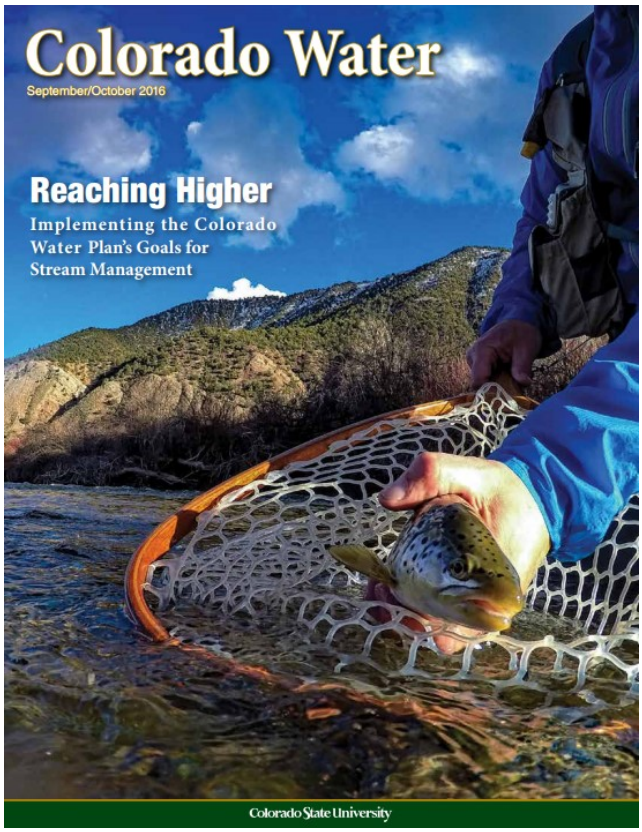
Stream Management Planning Technical Workshop

Final Report



Prepared for:
Colorado Watershed Restoration Grant Program
Attn: Chris Sturm

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Colorado Water Trust
Grant Amount: $17,500
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COLORADO WATER TRUST

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Introduction

The Colorado Water Trust's mission is to restore flows to Colorado's rivers in need. As part of that effort, the Water Trust supports planning efforts that provide the science necessary to address river health issues around the state.

One of the measureable goals outlined in Colorado's Water Plan ("Water Plan") is for 80 percent of locally prioritized streams to be covered by Steam Management Plans ("SMPs"). However, many entities interested in SMPs were unaware of the tools and resources available to them to support a stream management planning effort.

Water Trust staff believed it was vitally important to catalyze information sharing and discussion to move the SMP engagement effort forward. To that end, the Water Trust applied for, and was awarded funding from the CWCB (Order Number POGG1 PDAA 20160000000000000755) to facilitate discussion and information sharing through a workshop and a publication to allow interested parties to understand more about SMPs, tools available to aid in creation of SMPs, and existing funding mechanisms. The initial workshop turned into two workshops in order to reach a larger audience and facilitate further discussion.

The workshops and publication were just the first steps in sharing knowledge and convening professionals to support development of stream management plans, an important step towards achieving the goals of the Water Plan. At the time of this writing, another nonprofit organization based in Colorado, River Network, is currently working to support several specific stream management planning efforts in addition to developing additional tools and resources for future stream management planning efforts, building on the Water Trust's initial engagement effort.

Background

The purpose of the initial workshop was to present technical platforms that can support stream management planning efforts, convene entities that had previously completed SMPs and those considering development of SMPs, and to provide a forum for discussion and dissection of the technical platforms. In addition to the technical aspect of the workshop, it was important to connect a group of technical professionals to foster progress toward the goals outlined in the Water Plan. The Water Trust also compared and contrasted various resources, supported by a technical consultant and a number of partners, and shared the available information publicly through the Colorado Water Institute's ("CWI") September/October 2016 edition of *Colorado Water*.

Methods and Results

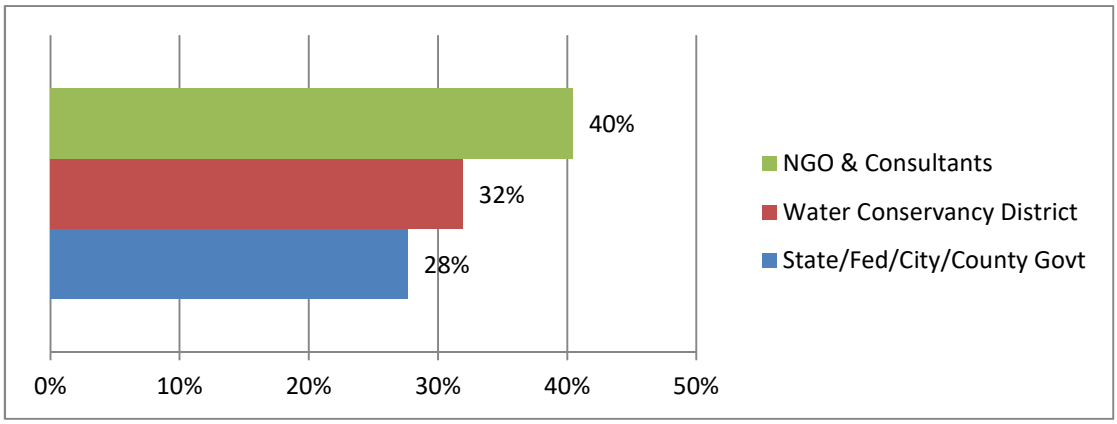
Task 1: Organize Workshop

Using CWCB funding and in-kind support, the Water Trust and its consultant, Biohabitats Inc. ("Biohabitats"), developed an online needs assessment survey in collaboration with the Colorado Water Conservation Board in early summer 2016. Through the survey, the Water Trust engaged a group of 49 professionals representing NGOs and governmental organizations to determine focus areas for the workshop and the subsequent publication from CWI. This survey group represented every major river basin in Colorado and every stage of SMP development. Using the survey response data, the Water Trust and Biohabitats coordinated with presenters to develop/adjust an agenda for the CWC workshop that covered a diverse range of topics related to SMPs that would be helpful for those considering developing SMPs. The survey response data is attached to this report as Appendix A.

To reach as broad an audience as possible, two workshops were held, the first at the Colorado Water Congress 2016 Summer Conference (CWC workshop) and the second at the 2016 Sustaining Colorado Watersheds Conference (SCW workshop). The two-workshop approach seemed to be the most effective strategy to reach a diverse group, from governmental organizations to consultants and NGO practitioners based on survey responses and the need to keep the conversation moving forward.

Task 2: Hold the Workshop

Using CWCB funding, match from Colorado Water Congress, and in-kind support from the Water Trust, CWC, and Biohabitats, the first workshop was held August 23rd and 24th at the Colorado Water Congress 2016 Summer Conference in Steamboat Springs, Colorado. Colorado Water Congress provided logistical support and audio/video support for the Workshop. The sold-out workshop was attended by 49 people in addition to seven presenters, and attendance was distributed among sectors, as shown in the chart below.



Presenters at the CWC workshop included a wide array of experts: Amy Beatie of the Water Trust, Chris Sturm of CWCB, Nicole Silk of River Network, Meg White of the Nature Conservancy, Steve Malers of the Open Water Foundation, Spencer Williams of Ponderosa Advisors LLC, Vince Sortman of Biohabitats Inc., Dan Baker of Colorado State University, Drew Peternell of Trout Unlimited, James Ecklund of CWCB, Jacob Bornstein of Spark Policy Institute, Seth Mason of Lotic Hydrological, Claudia Browne of Biohabitats Inc., Ken Neubecker of the Colorado Basin Roundtable, and Kelly Romero-Heaney of the City of Steamboat Springs. The CWC workshop gave interested parties context about stream management planning and how it can be used, in addition to tools and approaches to start the process of creating an SMP, including available funding. Other topics included stakeholder engagement, existing data and prioritization, physical assessment techniques, quantitative measures, and pending stream management plans. Notes from the CWC workshop are attached to this report as Appendix B.

In addition to the workshop held at CWC, CWCB funding and in-kind support from the Water Trust and Biohabitats supported an additional workshop was held on October 11th at the 2016 Sustaining Colorado Watersheds Conference (the second workshop was coordinated by a steering committee that included the Water Trust and Biohabitats, but was held by the Colorado Watershed Assembly). The second workshop focused more on conversation and involved world-café style interactive discussion groups. The Water Trust and Biohabitats worked closely with the steering committee and others to ensure that the second workshop built off of the information shared and the lessons learned in the first workshop. The Water Trust created materials and supported program development, and Biohabitats was deeply involved in the planning and development of the second workshop in addition to facilitating a portion of the workshop. Notes from the second workshop's world café, compiled by River Network, are attached to this report as Appendix C.

Task 3: Prepare White Paper/Report

With CWCB funding and in-kind support, Colorado Water Trust's consultant, Biohabitats, coordinated the creation of a special edition of the Colorado Water Institute's *Colorado Water* that focused specifically on stream management planning. Claudia Browne at Biohabitats wrote an article for the publication, communicated with article authors, compiled and reviewed draft articles, and worked closely with Colorado Water Institute at Colorado State University to facilitate the creation of an edition of *Colorado Water* that focused on SMP background, development, funding, and implementation. This publication provided information about various technical approaches that can be applied to SMP efforts, as well as background information about stream management planning and Colorado's Water Plan.

The publication of the SMP-focused edition of *Colorado Water* in lieu of an independent white paper allowed the Water Trust and Biohabitats to leverage the broad reach of the Colorado Water Institute to reach a larger audience. The publication included articles authored by many of the workshop presenters. Topics were numerous and included: stakeholder engagement, data availability, analysis and presentation techniques, establishing targets and metrics for flow, flow evaluation tools, case studies and lessons from several completed SMPs, fish passage, and water markets. This 36-page publication

provided interested parties with a great entry point to engage in a larger stream management planning discussion. The publication is attached to this report as Appendix D.

Conclusions and Discussion

The original objectives of the Workshop were achieved, as a significant group of stakeholders gained exposure to resources they could utilize to begin a stream management planning process. As a measureable objective in Colorado's Water Plan for attainment by 2030, the statewide SMP effort will continue for years to come. The resources and conversations shared at the SMP workshops, and the resources shared via *Colorado Water* helped to inform the first generation of SMPs created after the release of Colorado's Water Plan.

In addition to the workshop and the published resource, the Water Trust and Biohabitats engaged partners at the Colorado Watershed Assembly and River Network to ensure that there was continuity as the awareness and knowledge sharing effort progressed. While the Water Trust never intended to be the long-term home for SMP resources, we worked with willing partners to ensure that the continuing effort was not duplicitous, but rather, built on the foundation established by the August workshop and publication. The work continues, as River Network has been engaging both restoration professionals and interested parties in 2017 to help connect those interested in stream management plans with professionals and methods that have been identified and utilized on other similar efforts.

It became apparent, through conversations with CWC workshop attendees, that there are many ideas about what a stream management plan could be. The CWC workshop focused primarily on the necessary steps for the development of an SMP as outlined in the Water Plan and available tools. While this was an important starting point, the SCW workshop was able to focus more on how SMPs are supposed to be locally-driven, adaptable planning frameworks, and can be very flexible.

The underlying goal of the workshop and CWI publication was to expand awareness and access to stream management planning tools. The workshop engaged stakeholders from around the state, in various stages of developing and pursuing stream management plans. Many of the attendees of the 2016 workshops are involved in various stages of development and implementation of stream management plans in 2017.

Actual Expense Budget

Task	CWCB	Match	In-Kind	**Total**
Task 1: Organize Workshop	$4,550.00		$10,551.28	**$15,101.28**
Task 2: Workshop		$2,350.00	$3,525.00	**$5,875.00**
Task 3: Consultant Expenses for Workshop and White Paper	$12,950.00		$7,470.00	**$20,420.00**
Total	**$17,500.00**	**$2,350.00**	**$21,546.28**	**$41,396.28**

Appendices

Appendix A: SMP Survey Results

Appendix B: Notes from 1st workshop held at Colorado Water Congress Summer Conference 2016

Appendix C: Notes from 2nd workshop held at Sustaining Colorado Watersheds 2016

Appendix D: Colorado Water Institute. (2016, September/October). *Colorado Water.*

References

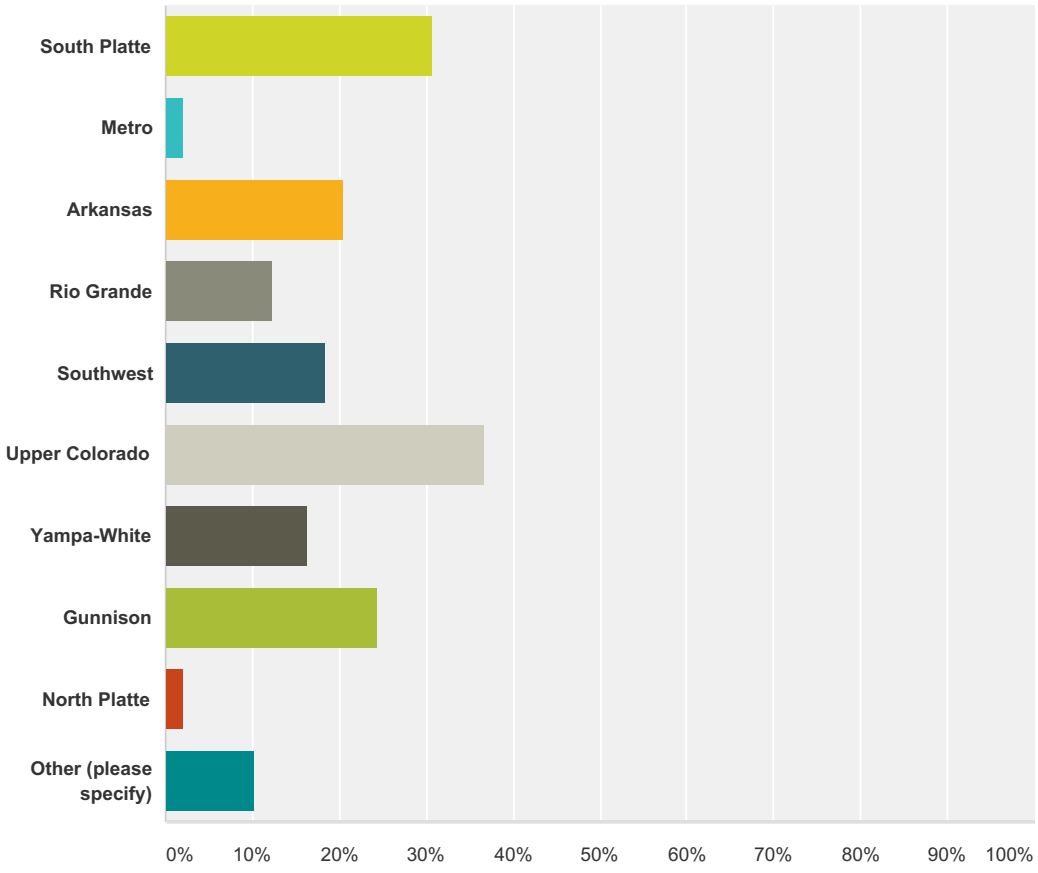
State of Colorado. (2015). *Colorado's Water Plan.* Retrieved from: https://www.colorado.gov/pacific/cowaterplan/plan

Appendix A:

SMP Survey Results

Q1 What major river basin encompasses your site(s)?

