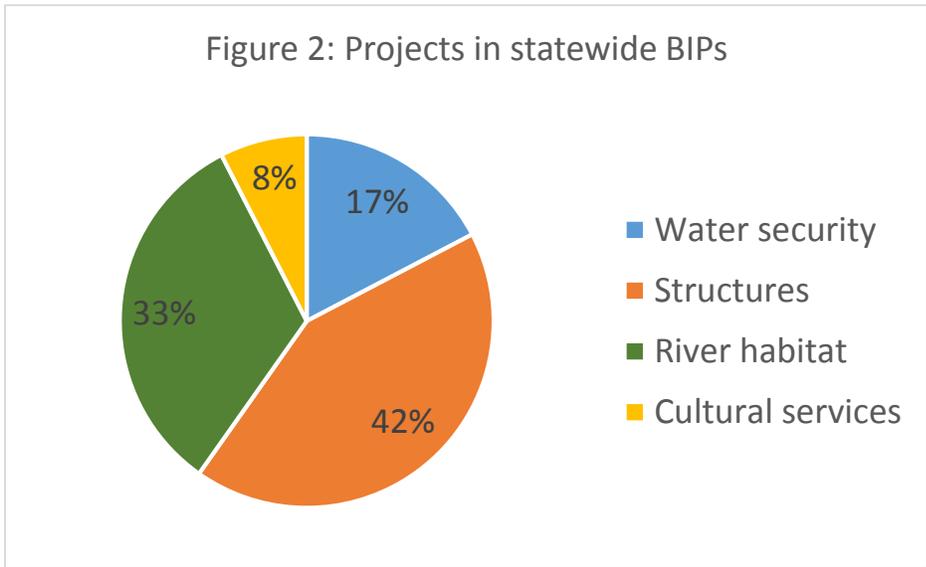
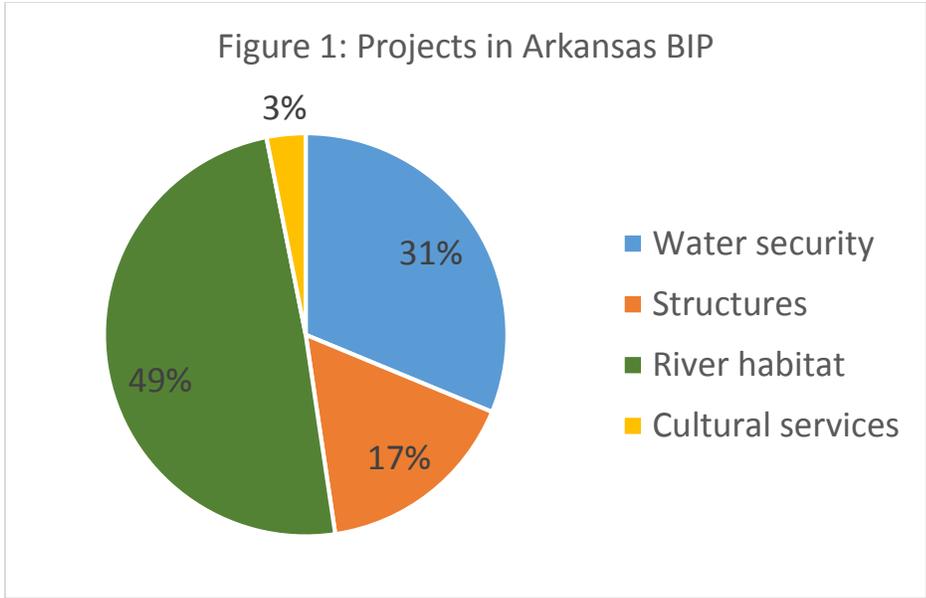
Project categorization

To assess each of the projects equally, I determined that four underlying strategies were common to all projects. These strategies included interventions for water security, planned or existing grey infrastructure, restoration alternatives like bio-physical river habitat production, and interventions to produce socially-desirable cultural services like recreation and aesthetic values (see below). Possible interdependence between water security and structures was considered, but I determined that the distinction was required to classify the projects effectively.