Answered: 49 Skipped: 0



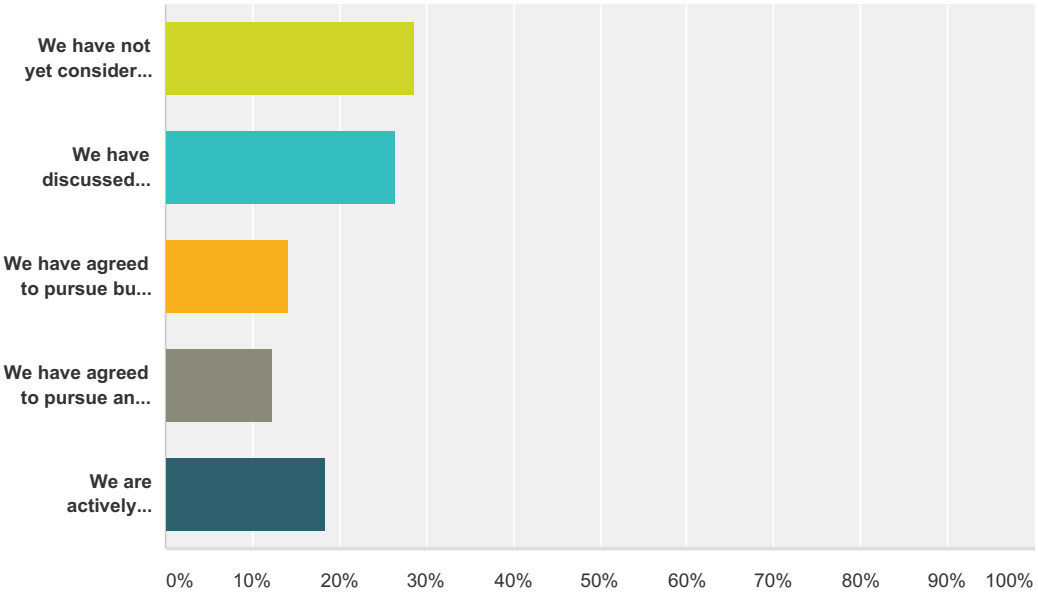
Answer Choices	Responses	
South Platte	30.61%	15
Metro	2.04%	1
Arkansas	20.41%	10
Rio Grande	12.24%	6
Southwest	18.37%	9
Upper Colorado	36.73%	18
Yampa-White	16.33%	8
Gunnison	24.49%	12
North Platte	2.04%	1
Other (please specify)	10.20%	5
Total Respondents: 49		

#	Other (please specify)	Date

1	My organization works with several groups around the state.	7/13/2016 12:38 PM
2	n	6/28/2016 7:32 PM
3	Lower Colorado too (in Colorado)	6/28/2016 2:49 PM
4	We are a statewide organization	6/24/2016 5:32 PM
5	Colorado mainstem	6/16/2016 3:29 PM

Q2 Is your organization currently considering an SMP? If so, how would you describe your stage in the process?

Answered: 49 Skipped: 0



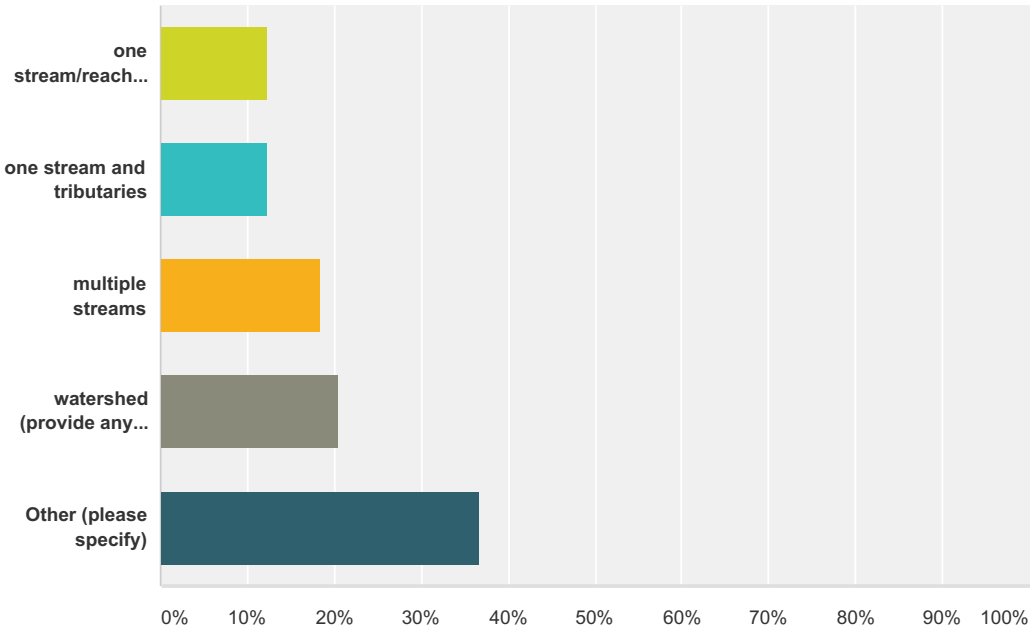
Answer Choices	Responses	
We have not yet considered developing an SMP	**28.57%**	14
We have discussed briefly	**26.53%**	13
We have agreed to pursue but have not started yet	**14.29%**	7
We have agreed to pursue and have started to organize materials	**12.24%**	6
We are actively seeking resources and funding to develop an SMP	**18.37%**	9
Total		**49**

#	Please describe in more detail (optional)	Date
1	a contractor is hired and the process is underway	7/13/2016 3:48 PM
2	As a facilitating organization, we are in the process of identifying priority sites with local support.	7/13/2016 12:38 PM
3	More conversation is needed to determine where best to apply funds and studies. Pitkin County HRS will be reviewing grant requests for the recently completed Crystal River SMP	7/9/2016 8:51 AM
4	The Saint Vrain Creek Coalition would like to be part of the SMP process for our region.	7/8/2016 2:51 PM
5	In collaboration with Trout Unlimited, conducting stakeholder interviews for a sub-basin assessment to better determine scope of SMP	7/7/2016 12:28 PM
6	We are now developing a stream/wetlands strategic master plan to guide where restoration projects.could benefit stream/wetland health and functions.	6/30/2016 10:18 PM
7	Through the CBRT efforts	6/28/2016 2:49 PM
8	peripherally involved as technical liaison to western slope SMPs in development. Our agency is not a sponsor for an SMP but involved in many.	6/28/2016 1:18 PM

9	American Rivers and the Colorado Basin Roundtable	6/28/2016 10:29 AM
10	As a very young organization busy doing flood recovery, this is on our radar for another year or so down the road. If we have support to get an SMP off the ground for our organization sooner, we will be that much more prepared for future project planning and organizational capacity building.	6/27/2016 1:30 PM
11	The Colorado RT applied for funding to support a first phase of information gathering in preparation for SMP development throughout the basin. I can provide a copy of our funded proposal upon request.	6/23/2016 11:41 AM
12	Interested in state policy development angle to financially support SMP development and to incorporate agriculture water use /on-farm conservation measures	6/22/2016 3:41 PM
13	as part of a larger group, I've been involved with discussions	6/22/2016 12:25 PM
14	We have funding to begin and have entered into contract with consulting team. Kickoff meeting in July.	6/17/2016 12:53 PM
15	HCCA is serving on an ad hoc committee through the Upper Gunnison River Water Conservancy District to determine how to proceed with stream management planning in the Upper Gunnison Basin. The Stockgrowers Assn, TU and Bill Trampe are also participating on the committee along with UGRWCD board members.	6/17/2016 11:25 AM

Q3 What geographic scope/scale are you considering for an SMP?

Answered: 49 Skipped: 0



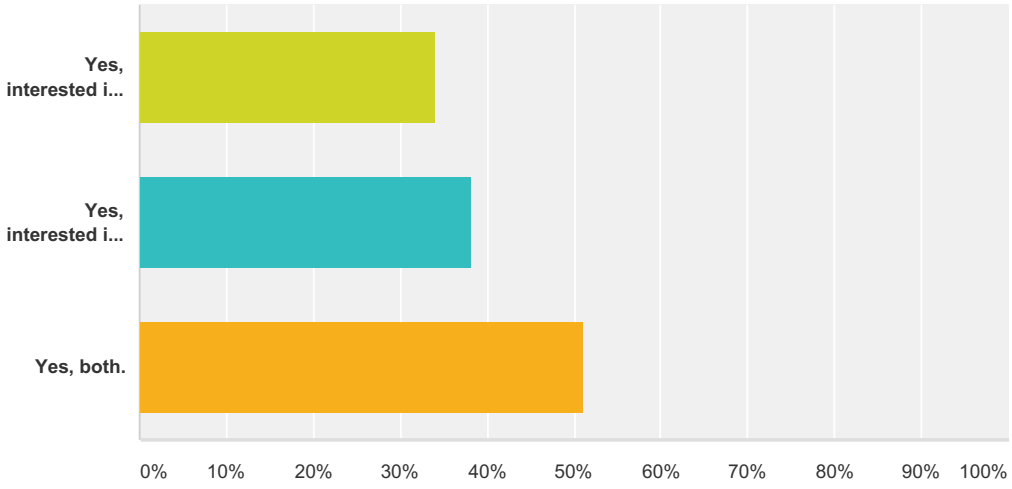
Answer Choices	Responses	
one stream/reach (mainstem)	**12.24%**	6
one stream and tributaries	**12.24%**	6
multiple streams	**18.37%**	9
watershed (provide any additional details below)	**20.41%**	10
Other (please specify)	**36.73%**	18
Total		**49**

#	Other (please specify)	Date
1	Upper Colorado River Watershed Group	7/9/2016 10:09 AM
2	Extention of Crystal SMP to include tributary recovery from ditch return flows	7/9/2016 8:51 AM
3	Gunnison River with a tributary sub-basin by sub-basin approach	7/7/2016 12:28 PM
4	Upper South Platte watershed	6/30/2016 10:18 PM
5	Working on developing a framework for SMP's throughout the Upper Colorado Basin.	6/30/2016 4:35 PM
6	n	6/28/2016 7:32 PM
7	Generally watershed scale, but some cases (e.g., Yampa R) are targeting specific needs/ reaches of critical concern.	6/28/2016 1:18 PM
8	not considering	6/28/2016 10:44 AM
9	Sub-basins and smaller watershed units on the West Slope	6/28/2016 10:29 AM
10	N/A	6/28/2016 10:19 AM
11	N/A	6/24/2016 5:32 PM

12	While the proposal I mentioned applies basinwide, there is recognition that smaller scope SMPs will probably be the chosen method, although the CoRT would like to see continuity in their development so that individual SMPs could be linked at some point in the future.	6/23/2016 11:41 AM
13	Considering multiple scales, probably mid-watershed	6/22/2016 6:09 PM
14	Gore Creek Watershed	6/22/2016 6:02 PM
15	Focus on Roaring Fork, Mancos River, San Juan Basin, Upper Rio	6/22/2016 3:41 PM
16	multiple watersheds in Upper South Platte and all of Ark Basin	6/22/2016 3:11 PM
17	eagle and roaring fork watersheds	6/22/2016 12:35 PM
18	Sub-basins, eventually extending to the majority of the Upper Gunnison Basin.	6/17/2016 11:25 AM

Q4 The full workshop will be held in August in conjunction with Colorado Water Congress Summer Conference in Steamboat Springs, and then a shorter workshop will also be held at the mid-October Sustaining Watersheds Conference in Avon. For the Steamboat CWC Summer Conference, the first part will be held Tuesday afternoon from 2-5 pm, and then finishing on Wednesday morning 9-11:45 am. At the Sustaining Colorado Watersheds conference, we would provide a more condensed/abbreviated version of select information in a 4-hour session.

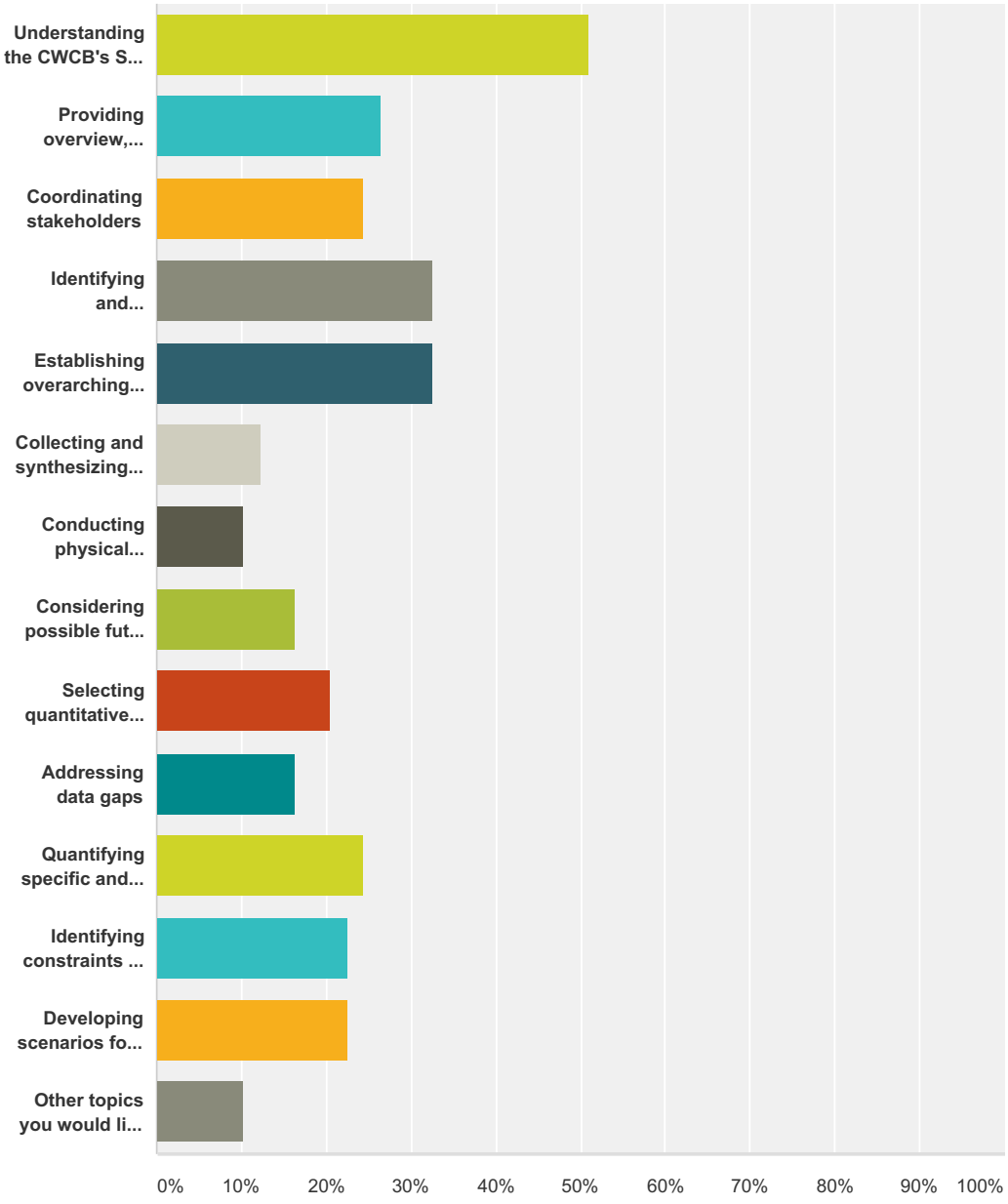
Answered: 47 Skipped: 2



Answer Choices	Responses	
Yes, interested in August 23rd-24th Colorado Water Congress Summer Conference in Steamboat Springs, Colorado	34.04%	16
Yes, interested in October 11-13 Sustaining Colorado Watershed session in Avon, Colorado	38.30%	18
Yes, both.	51.06%	24
Total Respondents: 47		

Q6 The 2015 Colorado Water plan gives an overview of the steps for developing Stream Management Plans in Section 6.6 (page 6-168). The SMP workshop can help attendees understand the steps and the resources available for completing them as well as understand the SMP program and how to apply for its funding. Which of the following topics or steps in the SMP process are you most interested in learning about in a workshop? (pick top 3)

Answered: 49 Skipped: 0

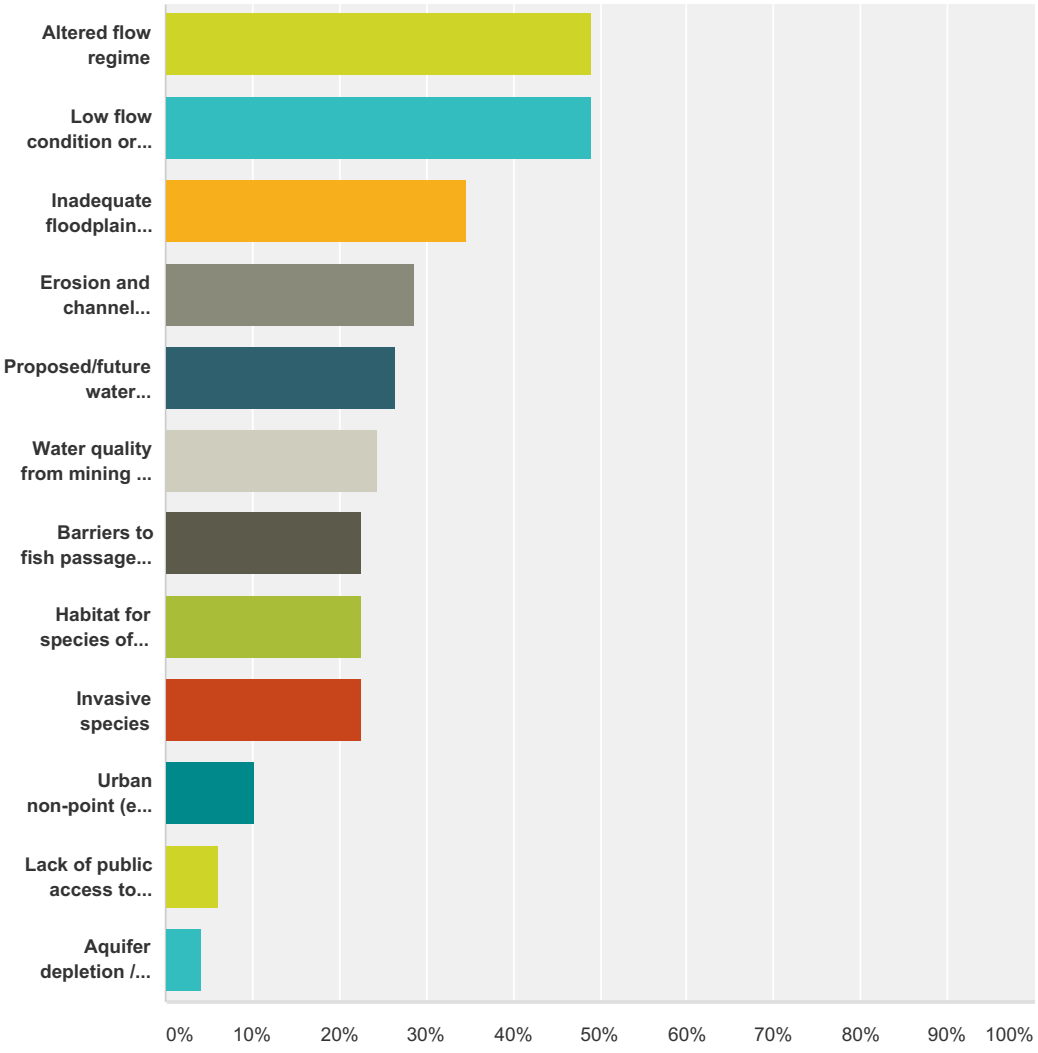


Answer Choices	Responses
Understanding the CWCB's SMP grant application process.	**51.02%** 25
Providing overview, background and relationship to other programs such as the Water Reserve Account	**26.53%** 13
Coordinating stakeholders	**24.49%** 12
Identifying and prioritizing ecological and recreational values along with other traditional stream values	**32.65%** 16
Establishing overarching goals and objectives for physical conditions	**32.65%** 16
Collecting and synthesizing existing data (existing resources)	**12.24%** 6
Conducting physical assessments	**10.20%** 5
Considering possible future conditions	**16.33%** 8
Selecting quantitative measures to assess progress	**20.41%** 10
Addressing data gaps	**16.33%** 8
Quantifying specific and seasonal flow recommendations, assessing physical conditions, and evaluating the potential for channel reconfiguration	**24.49%** 12
Identifying constraints and opportunities	**22.45%** 11
Developing scenarios for future conditions	**22.45%** 11
Other topics you would like to learn about:	**10.20%** 5
Total Respondents: 49	

#	Other topics you would like to learn about:	Date
1	how to put the burden of proof of impacts and subsequent mitigation on the entities responsible for de-watering, current diverters, but especially future projects	7/13/2016 3:48 PM
2	Maintaining Value of water rights for the holder of a water right.	7/11/2016 2:03 PM
3	leveraging funds - public/ private partnerships; 'impact investors' - who are they? how do I get to know them?	6/28/2016 1:18 PM
4	Prioritizing steams that need restoration based on avian data	6/24/2016 12:58 PM
5	identifying opportunities for private investment	6/16/2016 3:29 PM

Q7 What are the three highest priority environmental and recreation issues and opportunities for improvement for the stream system where you work or where you are considering an SMP?

Answered: 49 Skipped: 0



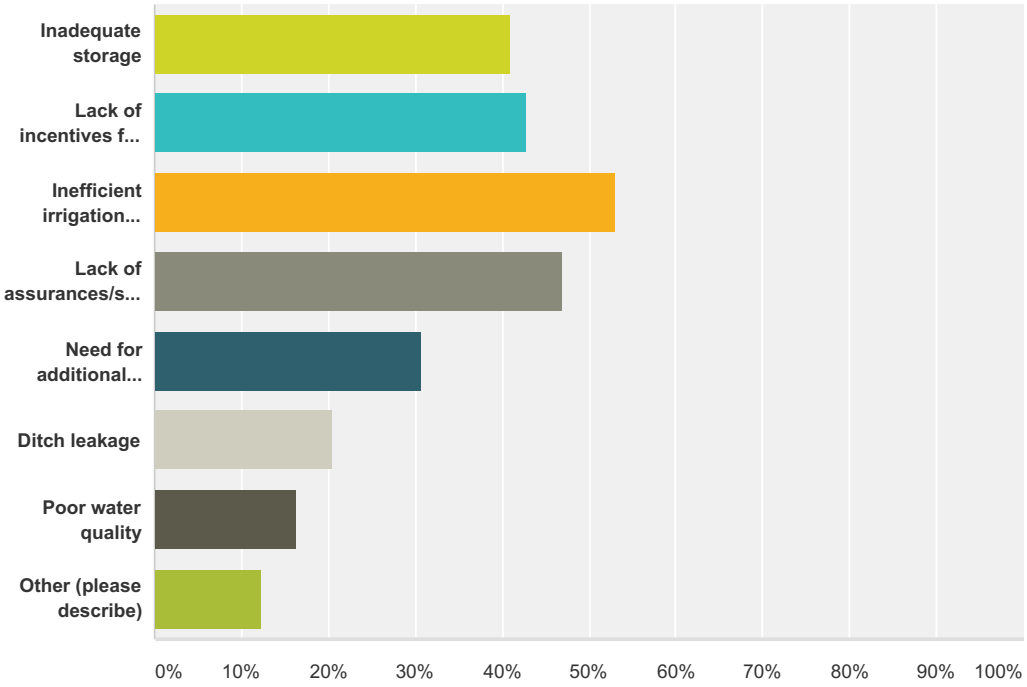
Answer Choices	Responses	
Altered flow regime	**48.98%**	24
Low flow condition or absent riparian buffer	**48.98%**	24
Inadequate floodplain connectivity and capacity	**34.69%**	17
Erosion and channel degradation	**28.57%**	14
Proposed/future water development/storage projects [explain]	**26.53%**	13
Water quality from mining or other industrial or energy operations	**24.49%**	12

Barriers to fish passage (e.g. dams, culverts, etc.)	**22.45%**	11
Habitat for species of concern (e.g., Threatened and Endangered)	**22.45%**	11
Invasive species	**22.45%**	11
Urban non-point (e.g. stormwater) pollution	**10.20%**	5
Lack of public access to waterways	**6.12%**	3
Aquifer depletion / groundwater pumping	**4.08%**	2
Total Respondents: 49		

#	Proposed/future water development/storage projects [explain]	Date
1	Future firming of conditional water rights, future transmountain diversion increases	7/13/2016 3:48 PM
2	Water Quanity for production of food and fiber. vs. other uses	7/11/2016 2:03 PM
3	Our watershed will be 80-90% depleted	7/9/2016 10:09 AM
4	New storage projects have a direct impact on both	7/5/2016 5:38 PM
5	We need to explore more opportunities for groundwater storage.	6/28/2016 9:17 PM
6	General concern re: additional depletions w/out shoring up the mess we already have. SMPs can help w/ both. Would add 'NPS ag runoff' to list of concerns but that is touchy.	6/28/2016 1:18 PM
7	Dry Gulch Reservoir	6/28/2016 10:47 AM
8	innovative; multiple benefits	6/24/2016 5:32 PM
9	top issue: Buy and dry	6/22/2016 6:09 PM
10	Box Creek Reservoir--Aurora Water	6/22/2016 4:27 PM
11	Eagle River MOU projects (big unknowns with this)	6/22/2016 1:48 PM
12	Implementation of projects stemming from the Eagle River MOU	6/22/2016 12:35 PM
13	conditional water rights exist for more trans-mountain diversions	6/17/2016 12:53 PM

Q8 What are the three highest priority agricultural and municipal water supply issues and opportunities for the stream system where you work or where you are considering an SMP?

Answered: 49 Skipped: 0



Answer Choices	Responses	
Inadequate storage	**40.82%**	20
Lack of incentives for municipal and industrial conservation	**42.86%**	21
Inefficient irrigation systems	**53.06%**	26
Lack of assurances/safety for trying innovations	**46.94%**	23
Need for additional water sharing	**30.61%**	15
Ditch leakage	**20.41%**	10
Poor water quality	**16.33%**	8
Other (please describe)	**12.24%**	6
Total Respondents: 49		

#	Other (please describe)	Date
1	lack of riparian vegetation for habitat & wildlife corridors	7/13/2016 12:38 PM
2	Maintaining value of water right. keeping Agriculture in production as a top priority.	7/11/2016 2:03 PM
3	Instream flows	6/27/2016 1:30 PM
4	Soil health, consumptive use reduction practices	6/22/2016 3:41 PM

5	Between various areas we work, all of the above...	6/22/2016 3:11 PM
6	Irrigation efficiency is delicate b/c of late season return flows	6/17/2016 11:25 AM

Q9 Please specify any other priority issues for the stream system where you work.

Answered: 21 Skipped: 28

#	Responses	Date
1	"waste" in the form of diverters taking their paper water right and diverting it all season whether they can "use it" or not. Lack of enforcement of CO H2O law as it currently exists in regards to issues of "waste" in taking more than you can use and "dumping" the rest.	7/13/2016 3:48 PM
2	Adequate environmentally timed dynamic flows for riparian habitat / sediment movement / overall sustainable ecological function of the stream.	7/13/2016 12:38 PM
3	Numerous flood recovery projects throughout the watershed.	7/8/2016 2:51 PM
4	Understanding constraints of funding.	7/8/2016 10:09 AM
5	Need to preserve an existing PBO in the lower Yampa and there is a need to establish an ISF water right in the lower Yampa.	7/8/2016 10:03 AM
6	surface water quality monitoring for impacts of liquid mineral development	7/7/2016 8:18 PM
7	Balancing recreation and environment with maintenance of viable agriculture. Persuading irrigators that the SMP process is not intended to tell them how to use their water rights differently.	7/7/2016 12:28 PM
8	The Upper Gunnison is a 'headwaters basin' - all tributaries, all of which are economically important and of which have their own personalities....	6/28/2016 9:17 PM
9	TMDs	6/28/2016 2:49 PM
10	Re: 'efficiency' and 'conservation' - they are not the same; they are used synonomously; some efficiencies are good; some are not but we haven't agreed how to sort this out. Water bankers are scared of efficiency, and there is no silver bullet. We need to recognize this and get past rhetoric and into science and hydrology.	6/28/2016 1:18 PM
11	Gaining the trust of the Ag community is probably the single biggest hurdle we face, Statewide.	6/28/2016 10:29 AM
12	N/A	6/28/2016 10:19 AM
13	Funding	6/27/2016 6:49 PM
14	Habitat restoration	6/27/2016 1:30 PM
15	Piping of irrigation ditches w/ loss of wetlands	6/22/2016 6:09 PM
16	We're dealing with low macro numbers as a result of urbanization, impervious surfaces, stormwater runoff and landscaping practices.	6/22/2016 6:02 PM
17	The environmental impacts caused by the trend of providing unfettered public access to streams for fishing and boating (development of new boat ramps); developing paths and trails along streams; and the development of recreational water parks, all in exchange for local economic benefit. Our water resources are becoming loved to death!	6/22/2016 12:35 PM
18	not sure	6/22/2016 12:25 PM
19	Flood recovery efforts in conjunction with SMP's	6/22/2016 12:22 PM
20	How to protect water that is left in the river for river health, how to escort it down river without being picked up by jr water rights holders	6/17/2016 12:53 PM
21	- How do we protect existing ag uses and potential expanded uses while restoring flow?	6/17/2016 11:25 AM

Q11 The Colorado Watershed Plan discusses "priority streams" but does not provide a definition. Please describe your sense of what would make a stream a priority and/ or suggestions for a process to asses that on a statewide basis.