- **Water security** - emphasis on water to secure water supply, ecological, and/or recreational goals (e.g., conservation and reuse programs, flow augmentation, water rights, and water leases like agricultural water transfer agreements)
- **Structures** - emphasis on built infrastructure by developing new or intervening on existing water supply and/or irrigation structures (e.g., new or enlarging reservoirs, rehabilitating agricultural diversions and canals)
- **River habitat** - emphasis to achieve a direct environmental outcome by implementing instream and/or riparian interventions (e.g., restoration, species management)
- **Cultural services** - emphasis on programs and actions that focus on socially desirable recreation and/or aesthetic values (e.g., boating, fishing, watershed education, wilderness designations)

This categorization was performed to streamline the evaluation of the projects in each BIP regarding what was written in each project description. I chose to focus on purpose rather than outcome. For example, dam re-operation and wilderness designations may both have similar outcomes like water conservation, but they are completely different as far as the underlying mechanism for achieving the outcome (structural vs. cultural). Further, many projects were listed to secure water rights, which was straightforward. However, if securing water rights was not included in the project description for a new reservoir proposal, then I categorized the reservoir as a structure because that was the primary purpose of the project scope as outlined in the BIPs.

Precisely 716 projects were placed into an intervention category. Some projects were left out because there wasn't enough information to make a determination of the underlying implementation strategy of the project. I calculated the proportion of projects placed into each category and developed the following pie charts for the Arkansas basin and for all basins statewide. An Excel spreadsheet is attached to this letter with details about this classification of projects from Appendix 5.2-C of the Arkansas basin BIP.



The pie charts show that the number of projects in the BIPs are skewed more towards structures and river habitat as management strategies to sustain water resources in Colorado. It is important to stress that these initial project percentages were developed from the number of planned or existing projects from each BIP. They do not represent the relative importance of criteria, neither do they represent previously completed projects from, for example, SWSI 2010 reports. To illustrate, there were over 50 projects characterized by “river habitat” strategies in the Arkansas BIP, many of which are likely small in scale and do not require broad political support and complex governance procedures to implement like projects characterized by water security and structural intervention strategies.