Answered: 37 Skipped: 12

#	Responses	Date
1	I don't have a sense of this. I think all streams are a priority. Could it mean streams that are most impacted by water diversions, or streams that support the greatest diversity or that have the greatest impacts on regional economies?	7/13/2016 3:48 PM
2	Priority streams (to me) contain, or could be restored to contain, reaches of critical ecological function (native riparian habitat, spawning beds, etc) or, provide ecosystem services that benefit the environment -contributing to overall watershed health and local communities (recreation economies, property values, etc.).	7/13/2016 12:38 PM
3	Stream reaches amenable to cost-effective riparian improvements, trending toward "Proper Functioning Condition" (PFC), with motivated stakeholders	7/9/2016 10:09 AM
4	Over allocated rivers/streams, seasonal low flows, over use (recreational), lack of enforcement and monitoring	7/9/2016 8:51 AM
5	My sense is that a priority stream scores high on a number of important issues: high population dependent on the water, high acres of agricultural serviced, habitat for terrestrial and aquatic species of concern, high value related to recreation and the local economy, high risk of contamination that can reduce aforementioned values. Additionally a stream can be high in priority if the cost of rehabilitation and enhancements are low relate to the resources gained or protected.	7/8/2016 2:51 PM
6	Use of stream, degradation of stream, native species.	7/8/2016 10:09 AM
7	Lower Yampa is a designated Critical Habitat Area for Endangered Fish. Lower Yampa also supports a world Class recreational white water experience through Dinosaur Nat'l Monument.	7/8/2016 10:03 AM
8	Priority streams: 1) provide habitat for important wild and/or native fish, 2) provide public access fishing access, 3) provide important corridors for fish habitat connectivity, 4) provide important riparian habitat for species of interest other than fish	7/7/2016 8:18 PM
9	Priorities - and the criteria for establishing them - should be determined at the Basin level by the stakeholders within the Basin. This is consistent with the Water Plan's grassroots "bottom up" approach to planning. Having said that, it will ultimately be necessary for the interconnected Basins (i.e. users of Colorado River water) to collaborate on developing state priorities. To do that it will be necessary to thoroughly understand in-Basin priorities.	7/7/2016 12:28 PM
10	S.W.O.T. + population affected?	7/1/2016 6:11 PM
11	Impacted by past and present activities (man-made and natural) that have reduced the stream's functionality, including associated floodplains, riparian areas and wetlands.	6/30/2016 10:18 PM
12	'Priority streams' in a basin like the Upper Gunnison would seem to me to be streams that produce more water than their ecosystem uses consumptively. Statewide, I guess we should be looking at the productivity of our streams over time: are some declining in their production? Why? And what can we do about it?	6/28/2016 9:17 PM
13	A priority stream is one that supports the needs of the Basin/sub-basin, water quality impairments exist, large conditional water rights exist, lack of environmental/recreational uses.	6/28/2016 2:49 PM
14	T&E or non-listed sensitive species; high value commercial/ recreational reaches; critical human needs (ie, municipal supplies, or ag supplies w/ multiple uses)	6/28/2016 1:18 PM
15	High degree of stress- multiple uses, high percentage of flows diverted throughout the year Outstanding potential for ecological or recreational value Visible location for public to see improvements	6/28/2016 12:04 PM
16	Highly appropriated streams on a first cone first serve basis.	6/28/2016 10:47 AM
17	Priority streams seem to be the ones most at risk.	6/28/2016 10:44 AM
18	N/A	6/28/2016 10:19 AM

19	Priority streams would be those important to the persistance of species of concern, that support a high level of recreational and/or environmental values, and/or those that support a high number/level of agricultural, municipal, environmental and recreational values and therefore that have a high and potentially increasing potential for conflict among uses/values.	6/27/2016 10:37 PM
20	A priority stream would look like a stream that had multiple anthropogenic impacts. In addition, priority streams may also look like a stream that was recently impacted by a significant natural disaster.	6/27/2016 6:49 PM
21	Work through the Roundtables.	6/27/2016 3:46 PM
22	Habitat quality, low impact of development throughout watershed	6/27/2016 1:30 PM
23	Highly valued for habitat and recreation; high potential for innovative storage; willing partners	6/24/2016 5:32 PM
24	A stream that is ecologically impaired or limited in its ability to provide ecosystem services.	6/24/2016 11:20 AM
25	For Recreation, a priority stream is one that contains an RICD or whitewater park, or supports non-commercial, and commercial use or visitation.	6/23/2016 4:21 PM
26	I think the "mainstems" of Colorado's seven basins are most important to address first, as these generally host the population centers and have the most visible competing interests. It is quite possible that some of the needs identified in the mainstems could be met through optimizing management of the tributaries, which will necessarily create the need to start working into those sub-basins.	6/23/2016 11:41 AM
27	A priority stream is one with ecological function, multiple water uses, senior agricultural water rights with threat of exportation, and the social and political will to affect change. I am biased toward the headwaters, the waters of which are used multiple times as they travel down through the basin.	6/22/2016 6:09 PM
28	Priority streams should include those that are recently showing signs of degradation, those that have high potential for improvement, and those that are home to species of concern or have high aesthetic or recreational value.	6/22/2016 6:02 PM
29	Priority should be any stream or reach that has environmental degradation or has water quantity issues.	6/22/2016 4:27 PM
30	(1) No major impoundments, (2) critical to multiple uses (ag, enviro, rec), (3) threat of development, (4) significant potential for conservation to make a difference	6/22/2016 3:41 PM
31	Streams that have multiple challenges or extreme challenges and that, at the same time, have significant impact on multiple values	6/22/2016 3:11 PM
32	A stream with high water quality currently, but that has high potential for increasing impacts/threats to the WQ thru development, highways, stormwater, diversions, etc. I can see an argument to make already impacted streams a priority, but I feel that there are more resources for those already and I would hate to improve those at the cost of seeing something in pristine (or at least good) condition be impacted while attention was diverted.	6/22/2016 1:48 PM
33	The use of a stream fro drinking water purposes, wastewater discharges and for recreational uses.	6/22/2016 12:35 PM
34	don't have enough info to answer this sufficiently. But I do think that streams/watersheds with active local stakeholder groups that are doing work and improving conditions should somehow get 'credit' when prioritizing. Also, if larger, interstate issues (e.g. compacts) are part of the system, then all groups need to be educated on responsibilities of state, priority areas as identified by landowners (including federal agencies).	6/22/2016 12:25 PM
35	Stream that have significant nexus to candidate, or T&E Species	6/22/2016 12:22 PM
36	Yikes! That's a lot to think about in a survey! Maybe priorities are all headwaters and you can hope/show that improvements made in headwaters trickles down to improvements downstream?	6/17/2016 12:53 PM
37	-	6/17/2016 11:25 AM

Q12 When I need technical expertise on water, water rights, river health, and other related issues, I turn to:

Answered: 36 Skipped: 13

#	Responses	Date
1	Water lawyer friends, the Roaring Fork Conservancy locally, water commissioner friends, anyone who I think is an expert in whatever the topic is. Should call CWT too!	7/13/2016 3:48 PM
2	Water rights - CWT River health - TNC, TU. Riparian health - CRA, Audubon.	7/13/2016 12:38 PM
3	CWT has been a great partner, also NRCS, Middle Park Conservation District, CPW, USFWS	7/9/2016 10:09 AM
4	Lotic, County Attorney, Other local experts. Need more help with understanding and communicating about flows	7/9/2016 8:51 AM
5	CWCB, CDPHE, CPW, Water Conservancy District	7/8/2016 2:51 PM
6	Experts and technical papers. CWCB guidance would be nice.	7/8/2016 10:09 AM
7	TNC technical folks and legal.	7/8/2016 10:03 AM
8	Colorado Water Trust, USFS and BLM hydrologists, CPW experts	7/7/2016 8:18 PM
9	CWCB, Wilson Water Group	7/7/2016 12:28 PM
10	Mostly resources available to me through Colorado Springs Utilities or our partners, such as the Coalition for the Upper South Platte	7/1/2016 6:11 PM
11	Water Commissioner, water attorney, local river health companies/contractors	6/30/2016 10:18 PM
12	Frank Kugel, UGRWCD General Manager. He also corrects me publicly when we are doing a joint production.....	6/28/2016 9:17 PM
13	many and varied - there are a lot of smart people in every watershed in every sector	6/28/2016 1:18 PM
14	Community partners, publications	6/28/2016 12:04 PM
15	Colorado Water Congress	6/28/2016 10:47 AM
16	attorneys, Northern water, legal treatises	6/28/2016 10:44 AM
17	The appropriate resource/agency.	6/28/2016 10:19 AM
18	CWCB, DWR, CPW,and local watershed groups or hydrologists or engineers, depending on the question.	6/27/2016 10:37 PM
19	CWCB, engineers, journal articles, local water experts	6/27/2016 6:49 PM
20	My water-professional network.	6/27/2016 3:46 PM
21	The CWCB Technical Assistance Team hired to assist Coalitions in the flood recovery effort.	6/27/2016 1:30 PM
22	professional consultants	6/24/2016 5:32 PM
23	City of Boulder staff and colleagues in local and state agencies	6/24/2016 11:20 AM
24	American Whitewater	6/23/2016 4:21 PM
25	Tough question to answer. I'm a technical person who has a great network of other technical folks who I would turn to depending upon the specific issue.	6/23/2016 11:41 AM
26	Division of Water Resources	6/23/2016 2:01 AM
27	Ranchers, local water commissioners, local land trust, water districts, CFWE, etc.	6/22/2016 6:09 PM
28	My colleagues at the Town of Vail, Lotic Hydrologic, Eagle River Water and San or Eagle River Watershed Council	6/22/2016 6:02 PM
29	USGS, or other subject matter experts related to the issues at hand.	6/22/2016 4:27 PM
30	A network of fed, state, local, nonprofit, or private sector resources	6/22/2016 3:11 PM
31	Lotic Hydrological, CFWE, Eagle County	6/22/2016 1:48 PM
32	many sources, depending on the issue - Colorado River District, DWR district offices, watershed groups, WQCD, etc.	6/22/2016 12:35 PM

33	depends on what is needed and if another stakeholder is leading. CWT has been used on some projects I'm involved with, also TU, CPW, FWS, local groups, etc.	6/22/2016 12:25 PM
34	Private consultants	6/22/2016 12:22 PM
35	A whole host of resources and contacts across the state.	6/17/2016 12:53 PM
36	Colleagues	6/17/2016 11:25 AM

Q13 My most pressing need for technical expertise on water, water rights, river health, and other related issues is:

Answered: 33 Skipped: 16

#	Responses	Date
1	Is how to begin to address the issues of "waste" and water dumping on the Western Slope that creates positive outcomes both for water diverters and the rivers and streams. How to begin the discussion and not upset everyone involved.	7/13/2016 3:48 PM
2	Dynamic environmental flows - addressing the stigma of EF with water right holders and water developers.	7/13/2016 12:38 PM
3	water law and maintaining value to current water right holders.	7/11/2016 2:03 PM
4	Dealing with very slow movement toward sustainability, VERY frustrating, feeling trampled by water buffalos.	7/9/2016 10:09 AM
5	Getting people attention to focus on the right things	7/9/2016 8:51 AM
6	Water rights legal information and permitting	7/8/2016 2:51 PM
7	How to engage communities to supprt applying for SMP grant.	7/8/2016 10:09 AM
8	We've done a pretty good job through the BRT with studies over the past 11 years. These studies have provided significant information regarding the issues raised in this question.	7/8/2016 10:03 AM
9	1) surface water quality monitoring 2) design of diversion structures optimized for fish passage, ease of operation & reliability 3) flow and stream-bed profile definition	7/7/2016 8:18 PM
10	Programmatic approach to watershed/stream system improvements (yes, I'm talking about Fountain Creek)	7/1/2016 6:11 PM
11	presently none	6/30/2016 10:18 PM
12	Personally, I think we need to be finding ways to get more water out of the streams and into the ground even in the headwaters reaches (forget sending fresh water to the ocean, look what the Mississippi is doing). But that idea is not gaining much traction around here.	6/28/2016 9:17 PM
13	quantification and methodology(ies) for quantifying consumptive and non-consumptive needs across basins - creating replicable SMPs across the state, to the extent practicable	6/28/2016 2:49 PM
14	San Juan Water Conservancy District is planning an 11,000 AF reservoir at an off-stream site in the Upper San Juan basin. Flows from this basin were drastically deleted by the San Juan-Chama diversion years ago. Help supporting habitat and recreation in light of depletion is our most pressing need.	6/28/2016 10:47 AM
15	water law generally	6/28/2016 10:44 AM
16	N/A	6/28/2016 10:19 AM
17	Tools for water sharing, for informal water use agreements that partners can agree to use.	6/27/2016 10:37 PM
18	Funding for the technical expertise, access to experts for modeling, ArcView	6/27/2016 6:49 PM
19	Identifying preferred target flows.	6/27/2016 3:46 PM
20	River restoration construction projects	6/27/2016 1:30 PM
21	turning data into information	6/24/2016 5:32 PM
22	water rights, water sharing, ATMs.	6/24/2016 11:20 AM
23	River Access and protecting recreational flows	6/23/2016 4:21 PM
24	Don't know yet.	6/23/2016 11:41 AM
25	Funds	6/23/2016 2:01 AM
26	Alternative supply methods / leasing Multi-use projects for agriculture and watershed health	6/22/2016 6:09 PM
27	Storm water filtration	6/22/2016 6:02 PM
28	potential for expanding on-farm conservation practices, impacts on return flows, water available for leasing	6/22/2016 3:41 PM

29	Stream impairment determinations and strategies to avoid listing.	6/22/2016 12:35 PM
30	not sure	6/22/2016 12:25 PM
31	-	6/22/2016 12:22 PM
32	How to determine river health and how to get water rights holders to agree that the health of the river is important.	6/17/2016 12:53 PM
33	Flow regime modeling	6/17/2016 11:25 AM

Q14 The greatest value a one-day SMP technical workshop could offer would be to (e.g., define the SMP process, describe data and modeling tools, identify potential sources of funding, exchange information with my peers, hear about others' SMP experience, or an item from Questions 6-9):

Answered: 35 Skipped: 14

#	Responses	Date
1	What are the goals of these plans? Without goals, it seems that it's a money making excercise for a few consultants and makes everyone simply feel like they are accomplishing something positive for their watershed. How is this not fiddling while Rome is burning? How are the water buffaloes involved? Are they watching this and happy that we are all just busy with thes SMP's while they are making other plans? All this money towards a few CFS here and there? Well, maybe that's all we can hope for. How to get past my cynicism!	7/13/2016 3:48 PM
2	How to adequately assess baseline environmental parameters, and set timely goals for environmental improvement.	7/13/2016 12:38 PM
3	Learn best practices	7/9/2016 10:09 AM
4	Convincing local officials to understand and engage	7/9/2016 8:51 AM
5	Have the SMP process and goals defined, hear about options for how this process can be achieved within the community (key players to drive the plan and discussion), time to chat in small groups based on planning areas to network and to begin discussing how such a plan can be carried out	7/8/2016 2:51 PM
6	Define the process and what areas need to be evaluated and how to get the communities invovled.	7/8/2016 10:09 AM
7	Share information with peers and build stakeholder support.	7/8/2016 10:03 AM
8	SMP process outline, sources of funding & data/modeling tools (all are important to me)	7/7/2016 8:18 PM
9	Hear about others' SMP experience, especially success (or lack of it) in getting vigorous participation by all stakeholders.	7/7/2016 12:28 PM
10	overview of process, data, and modeling tools - oh, and funding	7/1/2016 6:11 PM
11	identify funding sources & hear about others' successful SMPs	6/30/2016 10:18 PM
12	Coordiating stakeholders (mountain ranchers!?)	6/28/2016 9:17 PM
13	Yes	6/28/2016 2:49 PM
14	synopsis of implementation of the concept - they are taking many shapes and forms. None are wrong, but is there convergence? Is there possibility to integrate flow needs (and acquisition or 'non-diversion triage agreements') into SMPs?	6/28/2016 1:18 PM
15	How to create goals, objectives, and measurements	6/28/2016 12:04 PM
16	All of the above	6/28/2016 10:44 AM
17	Yes	6/28/2016 10:19 AM
18	hear about other SMP experiences and outcomes	6/27/2016 10:37 PM
19	a combination of the examples given above	6/27/2016 6:49 PM
20	Define the SMP process and describe data and modeling tools.	6/27/2016 3:46 PM
21	Defining the process and identifying funding sources	6/27/2016 1:30 PM
22	peer to peer exchange	6/24/2016 5:32 PM
23	Identifying and quantifying flow recommendations	6/24/2016 11:20 AM
24	hear from others experiences, and to explore data and modeling tools	6/23/2016 4:21 PM

25	For me, it's a discussion on how these will ultimately be used. I firmly believe that these need to be developed so that they can be coupled with models that detail consumptive uses. We need to integrate both the consumptive and nonconsumptive uses in order to see where limitations arise and to determine opportunities for system optimization.	6/23/2016 11:41 AM
26	All of the above	6/22/2016 6:09 PM
27	hear about other experiences and exchange info with peers	6/22/2016 6:02 PM
28	Develop a better understand of how the SMP program is funded and how to encourage agricultural stakeholder participation -- marketing the program to ag stakeholders	6/22/2016 3:41 PM
29	Clarification of what CWCB is looking for and how it sandwiches into watershed plans and project specific plans	6/22/2016 3:11 PM
30	define the process and give details on lessons learned	6/22/2016 1:48 PM
31	Determining when a SMP would benefit a particular stream that may already be heavily managed due to water rights administration	6/22/2016 12:35 PM
32	defining the process and making it applicable	6/22/2016 12:25 PM
33	Propose ideas for engaging local support for SMP's	6/22/2016 12:22 PM
34	hear about others' SMP experience and understand the process for CWCB grant application	6/17/2016 12:53 PM
35	Sources of funding (other than Watershed Restoration Account) and establishing flow targets	6/17/2016 11:25 AM

Q17 What did we miss? What would you like to share with us? What should we be thinking about that we didn't ask?

Answered: 16 Skipped: 33

#	Responses	Date
1	Securing water right holder and water developer support for tangible environmental improvement to streams and rivers.	7/13/2016 12:38 PM
2	We have recently been approved for USBR WaterSMART Grant, looking forward to continued collaboration with CWT	7/9/2016 10:09 AM
3	This is awesome, I am always bugging Chris Sturm about this kind of information. And a fully encompassing workshop to cover everything will be great.	7/8/2016 10:09 AM
4	Where can funding be found for surface water quality monitoring?	7/7/2016 8:18 PM
5	Apologies I didn't respond to all questions. Working under some tight deadlines.. :)	7/6/2016 11:14 AM
6	I'd say you covered it pretty well - at least so far as we've gotten in the process.	6/28/2016 9:17 PM
7	Jessica Test	6/28/2016 7:32 PM
8	Sponorship needs/opportunities?	6/28/2016 2:49 PM
9	will think on this... I think it's a great idea to take a breath and do a quick retrospective in how SMPs are evolving and being implemented. Hi to the CREW! -dg ps- show me the bag!	6/28/2016 1:18 PM
10	I think people don't know much about the SMP generally to even know that we need or want one.	6/28/2016 10:44 AM
11	I'll be getting back with my thoughts on how to identify "priority streams". This is not a simple question, nor easy to answer in the course of a survey like this. Thanks!	6/28/2016 10:29 AM
12	N/A	6/28/2016 10:19 AM
13	I would encourage you to offer the same program at both meetings. I personally do not attend Water Congress but have been attending the CWA conference for many years running. You may find that you can reach more watershed-based practitioners at the CWA conference.	6/23/2016 11:41 AM
14	Very interested in working on legislation to permanently fund SMP program, incorporate agriculture conservation practices/sharing potential and marketing the program to encourage broader stakeholder support	6/22/2016 3:41 PM
15	How existing agreements might inform stream management plans, ie Colorado River Cooperative Agreement or the Eagle River MOU	6/22/2016 12:35 PM
16	Our major struggle thus far in the SMP committee process has been determining how to establish flow targets with buy-in from our predominately ag community. Discussion of strategies for flow quantification (other than R2Cross) would be helpful.	6/17/2016 11:25 AM

Appendix B:

Notes from 1st workshop held at Colorado Water Congress Summer Conference 2016

Stream Management Plan Resources Workshop Summary and Notes
August 23rd and 24th, 2016
DRAFT September 12, 2016

This summary of the Stream Management Plan Resources Workshop includes the notes collected from each session by Colorado Water Trust's Mickey O'Hara and Biohabitats' Claudia Browne. It is intended to be an internal documentation of the workshop effort for CWCB, but most of the presenters' powerpoints and other presentation materials are available online at a site hosted by RiverNetwork.org. In October, Colorado State University's Colorado Water Institute is putting out a special issue of their quarterly newsletter on stream management planning. Most of the contributors to the workshop wrote something or were interviewed for that newsletter, so it might be a useful written resource, as well.

The preparation for this workshop also included a survey completed by about 45 water resource professionals and stakeholders throughout Colorado. The survey was largely used to guide the design of the workshop, but it also captures thoughts from the Colorado water management community on some key issues such as how to define the "priority" streams mentioned in the Colorado Water plan. A summary of the survey responses is appended to these notes. Also attached here is the attendee list from the August workshop.

Introduction

Amy Beatie, Executive Director, Colorado Water Trust, abeatie@coloradowatertrust.org
Chris Sturm, Stream Restoration Coordinator, Colorado Water Conservation Board, chris.sturm@state.co.us

The Stream Planning Workshop opened with comments from two leaders in the stream management planning process. Chris emphasized that this workshop and the SMP process is an opportunity for Colorado to learn to work better together around natural resource management. As SMP planning processes are launched around the state, it is important to ensure that participants are beginning with a broad view of the task and engaging with existing networks of stakeholders and managers. The state level support for SMP will be especially focused on watersheds that can demonstrate a process that pre-existed the availability of funding, wherein a community identified a problem or set of problems they wanted to come together to solve.

Chris then provided the SMP grant application guidelines, summarizing the requirements and steps. General background on SMPs and the grant and application guidelines are available at the CWCB website. The guidance is 7 pages long and should serve as the definitive resource for any questions about the process.

The following is excerpted from the Colorado Water Plan's description of the overall SMP process.

Well-developed Stream Management Plans should be grounded in the complex interplay of biology, hydrology, channel morphology, and alternative water use and management strategies. They should also consider the flow and other structural or management conditions needed to support both recreational uses and ecosystem function. A stream management plan should: (1) Involve stakeholders to ensure their acceptance of the plan; (2) assess existing biological, hydrological, and geomorphological conditions at a reach scale; (3) identify flows and other physical conditions needed to support

environmental and recreational water uses; (4) incorporate environmental and recreational values and goals identified both locally and in a basin roundtable's BIP; and (5) identify and prioritize alternative management actions to achieve measureable progress toward maintaining or improving flow regimes and other physical conditions. For basin roundtables, local stakeholder groups, and decision makers, such plans can provide a framework for decision-making and project implementation related to environmental and recreational water needs.

The necessary steps for the development of a SMP include:

(1) gathering stakeholders to participate in plan development;
(2) identifying the plan's objectives;
(3) identifying and prioritizing ecological and recreational values;
(4) establishing goals for flows and other physical conditions in order to protect or enhance environmental and recreational attributes on streams and rivers within a given watershed;
(5) collecting and synthesizing existing data describing flows for river ecosystems, boating, or other needs in the watershed;
(6) assessing existing physical conditions of stream reaches, including geomorphological and riparian conditions;
(7) selecting quantitative measures that can be used to assess progress made toward articulated goals;
(8) determining what new information is needed and the best methods for obtaining that information;
(9) quantifying specific numeric flow recommendations (or ranges of flow) and physical conditions and assessing the potential for channel reconfiguration to support environmental and recreational values;
(10) identifying temporal, geographical, legal, or administrative constraints and opportunities that may limit or assist in the basin's ability to meet environmental and recreational goals; and
(11) implementing a stakeholder-driven process to identify and prioritize environmental and recreational projects and methods.

SMPs should provide data-driven recommendations that have a high probability of protecting or enhancing environmental and recreational values on streams and rivers. More information on environmental and recreational projects and plans can be found in Chapter 6.6 and 7.1 of the Colorado Water Plan.

Stakeholders, Goals, Objectives and Values 2:30 Tues

Nicole Silk, Executive Director of the River Network, nsilk@rivernetwork.org

- *River Network connects people to save rivers*
    - *They envision a future where clean and ample water is available to all of us*
        - *Important to equip 'local caretakers' in their efforts on the ground*
- *What is a SMP?*
    - *Ultimately it's about our future, our future relationship with the land and waters that are part of our communities*
- *Stakeholders are the caretakers for the future – they hold a vested interest in local rivers*

    - *Engaging stakeholders to define what they want from the resource (river) is an important step*
- *It is necessary to think about community – who does the river benefit, what do we want from the river, how can we define specific goals and objectives for the river?*
- *When approaching the SMP process, it's crucial to turn to stakeholders to characterize the river and its needs*
- *Stakeholders can help define many aspects of rivers since they're generally the most involved community members. We need to use local knowledge through stakeholder engagement process.*
- *River Network is offering various online trainings that will be helpful to those embarking on SMPs.*

Reference links

See Open Standards online course:
https://www.conservationtraining.org/course/index.php?categoryid=38

Systems approach for conservation planning: Open Standards: http://cmp-openstandards.org/

Practical learning for environmental flows and water budgets:
https://www.rivernetwork.org/resource/environmental-flows-water-security/

Existing Data Collection and Prioritization I 3 PM Tues

Meg White, Freshwater Scientist at The Nature Conservancy, meg_white@tnc.org

- *The importance of water security in Colorado*
- *Need to figure out grand vision first and work backward towards the 'bite-size' pieces*
- *We have lots of good data in CWP and BIPs basin implementation plan*
    - *SWSI update will include further data*
- *The targets and goals developed for each SMP will be slightly different*
    - *Environmental, agricultural, etc*
        - *While there is room for creativity, it's about the water in the end*
            - *Use water security as the "north star" to guide SMP*
- *Ideas and recommendations need to be TRULY actionable*
- *Open standards*
    - *Lots of tools and training activities*
- *TNC has been assessing actions identified in BIPs*
    - *34% had enough meat for TNC to actually cost them out*
    - *There is a need to further develop goals and projects identified in BIPs*
- *There are a number of tools to assess flow needs*
    - *Notes in presentation include links to websites for flow modeling*
- *WFET Watershed Flow Evaluation Tool*
    - *Index of how altered a stream's flow is in a certain place*
    - *Lots of BIPs used this*
- *Meg White has been working on a statewide watershed "scorecard" based on 24 variables at the HUC 12 (Hydro unit code) level*

- *Results will identify HUCs with big issues (impairments?) Values? Considerations*
  - *The result is a spatial representation of the HUCs that are likely to be high priority watersheds*
- *Hope that stakeholders will then dive into these specific HUCs*
  - *Ideally this will align with SMP process*

See links under Nicole Silk's preceding for Open Standards in Conservation Planning resources

Q+A

Q: When looking at data gaps, the need to fill the gap could take many years. Do you just call it at some point and move forward?

> *A: Be transparent about data gaps, there may be an opportunity in the future to address them when more resources are available.*

Existing Data Collection and Prioritization II 3:30 PM Tues

Steve Malers, Founder and Chief Technology Officer of the Open Water Foundation, steve.malers@openwaterfoundation.org

Developing open-source software for stream planning, a process in which early adopters are essential

- *Consider the entire system when addressing one part –water touches MANY uses, processes, etc*
- *Data should be transferable and accessible, such that information such as location identifiers are easy to connect to information from the real world.*
  - *Time stamps and even date conventions are important for creating compatible, standardized databases, and they are important for tracking any alterations or edits that may happen throughout the life of the database.*
- *A lot of work is done and it disappears into some database that the public cannot access*
- *For South Platte BIP*
  - *Modeled off of google maps traffic display*
    - *Everyone understands*
  - *Green = good, red=bad*
    - *Better than a GIS heavy world – makes it accessible for most folks*
- *Source water route framework developed as easier alternative to NHD*
- *Consider including a data management plan in the SMP process*

Q+A

Q: GNIS Id is great for identifying streams. Is there any standard so far for stream miles?

> *A: Stream miles are included in many documents and there is no standard currently. Timestamps and automation are important for stream mile data going into the future as these are dynamic systems that can change.*

Q: how do stream miles correlate with watersheds?

> *A: stream miles are usually calculated from a confluence or a state line*

Existing Data Collection and Prioritization III 3:30 PM Tues

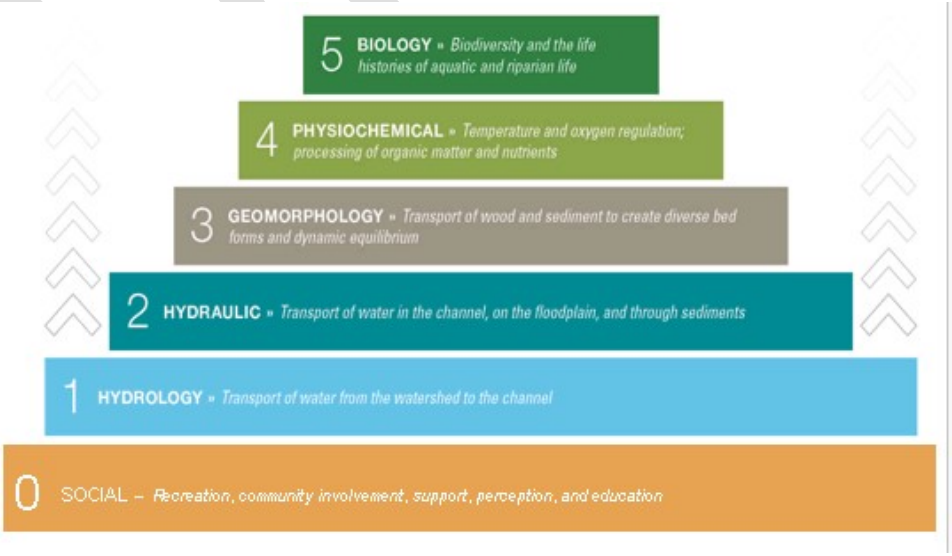
Spencer Williams, Manager at Ponderosa Advisors LLC, swilliams@watersage.com

- *Software product that allows users that lack technical expertise to filter and analyze publicly available water data*
- *The Water Sage priority feature shows water rights in comparison to others on a source and its tributaries, so the relative priority of a right can be viewed and analyzed at a glance. Water rights within an area up to a 100 mile radius of a selected right may be included in the priority feature.*
- *Can also search and filter groundwater rights, and find status, permitting, and related augmentation information.*

Physical Assessments I 4 PM Tues

Vince Sortman, Fluvial Geomorphologist at Biohabitats, vsortman@biohabitats.com

- *In terms of fluvial geomorphology, it is important to address which zone of your stream you're working in (headwaters, transfer zone, depositional zone)*
- *Important to consider the smallest scale when considering the health of the system*
    - *Linked-stream riparian ecosystem*
- *The goal is to improve biology at the top, but need to understand controlling paftors.*
- *When hydrology, sediment supply, hydraulics are altered – the whole system is impacted – these are the base of the stream functions pyramid*
- *Many methods are available for physical assessments, rapid assessment tools can be tailored to individual systems.*
- *Consider the social aspects of SMP activities. The basis for the whole SMP process is engaging the community, and can provide a modification of the standard stream*
    - *Add a community to base of pyramid – add social or community context to the base of the stream function pyramid (below)*
    - *Apply a conservation ethic to the whole system*
    - *Consider the river a part of the community – the community will drive change*



Physical Assessments II 4:30 PM Tues

Dan Baker, Civil & Environmental Engineering, Colorado State University,
dan.baker@colostate.edu

Dan described his work collaborating with Fort Collins on the Cache la Poudre flow studies. This work took place before the emergence of the SMP process as defined by the Colorado Plan, but it included many of the same elements.