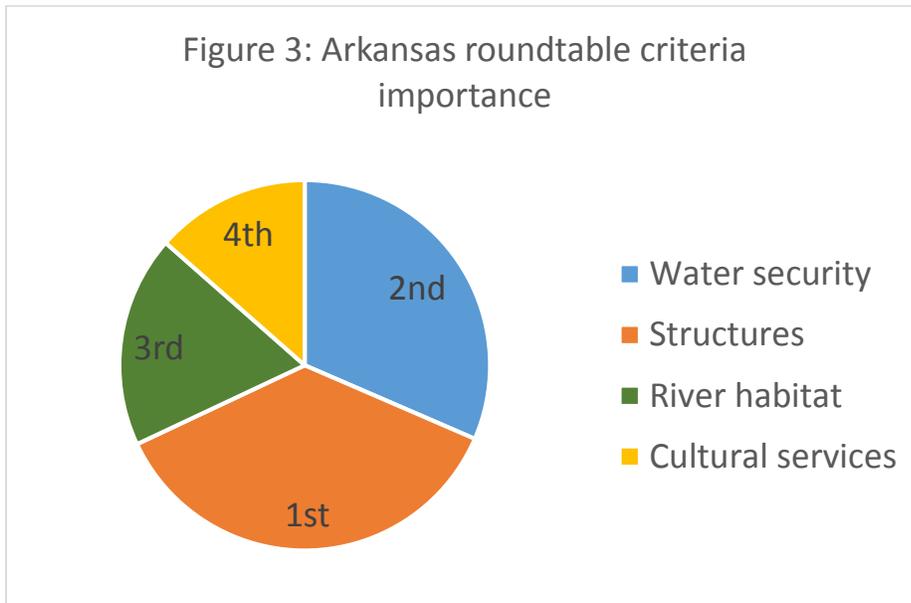
Preference survey & results

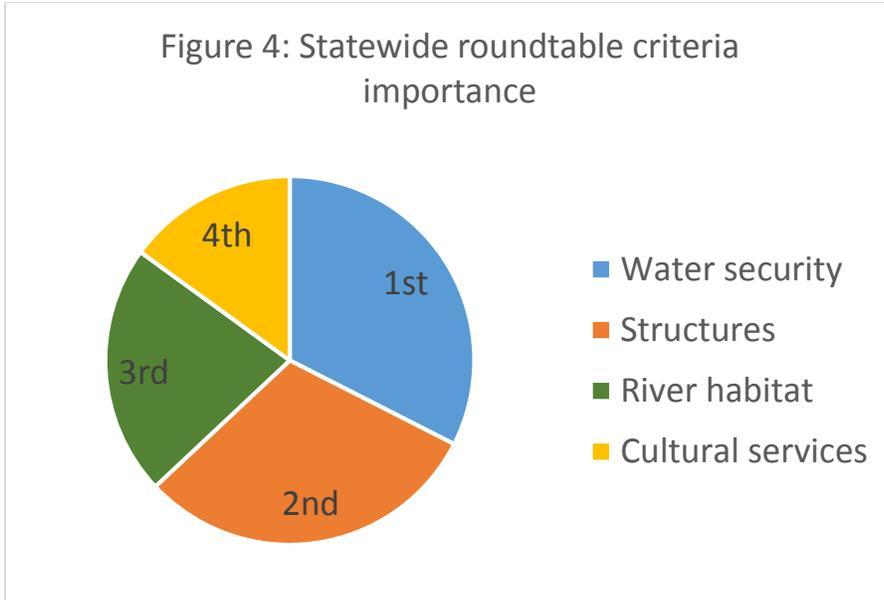
I developed a research agenda to examine roundtable member preferences regarding the intervention criteria so that the preferences may be used to support future prioritization of the

projects described in the BIPs. I designed and delivered a web survey to the current lists of members of the basin roundtables. The survey was split into two types that asked respondents to use (i) numbers or (ii) words to provide an ordinal preference judgment (for templates, visit the following URLs: www.brtsurvey2016.davidminormartin.com/ap1; www.brtsurvey2016.davidminormartin.com/eu1). The basin roundtable member list was randomly split into two so that roughly half of the prospective respondents were given one of the survey types. The survey included a short narrative of background information on the challenges for addressing water resources management in Colorado’s Water Plan and on the intervention criteria that underlie possible implementation strategies to address those challenges. The questions were drafted to elicit which criteria were more important to address the water resource management challenges in the state. A link to the survey and login requirements for each prospective respondent were delivered to the basin roundtable member lists via email in February, 2016. Each prospective respondent was de-identified and given a unique six digit login code. After the respondents answered the questions and clicked the submit button, an email was sent to myself with tags for login code and survey answers.

The survey closed in May, 2016. I received 94 responses to the survey statewide and 18 from the Arkansas basin roundtable. The statewide (36%) and Arkansas (44%) response rates were fair, but a disproportionate amount of responses came from each of the eight basin roundtable member lists. The response rates per basin varied between 18-55% and, therefore, the results are not representative but illustrative of possible trends in preferences of the roundtable groups within the water basins and statewide.

The following pie charts show how each criterion ranked in order of importance with respect to the basin roundtable member responses to the survey:





Proportion in the pie charts refer to the mathematical calculations required to translate the respondent preferences into a criteria weighting. Information about these calculations can be delivered upon request. However, the proportions don't mean as much to the basin roundtables as the rankings do, which is shown in the figures. Regarding the Arkansas roundtable member preferences, results are similar to the preferences of all roundtable member responses as a statewide group.

To summarize my initial interpretation of the results, these rankings make sense. Projects categorized by the “structures” criterion are costly and are designed to address pressing political and socio-economic needs like drinking water supply. Likewise, “water security” initiatives like water rights acquisitions or city conservation programs are burdened by complex socio-political and legal institutions, and are therefore more important of a strategy. Because water is considered a scarce resource in Colorado, among the most important issues surrounding water resources are providing the institutional capacity for water security as drinking water for a growing population, and investing in built infrastructure to secure that water (see Colorado’s Water Plan; <http://coloradowaterplan.com/>). Therefore, it is not surprising to me that there is extreme variation in how the criteria are proportioned by number in Figures 1 & 2, but as intervention strategies water security and structures happen to be among the highest priority criteria estimated from the preference survey (Figures 3 &4).

Conclusion

The basin roundtables will be making decisions to implement the proposed and ongoing water management projects in the BIPs over the next several decades. When pertinent information about the consequences of the projects is further developed (e.g., through screening WSRA grant applications), the results may be used to prioritize the projects for sustainable water resource management in Colorado.

David M. Martin
DavidMinorMartin@gmail.com

I appreciate the time and feedback that the Arkansas roundtable gave to develop this project. I also appreciate any additional feedback you may provide regarding the project and results. The methods developed during the survey project are both theoretically interesting and of value to the science of decision making, and I will be drafting technical parts of this story in an article for submission to an academic peer-reviewed journal.

For more information, please do not hesitate to contact me. I look forward to communicating with you more about the project as you see fit.

Kind regards,

David M. Martin
DavidMinorMartin@gmail.com
(970) 286-8379