- *Consider holistic model of river function – ERM slide*
  - *Created model that looked at various potential scenarios*
  - *Initial process took approximately a year – developing a conceptual model is time consuming*
    - *Hard numbers were used when possible, expert judgement for areas where there were no numbers available*
- *RHAF*
  - *Assessment protocol for looking at whole system*
  - *General indicators + metrics that matter for each stream system*
  - *A-F grading scale*
    - *Specific to each watershed*
      - *Ask the question: What's an A for the _____ River?*
  - *Define which grades will meet ecosystem goals*
  - *Evolving process when it comes to qualitative vs. quantitative*

- *Must be willing to move forward without perfect relationships and definitions*
- *Use volunteers. They can offer a lot to the process and make it more affordable*
- *ERM model cost approximately $200,000 to develop*

Q+A

What were your scenarios?

A: Used MODSIM data from Ft. Collins, ran it with available data, ran with newer data…all based upon monthly data, simulated down to daily time step.

Specific strategies to address stream deficiencies?

A: In Colorado it's all about the amount of water. You must create mutually beneficial solutions, or at least NOT make mutually painful decisions. This requires a significant amount of creativity.

John Stokes: There are new strategies being developed. One idea is the combining of an augmentation plan with the idea of ISF. We are using information from Dan's research and sharing it with partners in the basin. This is politically complicated issue and complicated partnerships are also a piece of the puzzle.

Keynote Address 8:45am Wednesday

James Ecklund, Director of Colorado Water Conservation Board, James.Eklund@state.co.us

- *"Colorado is watched by the rest of the country"*
- *The Largest civic engagement program in the state's history is the Basin roundtables*
- *Values have changed a lot over the last hundred years*
    - *Want to make sure that water financing, policy, and law reflects the changing values reflected in the state*
    - *A healthy environment is part of our brand as a state*
        - *Our brand isn't healthy unless we have a very strong environment and recreation component*
- *We need to find a new way to talk about 'environmental water'*
- *Businesses are starting to look at their bottom line and considering what environmental and recreational needs mean to their brand*
- *Many businesses are very aware of how Colorado's environment impacts their brand*
- *We're getting a better understanding of regional economies now than we did 30 or 40 years ago. A healthy river on the western slope matters to many people in LoDo.*
- *We have serious challenges*
    - *Climate change adds complexity*
    - *As a water manager – you MUST understand the implications of climate change*
- *One of the important outcomes for this SMP workshop is if we've heard from folks in the room regarding ideas – we want to hear from you what the management priorities are.*
    - *a clearer understanding of the common "ingredients" and costs to complete a SMP*

** Ed note - Although it wasn't mentioned by Mr Ecklund, the survey completed by many workshop participants and a wider group solicited a detailed response to this question, and the results are summarized in the attached document. One important result was that overall, when asked to define "priority streams," roughly half of the respondents identified streams that were in excellent condition as a management priority so that their quality would be protected, while half identified streams that were in poor condition as a management priority so that their quality could be improved.*

- *Sequencing is very important to the SMP process*

1. **Watershed objectives/mission**
    i. **Cohesive SMPs cannot happen unless you have a complete picture of the watershed**
2. **Need to have a finger on pulse, overview and understanding**
    i. **2. Prioritization needs to be science driven**
    ii. **Need to avoid "money pits," focus on rivers that can see improvements**
3. **Need the capacity to "do the lift" of creating a SMP**
4. **Consistent updates of data and plan are very important**
    i. **These are not static systems, so go back and revisit your assumptions**
    ii. **Need to build in resiliency to SMPs**

- *The SMP effort statewide needs to start as soon as possible to achieve the 80% goal*
    - *The science will never be perfect, we need to get started immediately*

Q+A

Q: As you talk about the recipe for SMPs, as someone that's about to embark on SMP, I like that we have flexibility. The flexibility is great when compared to the watershed planning prescriptions from the EPA. It is important to put some parameters on SMPs in the state. It's important to have a recipe.

A: There is guidance - talk with stakeholders, trade information with others creating SMPs

Q: It seems as though CWP gives us a chance to change the narrative. We need to include multi-use multi-benefit discussion when it comes to environmental and recreation.

A: Many water uses are very connected.

Future Scenarios 9:00 Wednesday

Jacob Bornstein, Director of Strategic Operations at Spark Policy Institute, jacob@sparkpolicy.com

In modeling future scenarios, it is particularly important to reach a solid understanding of the system's outcomes and drivers, select the drivers that can be affected, and then build scenarios to test which actions can modify outcomes according to what strategy.

This session opened with a scenario planning activity in which workshop participants were given four minutes to define four primary drivers in the river system where they work. The groups reported back on their breakout results:

Dolores River:

- Some of the drivers are:
    - climate and drought
    - Large water districts that hold large water rights
    - Contract obligations
    - ESA
- Strategies
    - Larger question of stakeholders and engagement
    - Indexed flows from the dam
        - Moved to fisheries pool
    - DRD has been working for 12 years
    - Lower Dolores working group also involved
- Work is hard and iterative and is still not going forward

Poudre runs through it:

- The goal is to create the best example of healthy working river
- Create peak flows and maintenance flows

- Many drivers that are hard to deal with

Eagle:

- Serve growth
- Meet economic needs while keeping the river healthy

After this exercise, Jacob went forward with other remarks based on his experience:

- There are many outcomes that could be impacted by climate change, water law, drought, development, etc.
- For the water plan we had several outcomes to consider:
  - Water supply
  - Growth
  - Social values
- It's very important to understand drivers to achieve the outcomes desired.
- Must consider how you're going to operate in wet/dry years. How to structure channel to allow fish to survive in drought year etc. magnitude and duration of droughts will change in future, need to prepare for that.
- Bottom of the pyramid is the social component – it's important to have a diverse group of stakeholders involved to move forward
- Focus on "Collective impact"
- Scenario planning was very helpful
  - stakeholders have different visions of the future
  - define the future for potential outcomes
  - one way to add the social component
- We must involve stakeholders
  - They may not all be willing to put in the effort to show up
    - we must reach out and go to them, which shows respect
      - these efforts should reach 98% of folks
      - some simply won't be interested
- What do you use a stakeholder group for?
  - not as staff
  - they are there to set goals and direction
  - keep them out of the weeds
- You may not have data – but it's ok to accumulate data along the way.
- Practice. Experiment. Get small wins to gain support. Snowball effect – group will hone in and move forward with actions.
- Scenario planning – prepare for a range of futures – potential outcomes
- Identify actions that fit multiple scenarios at the beginning of the process
- Limit your choices - when there are too many choices – you pick the simplest choice available.
- When choices are limited, for example 2 to 6, it allows for more creative thinking.
- Identify drivers that can help 'tip the future':
- Consider levels of uncertainty with relation to drivers
  - Adaptive strategies, mitigation, and resilience

    - Real-time assessment to adapt along the way.
- Working with stakeholders takes time – set that expectation of how long it takes early on.
- Think of scenario planning for SMPs as haiku, distilled to only the essence of the drivers and results.
    - Stay practical, not academic
- Do a pre-mortem and post-mortem on action and strategies to determine causes if something doesn't work.

Q+A

It does take time to build trust within community of stakeholders. Years. That's where we're going – to gain perspective and integrate rivers into our communities.

Quantitative Measures 9:45 Wednesday

Seth Mason, Lotic Hydrological

- Developed ecological support system for Crystal River that allowed SMP creators to play "what if?" This spurred creative problem-solving and served as a powerful basis for conversation.
    - The approach enabled users to incorporate varying assumptions regarding diversions
        - Weather
        - Climate
- There must be a catalyst to embark on Stream Management Planning
    - Drought, regulatory action, Water Plan, etc
    - Development of a mutual solution to a problem
        - Engage stakeholders to develop
- There's no one way to do an SMP
- The ideas presented are the starting point for a conversation with your local stakeholders in your watershed
- analytical framework important for establishing credibility, can answer stakeholder questions and appropriately convey the existing data
    - using framework, whatever planning recommendations you make will reflect the condition of the system
- important to consider municipal, industrial, recreation, agriculture
    - incorporated into modeling using CDSS systems
- hydraulic modeling may or may not be necessary, it was completed for crystal river under different potential management strategies
    - can investigate link between changed hydrology and water users
- we're stuck with frameworks to keep work timely – they are useful to evaluate different strategies
- 2-D modeling allows for modeling hydraulics based on late season low flows
- Compromise is key
    - Important to identify an intersection between feasible and effective.
- important to work with stakeholders interactively so that they can understand flow targets on their own terms
- Other lessons learned:

- lots of concerns about water rights and how they would be protected, especially coming from agricultural water users
    - got local water attorneys and local users in the room so everyone was comfortable and discussed options
    - important part of building trust
- In hind sight, it might have been wise to set up more time up front to ID the best opportunities for implementation with them at the start.

Q+A

Q: Method for quantifying credits for return flows to stabilize through the year?

A: Yes, can be done with modeling of return flows. Lotic did not establish a credit that could be exchanged in a meaningful way for the Crystal SMP. On the crystal right now there are the beginnings of a water market. It may be something that could happen in the future. The modeling completed would allow for development in the future.

Q: There are a lot with metrics – quantifying habitat measures, etc. How can this tie into the prioritization component? Can they be part of the first step to look at what streams should move forward?

A: The "top down, let's look around and find the right one for a SMP" isn't the right approach. There's an increased likelihood of success if SMPs come from the ground up. Need the local catalyst. It can be helpful to understand what's been done (and where) to understand degree of risk to specific stream segments. Metrics can be used in concert with the ground up strategies.

Q: What are the fuzzy boundaries between SMPs and other types of land or watershed planning?

A: While moving through the stakeholder process, people (mostly agricultural users) described their constraints on the Crystal as water users. Agricultural users manage water outside of the stream, while SMPs are largely addressing what's happening in the stream. The overlap between other land management and watershed planning is yet to be defined. There may be planning efforts that complement SMPs.

Pending Plans 11 Wed

Moderator: Claudia Browne, Water Resource Specialist at Biohabitats

Panelists: Drew Peternell, Director of Trout Unlimited
Ken Neubecker, Environmental Representative, Colorado Basin Roundtable
Kelly Romero-Heaney, Water Resources Manager, City of Steamboat Springs

SMPs come in a range of shapes and sizes, but there are some common ingredients emerging. As Lurline Curran from Grand County has summarized, they should 1) build *trust* within the group through credible data and a neutral technical platform; 2) establish *continuity and capacity* to ensure getting to implementation, and 3) understand the importance of *early "wins"* that come to fruition even before

implementation phase begins, as a benefit of the process itself. In this panel, So, panelists ask to include comments about these themes as address questions.
What is the catalyst for your project, and how did you pick the scale and scope?

Neubecker – Inspiration came from Grand County. Lots of conflict in the area over water - the county developed a SMP. Not an easy process for them. BIP identified the need for SMP. During BIP process, the need for environmental and recreational projects was identified. There is a knowledge gap when it comes to environmental and recreational flows. It will be important to have data to back up decisions, and we must have defined goals. SMP for entire CO basin does not make sense, needs to be a more locally driven effort. Trust building is very important - the agricultural community feels like they have a target on their back. They have most of the water rights, and they are a minority when it comes to the stakeholder groups.

Peternell - BIP process identified need for more information on recreational and environmental flows and the need for projects to meet those flows. UGWCD's new strategic plan will help to mobilize support for SMP process.
San Miguel – the SMP aim is top to bottom.
Upper Gunnison – starting with just Ohio Creek - scale that can be identified.
North Fork Gunnison – starting with the main stem

Romero Heaney- We have more opportunities in this basin than we have issues. Yampa watershed is one of the healthiest watersheds in state - no trans-basin diversions, relatively normal hydrograph. There are strong agricultural and environmental interests in the area. Drought moved community into thinking about planning with regards to the river. CWT stepped in (2012) to release water from stagecoach to deliver flows to ISF between Stagecoach and Catamount. The SMP process on the Yampa is seen more as a drought resiliency plan. Concerns include temperature, adaptation of river to lower flows (riparian restoration, channel geometry, flow timing). Goal is to develop some scenarios to have options for projects during different levels of drought. Kept scale of SMP narrow as it was viewed as an implementation project. City of Steamboat Springs has a financial interest in water quality as their WW plant discharges to the Yampa and treatment costs go up as flows go down.

Can you describe Stakeholder Process?

Neubecker- Today, we are focused on data gathering. "What do we already know in the basin?" We will take this information and organize it spatially to see geographically what is available. We have convened a stakeholder group to identify needs. It's important to include agricultural information, especially since this info is already organized through state engineers office. Folks from the agricultural community come to meetings and hear only environmental and recreation interests being discussed and feel ignored. It's important to include agricultural users in the process to ensure that SMP process is integrated with all water uses.

Peternell - On the two Gunnison projects, it's important to identify not only environmental and recreational gaps, but also agricultural gaps, including infrastructure. We must find a way to meet the needs of both sides. We have been careful to present both projects in a way that

addresses that need. TU is doing one-on-one interviews with water users to understand their needs and include them in the process. In the north fork process, contractor is doing the same. Goal of SMP is to meet both sets of needs.

Kelly – We haven't started on our stakeholder process yet. The consultant working on the plan will address this. City will identify targeted stakeholders and ensure that they are included. It's important to maintain transparency and include public in process.

How much is/was your budget? What were the source of your matching funds?

Neubecker: Around $100,000. Matching funds from Basin Roundtable, CMU (in kind and cash), WSRA SMP grant

Peternell: Budgets were near $125,000 for all plans – funding from WSRA, BOR cooperative watershed program, CWCB watershed restoration grants, municipalities

Romero Heaney: Budget is $110,000 – CWCB watershed restoration grant, WRSA, county, city, TU chapter

Conclusion

Chris Sturm, Stream Restoration Coordinator, CWCB, chris.sturm@state.co.us

Final thoughts on Stream Management Planning and how to engage with CWCB and Chris' office.

- If it can't be said or decided in a brief email, it deserves a call
    - Talk to stakeholders in person or on the phone
        - Let them know what you need, what value they bring
- Have coffee with your water commissioner!
    - The commissioners won't have time to sit in on the stakeholder meetings, but will provide valuable insights about water users and the systems
- There are exchange scenarios out there right now that could put wet water in critical reaches.

Q&A

Jay Paul Brown: Invasive plants must be considered, specifically Russian olive. Needs to be a part of the discussion - forced management may need to be considered as an option where conditions necessitate. Water storage may be helpful to ensure flows for endangered species. Thank you for considering Agriculture in the discussion.

Amy Beatie, CWT Final comments and response:

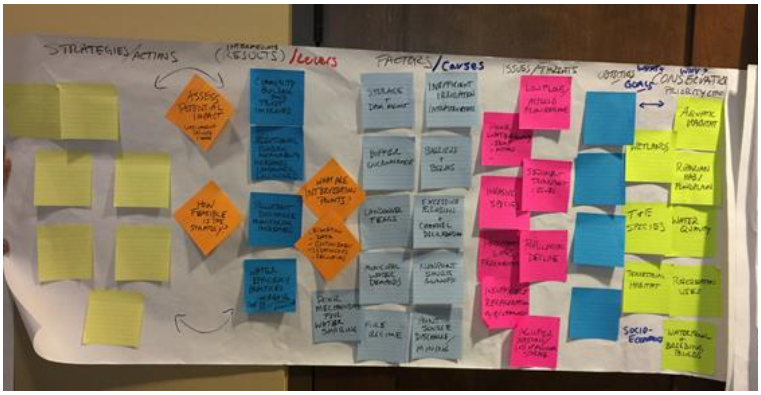
Overall, the close of this workshop is meant to mark the beginning of a process, not the end of one. Nicole Silk, from the River Network, has a particular interest in serving as a nexus and clearing house for information and progress in Colorado's Stream Management Planning. See their website for updates. Also note that the Colorado Water Institute newsletter focusing on

SMPs will be ready before the CO watershed assembly, where there will be a follow-up workshop in October.

Appendix C:

Notes from 2nd workshop held at Sustaining Colorado Watersheds 2016

World Café Notes - SMP Workshop
October 11, 2016 – SCW Conference (Avon, CO)



FACILITATORS[1]:

- Jacob Bornstein
- Claudia Browne
- Melinda Kassen
- Larry MacDonnell
- Heather Tattersall Lewin
- Nicole Seltzer
- Nicole Silk

CONTEXT: A workshop on Stream Management Planning (SMP) was held on October 11, 2016, immediately preceding the beginning of the Sustaining Colorado Watersheds in Avon, Colorado. The purpose of this workshop was to demystify what SMPs include, and explore the critical areas of inquiry essential to their success. The World Café portion of the workshop was structured around three topics that each organization should consider for their stakeholder engagement process related to SMPs (see below). This document serves as a written reminder of what was learned during these discussions.

The Colorado Water Plan states that 80% of priority streams will have stream management plans (SMPs) by 2030. Colorado's legislature has allocated substantial funding to support SMP grants, yet few local leaders know about this opportunity or have considered their role in stakeholder engagement or funding opportunities related to their community's water future. Stream Management Planning is defined by Section 6.6 of the Colorado Water Plan as including 11 steps (gather stakeholders to participate in plan development, identify the plan objectives (general and reach specific), identify and prioritize ecological and recreational values, establish goals for flows and other physical conditions in order to enhance environmental and recreational attributes on streams or rivers within a given watershed, collect and synthesize existing data describing flows for river ecosystems, boating, or other needs in the watershed, assess existing physical conditions of stream reaches, including geomorphological and riparian conditions, select quantitative measures that can be used to assess progress made toward articulated goals, determine what new information is needed and the best methods for obtaining that information, quantify specific numeric flow recommendations (or ranges of flows) and physical conditions and assess the potential for channel reconfiguration to support environmental and recreational values, identify temporal, geographic, legal or administration

[1] See final page for contact information for facilitators and participants.

constraints and opportunities that may limit or assist in the basin's ability to meet environmental and recreational goals, and implement a stakeholder-driven process to identify and prioritize environmental and recreational projects and methods.

Topic 1: GETTING STARTED, BUILDING TRUST, AND ACHIEVING SUCCESS

Explanation for participants: If you were to pursue a SMP for a specific stream reach, how would you identify stakeholders to engage related to E&R interests / are there natural partners you can identify now who would be key to your success (WHO)? When is the right time to approach these stakeholders / who is the right person to approach them (WHEN)? Is there a catalyst you can use to bring stakeholders together (HOW)? What are the challenges (what happens if stakeholders are not effectively engaged, what challenges are likely in working w/ these stakeholders to ID and prioritize local values & goals, and what other barriers and uncertainties do you worry about)? How do you overcome them (what is your plan, how do you rebuild trust, how do you know when breakdowns in trust occur)? And do you have milestones toward your finish line (how would your stakeholders define success, how will you celebrate success along the way, and what milestones will you track along the way)?

Notes / lessons from discussions:

- Who to include: Landowners, water rights owners, and other users, particularly people who may have to implement solutions. Consider folks already active with their local Water Conservation District (WCD), Soil Conservation District (SCD), or Basin Roundtable (BRT) and try to find willing participants with multiple interests. Must include people who have something to lose. Could also be boating community, guides, folks who fish, business owners including local bicycle shots, even local realtors. Do not include landowners and others who polarize. If you are already part of the community, use your network to identify the right folks through phone calls, coffee chats, etc., beginning with existing leaders in water community (e.g., who is already active in WCD, etc.).
- How to get started / catalysts can be: Natural disasters (drought, flood, fire); unnatural disasters or emergencies (spill, drinking water problem, fish kill); regulatory triggers like 303(d) listing; and also longer term issues like aging infrastructure, concern over climate impacts, concerns about property value decreases, increased pressure from growth and development or river segments that go dry. Positive catalysts exist too: availability of funding, new community outreach efforts and interest in growing the recreation/tourism economy.
- Who recruits: Ideally, recruiters need to be stakeholders themselves. Don't ask people who won't help, instead target those already engaged. Again, to engage agriculture interests, look to WCD, SCD, or BRT. Ask community leaders to use relentless networking/calling to identify and recruit.
- Challenges: Building trust takes time. For many, a "plan" means taking something away. Keeping folks at the table can be challenging too. Talking without action can be a challenge, as can competing for credit, and failure to sort out conflicts. Note: There is a tension between "urgency" (e.g., responding to an immediate disaster) v. building trust (long-term in nature).
- Opportunities for overcoming challenges: Solutions should be framed as win-win (everyone should have something to gain, not just lose). Always provide food, beer, and hats – make it fun to be involved. Identify community leaders, uncontroversial leaders, etc. to facilitate when trust breaks down or progress bogs down. Note: Listen before you organize – know the history present within your local community to the extent possible – be curious. Solutions will likely always involve going back to understanding all participants' interests and shared goals. Note: Big public meetings likely not ideal and language is important – try to have common language that eliminates jargon.

- Milestones / benchmarks along the way, including small project successes are important and must be identified along the way. Use monitoring to demonstrate success through data and also an opportunity for community to get their feed wet (literally).

Topic 2: ORGANIZATIONAL CAPACITY AND INSTITUTIONAL HOME

Explanation for participants: A Stream Management Plan exists within the context of a community and its vision for the future. Ideally, the SMP helps the community move one step closer to creating local stewardship and shared interests for the future of our state's waters, particularly those running through that community. And although SMP can be developed by a coalition of local interests, ultimately it will need an institutional home. That home should be an organization or institution that is committed to the success of the plan and its implementation as well serves as the champion for a future that includes healthy rivers as well as an economically and socially vibrant community. Who do you think would be the best organization or institution "home" for such a plan in your community? How do you figure out if your organization is or is not the right choice? What other options exist for your stream? What is your role if you are not the institutional home for the plan? What other capacity does your area need?

Notes / lessons from discussions:

- The right institutional home will likely vary from one locale to the next. Appropriate entity to sponsor/manage a SMP will vary from stream to stream, watershed to watershed.
- Consider who will be there for the long-term to invest in the community's vision for water and who has the fiscal, planning, and implementation capacity.
- Sometimes local government, WCD or SCD, or local river and watershed organization. In some settings, local municipality will be considered biased. In other cases, the local NGO may be viewed this way. Who is perceived as "driving the plan" matters.
- Important to consider scale of project and the scope of any management entity. If the scale of the SMP is small, the decision-making process regarding 'institutional home' may be less complex. If the scale is large, there may be many more players to choose from.
  Clarifying long-term roles and responsibilities as well as short term operational considerations will be key to the success of any coalition.
- Structure of successful coalitions is crucial – how will decisions be made, how will ownership be shared, how will environmental and recreational interests be included, etc. Creating a local advisory committee / MOU of sorts could help address concerns and spell out responsibilities. Creating the structure for the coalition to succeed could be considered separately from the institutional home.
- Examples:
  - Watershed groups / local NGOs may be appropriate entity if sufficiently well established, funded, staffed, and with needed partners. May be appropriate for individual members of a coalition to implement specific projects that are of most direct interest to them. Watershed groups formed to address flood restoration activities may be able to transition to take responsibility for implementing SMPs / restoration projects.
  - Conservation districts may be a good potential host in areas with substantial agricultural activity, well connected to agricultural community, and have access to watershed restoration funding from the NRCS. The Upper Gunnison Water Conservancy District has taken charge of identification and implementation of projects within their geographic boundaries, hiring

coordinators, and implementing both consumptive and non-consumptive projects. Are there other conservancy districts interested in taking on this role?

- Local governments may be able serve as the managing entity, assuming there is strong support from the elected officials and viewed favorably by the community. Grand County as prime example. Or may be helpful as a source of support or funding collaborator with some projects.
- Coalitions formed for other reasons may also have a significant role in in SMPs. In the southwest, a coalition that has focused primarily on forest health issues is now transitioning to take responsibility for SMP activities.
- Basin roundtables may not able to act in this capacity but can be helpful in other ways. Good to be connected with your basin roundtable.

Topic 3: PRIORITIZING GOALS AND ACTIVITIES

Explanation for participants: If you were to pursue a Stream Management Plan for a specific stream or reach, how would you build *the case* for its importance and prioritization? What is the *outcome* you are hoping to achieve? *Where* is it important to work and *why*? *What* are the biodiversity or recreational values we care about? And how well do we think they are doing? *Why* are these recreational or environmental values important? How might you quantify this value? *What issues* or threats are creating problems for the biodiversity/recreation we care about and what is the estimated seriousness or urgency of these threats? What is your "end of the road" goal for the reach, including species and recreational improvements along with the stream section's current condition? What actions are needed to achieve the desired outcomes? How do you set goals and activities that are clear and tied to outcomes that benefit flow and physical habitat? Additional questions for consideration: Are you prepared for a future that may include more a more extreme hydrologic cycle? Have you built climate resilience into your goals? What examples exist of environmental and recreational goals that lend themselves easily to evaluation and monitoring? Who is in charge of implementation of any restoration projects? Does implementation require new partnerships? Is there an opportunity to engage your community (aka local stakeholders) in data collection, citizen science, or physical restoration activities? What information do you need to evaluate progress?

Notes / lessons from discussions:

- Although starting with the desired end condition or outcome you are hoping to achieve makes sense as you can then reverse engineer how you can get there (e.g., what are the threats to achieving this end state, how can the community address them, etc.), the reality is that people are first motivated by their values. Give stakeholders the opportunity to express their values, then help the group identify outcomes from these values.
- Most communities are likely to have multiple objectives that relate to water – public safety (flood protection, reduced threat of wildfire), safe drinking water, and economic stability. Environmental and recreational interests are part of this picture too. The reality is that the boundary between consumptive and non-consumptive water management is porous – integrated water management may be key to new solutions that bridge the environment / recreation and agriculture.
- When threats have the potential to be irreversible, this can strengthen the focus of your community toward shared values/outcomes and specific action.
- Your job can be to help move your community take their values and turn them into outcomes that have clear, quantifiable goals and objectives. Wide range of examples of goals / objectives were developed by the participants:

- Adequate low flows –
  - Water is available in segment xxx to release in low flow conditions in drought summers for boating and fishing in the summer.
  - Groundwater levels are maintained or raised to support baseflow (or other functions)
  - Zero no flow days in 100% of the stream by Year x.
  - An improved understanding of water calls and augmentation plans provides a tool for flow planning discussions
- Headwaters protection and water quality
  - Flooding from xxx upland areas and risk to downstream urban areas is mitigated due to land protection in zone yyy and riparian restoration along zzzz section of the river.
  - Priority risks of urban runoff and mining discharges are known and mitigated in priority areas by Year x. (Assessment and monitoring plan identifies and verifies priority locations to guide improvement projects)
  - Fire planning identifies and abates risk in __% of headwaters by Year x.
- Enhanced asset for public – improve xxx ditches and incorporate new boat ramps in zzz area to allow families greater opportunities for river access
- Community engagement/benefits –
  - Landowners are motivated to work on SMPs because they understand value of strategic planning and have ownership in process (i.e., process itself can be a goal that helps increase participant investment and community ownership)
  - Each sub-basin develops a plan for 100% of its tributaries and includes demonstration project showing stacked benefit approach (e.g., how timing releases for fish can help recreation and work with agriculture and dam operations)
- Fish habitat
  - Decreased stream temperatures – Reduce temperature from xxx to yyyy by increasing flow by zzzz to improve conditions for trout.
  - Recreational fishing–channel restoration improves fish habitat along ___ feet of priority reach Y.
- Riparian habitat/Bank stability
  - Buffer widths of __ feet are established to improve habitat protection and flood resiliency along ___ river by __.
  - Increase beaver assisted restoration within first 2 miles of headwaters by Year x.
  - Erosion is reduced within ___ extent on stream __, and a monitoring agreement is established to confirm.
- Floodplain—___acres of high priority floodplain are protected through purchase or conservation easements to help protect downstream impacts.
- Increased sediment removal – Decrease sediment by xxxx at location yyyyy by increasing functionality of floodplain across zzzz segment of the river. May be good for local farmers whose intakes are prone to clogging. Riparian restoration / bank stabilization could then be an activity to get to this goal.

- Private landowners / local water users including farmers will be motivated to work in SMPs IF / WHERE they see value coming their way.

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Appendix D:

Colorado Water Institute. (2016, September/October). *Colorado Water*.

Colorado Water

September/October 2016

Reaching Higher

Implementing the Colorado Water Plan's Goals for Stream Management

Colorado State University

The release of the Colorado Water Plan ushers in a new era in our water management, where environmental and recreational values are given the same sense of urgency as traditional water development. As communities look for ways to get involved in Water Plan implementation at the local level, Stream Management Plans (SMPs) are an excellent place to get started.

The concept of the SMPs is still new, with only a few communities having completed or in the process of working on their plans. So, there is plenty for everyone to learn, and the existing plans that are featured in this issue of Colorado Water provide inspiring models for how the plans can go beyond previous efforts and help to bring communities together.

The Colorado Water Plan highlighted the need for SMPs as a tool to protect watershed health, the environment, and recreation in Colorado. It stated an ambitious goal to "cover 80 percent of the locally prioritized lists of rivers with SMPs by…2030."

SMPs are stakeholder-driven management plans that shepherd environmental and recreational goals and values into actionable projects aimed at "maintaining or improving flow regimes and other physical conditions," for localized environmental and recreational water uses. Per the Water Plan, SMPs "can provide a framework [to basin roundtables, local stakeholders, and decision makers] for decision making and project implementation."

This special issue of the Colorado Water newsletter is intended to serve as an initial resource guide with topics including an overview of what SMPs are, the steps of the process, available tools, and shared lessons learned from select case studies around the state. The case studies here, alongside others we were unable to include, provide a foundation of water management collaborations that have involved professionals and committed staff who are working on similar issues in every major river basin. Special thanks goes to CSU alumna Claudia Browne from Biohabitats for spearheading.

Two workshops supported by the Colorado Water Conservation Board provided forums for many of the contributors to gather and share these resources in August and October 2016. Workshop presenters included: representatives from the Colorado Water Conservation Board, the Colorado Water Trust, Trout Unlimited, The Nature Conservancy, Open Water Foundation, American Rivers, CSU, the City of Steamboat, and consultants, among others. Bridging the gap between academia and practitioners, CSU students, faculty, alumni, and partners are bringing integrated science, engineering, and social tools to the table. The process should yield better outcomes for Colorado's streams and rivers as SMPs are implemented.

SMPs are one part of the many approaches outlined in the Colorado Water Plan to secure future water supplies while protecting the environmental, social, and economic values held by Colorado citizens. The academic and research community has an important role in bringing objective science and education to the implementation process for the Water Plan. As the SMP process evolves, there will be room for many more creative minds and voices to help shape the future of wise water management for both humans and the environment.

Reagan Waskom

Reagan Waskom
Director, Colorado Water Institute

COLORADO
WATER

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On the cover: Flyfishing on the Eagle River reflects the Colorado Water Plan's stated need for SMPs as a tool to protect watershed health, the environment, and recreation in Colorado. Photo © 2016 iStock.com

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Special Issue— Stream Management Plans

The Open Standards conservation planning approach ensures selected strategies will result in effective outcomes that are tied to priority issues. Healthy Country Planning, Australia 2012. Photo by Stuart Cowell.

Cooperators include the Colorado State Forest Service, the Colorado Climate Center, and CSU's Water Resources Archive.

Introduction to Stream Management Plans

What Are They and Why Now?

Amy Beatie, *Executive Director, Colorado Water Trust*

One of the goals of the Colorado Water Plan is to develop SMPs for 80% of the state's priority streams. SMPs focus on integrating environmental and recreational values with traditional agricultural and municipal values. Stream systems that struggle with low flows, degraded habitat, storage and water rights challenges, flooding, recreation needs or pressures—in other words many of the streams are good candidates for an SMP. By encouraging organizations to work together with stakeholders from both upstream and downstream, SMPs offer the chance for creative, whole-system problem solving.

To help jumpstart the SMP process, the Colorado Water Control Board (CWCB) is offering grant funding through their Watershed program. See application instructions on their website at: http://cwcb.state.co.us/LoansGrants/colorado-watershed-restoration-grants/Pages/main.aspx. Applications will be due November 4, 2016. The grants have a 1:1 match ratio, and other funding parties will need to step up.

Colorado Water Trust also hosted a workshop at the Colorado Water Congress Summer Conference in Steamboat, Colorado this August with support from the CWCB and Colorado Water Congress (CWC). The workshop described ways to conduct an SMP, available funding, and showcased experiences from those who are experienced with this related work to help those getting started. A more condensed workshop is included in the Sustaining Colorado Watershed Conference located in Avon, Colorado this coming October.

A Photo Journal of Strategies Structural Improvements to Ensure Adequate Flows

Fraser River Inlet upstream of the Denver Water's Fraser Diversion Dam/Sediment Project. Workers are at the sediment project's 30-inch water bypass gates/pipeline, which is used to dewater the diversion dam to remove sediments. Photo courtesy of Denver Water.

Colorado Department of Transportation equipment removing accumulated sediments from Denver Water's Diversion Dam/Project. The pump is used to keep the diversion/settling pond area dewatered for sediment removal. Photo courtesy of Denver Water.

Well-developed Stream Management Plans should be grounded in the complex interplay of biology, hydrology, channel morphology, and alternative water use and management strategies.

According to the CWCB grant application guidelines:

"Well-developed Stream Management Plans should be grounded in the complex interplay of biology, hydrology, channel morphology, and alternative water use and management strategies. They should also consider the flow and other structural or management conditions needed to support both recreational uses and ecosystem function. A stream management plan should:

1. *Involve stakeholders to ensure their acceptance of the plan;*
2. *assess existing biological, hydrological, and geomorphological conditions at a reach scale;*
3. *identify flows and other physical conditions needed to support environmental and recreational water uses;*
4. *incorporate environmental and recreational values and goals identified both locally and in a basin roundtable's BIP; and*
5. *identify and prioritize alternative management actions to achieve measureable progress toward maintaining or improving flow regimes and other physical conditions. For basin roundtables, local stakeholder groups, and decision makers, such plans can provide a framework for decision-making and project implementation related to environmental and recreational water needs."*

Cache la Poudre River, Josh Ames Diversion Dam Structure, 2013. Photo courtesy of Biohabitats.

Cache la Poudre River after removal of Josh Ames Diversion Structure, 2014. Photo courtesy of Biohabitats.

The necessary steps for the development of an SMP include:

1. gathering stakeholders to participate in plan development;
2. identifying the plan's objectives;
3. identifying and prioritizing ecological and recreational values;
4. establishing goals for flows and other physical conditions in order to protect or enhance environmental and recreational attributes on streams and rivers within a given watershed;
5. collecting and synthesizing existing data describing flows for river ecosystems, boating, or other needs in the watershed;
6. assessing existing physical conditions of stream reaches, including geomorphological and riparian conditions;
7. selecting quantitative measures that can be used to assess progress made toward articulated goals;
8. determining what new information is needed and the best methods for obtaining that information;
9. quantifying specific numeric flow recommendations (or ranges of flow) and physical conditions and assessing the potential for channel reconfiguration to support environmental and recreational values;
10. identifying temporal, geographical, legal, or administrative constraints and opportunities that may limit or assist in the basin's ability to meet environmental and recreational goals; and
11. implementing a stakeholder-driven process to identify and prioritize environmental and recreational projects and methods.

SMPs should provide data-driven recommendations that have a high probability of protecting or enhancing environmental and recreational values on streams and rivers. More information on environmental and recreational projects and plans can be found in Chapter 6.6 and 7.1 of the Colorado Water Plan.

The conceptual framework in the Colorado Water Plan directs all interests to "identify, secure funding for, and implement projects that help recover imperiled species and enhance ecological resiliency, whether or not a new [transmountain diversion] is built." The voluntary projects and processes that SMPs recommend will help roundtables and other organizations continue to better integrate multiple stakeholder objectives into project planning.

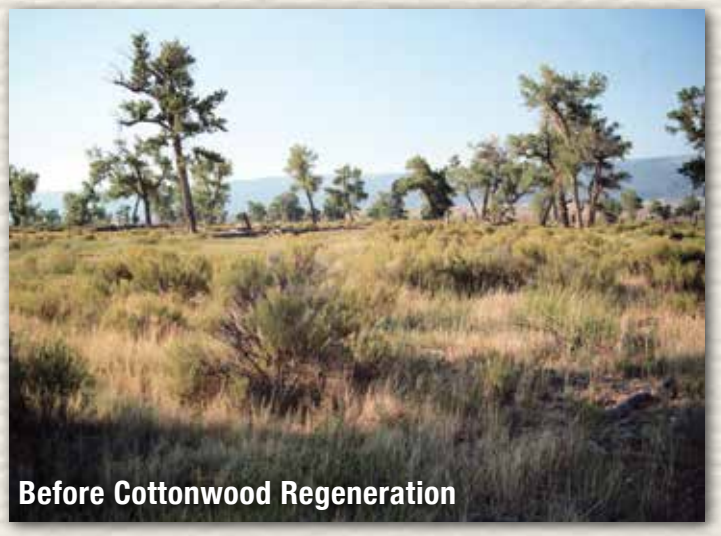
It has been said that the future begins in conversation, and SMPs help focus conversations on solutions to help the State better prepare for drought, floods, and population growth, while maintaining thriving natural resources, agriculture, recreation, and metropolitan economies. Now, nearly one year after the Colorado Water Plan was released, it is time to ramp up its implementation, and SMPs are an important place to begin.

A Photo Journal of Strategies Structural Improvements to Ensure Adequate Flows

Continued

Bridge culvert impeding fish passage in Fort Goff Creek, Klamath National Forest, California. Photo courtesy of USFS.

Retrofitted bridge to allow fish passage in Fort Goff Creek, Klamath National Forest, California. Photo courtesy of USFS.



Remnant cottonwood forests along the Green River in Browns Park, Colorado. Photo by David Merritt, USFS/CSU.

Cottonwood seedlings regenerating along Green River in Browns Park Colorado. Photo by David Merritt, USFS/CSU.

Eroding bank along Taryall Creek in Park County, Colorado. Photo courtesy of Biohabitats.

Wood toe for stabilization and improved fish habitat at Taryall Creek in Park County, Colorado. Photo courtesy of Biohabitats.

The Owens-Hall Diversion on Fountain Creek located between Colorado Springs and Pueblo, Colorado. Recently a fish passage was installed on the diversion with the guidance from Colorado Parks and Wildlife (upper left of the photograph). The goal of the structure is to improve native fish passage, especially for the at risk Flathead Chub and Arkansas Darter. Photo by Tyler Swarr, CSU.

The Fossil Creek Reservoir Inlet Diversion structure on the Cache la Poudre River near the CSU Environmental Learning Center. The diversion was destroyed after the 2013 flood but was rebuilt to include a rock ramp fishway. The fishway was completed in early 2016 to improve native and sport fish passage. Photo by Tyler Swarr, CSU.

Perspectives on Stream Management Challenges: A Survey

Summary of Key Questions from a 2016 Survey Effort

Whitney S. Beck, *PhD Student, Graduate Degree Program in Ecology and Department of Biology, Colorado State University*

During the summer of 2016, the Colorado Water Trust & Biohabitats, in collaboration with the Colorado Water Conservation Board, developed an SMP survey for water professionals working in governmental and non-governmental sectors across Colorado. The goal of the survey was to document the information, technical resources, or other needs of organizations interested in creating SMPs. The 49 survey respondents represented all of the major basins in Colorado. Respondents were in various stages of developing SMPs, although over half had not yet considered or had only briefly discussed SMPs.

When the water professionals were asked about recreational and environmental issues and opportunities, they usually highlighted the importance of basin water quantity rather than quality. Specifically, "altered flow regimes" and "low flow condition or absent riparian buffer" topped the survey rankings of the most important issues. Geomorphic processes such as floodplain connectivity and channel erosion were also identified as important environmental priorities. Policymakers and citizens across the state of Colorado are currently debating water rights allocations and future storage projects, and both of these issues were emphasized in the survey responses.

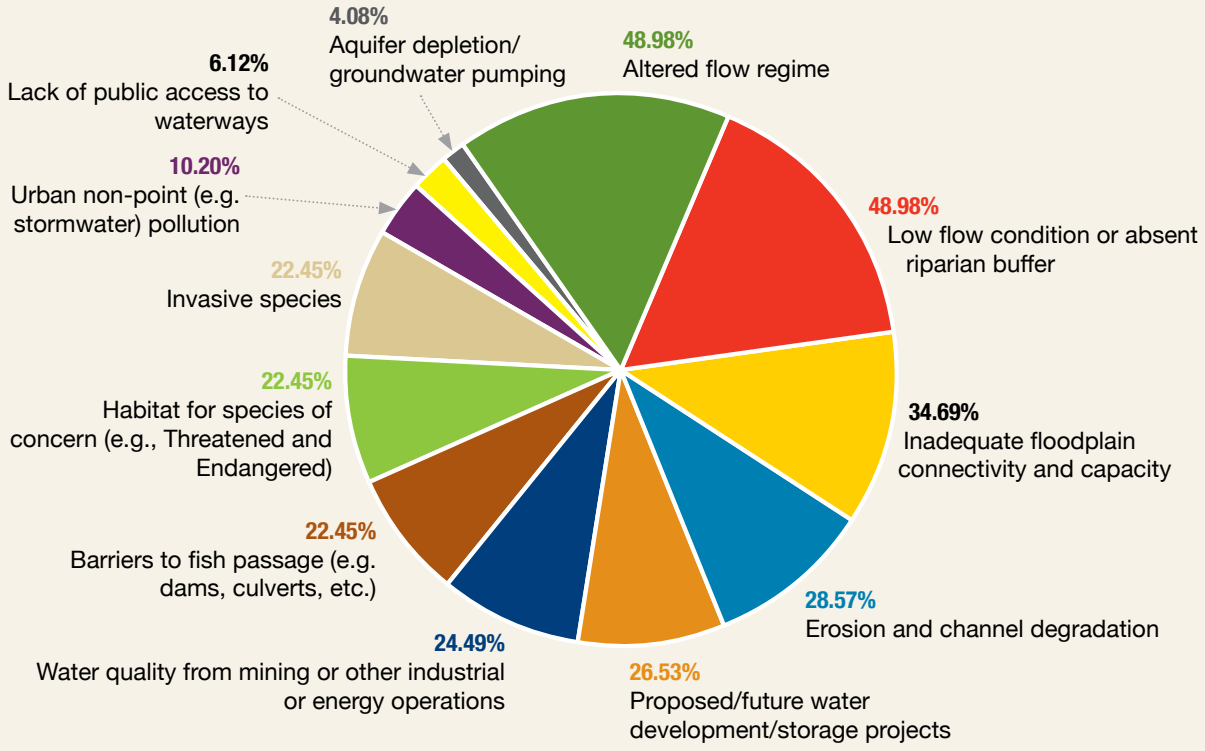
When asked to name agricultural and municipal water supply challenges, respondents highlighted the inefficiency of irrigation techniques and the need for a climate that encourages innovation by reducing its risks. The other top issues included lack of conservation incentives and inadequate storage. Although the question about supply did not specifically ask about environmental issues, the water professionals linked agricultural and municipal water use to ecologically important topics such as: in-stream flows, intact riparian vegetation, and soil health.

Respondents also pointed out the socioeconomic barriers to pursuing management priorities. Funding constraints are an obvious limitation, but navigating the state of Colorado's complicated system of water rights and in-stream flows can also be an enormous challenge. Respondents emphasized working together with the agricultural community to improve stream health, a process that relies on establishing trust and open lines of communication.

One of the questions implicit in the Colorado Water Plan's SMP goals is the definition of priority streams. Therefore, survey respondents were asked to describe what makes a stream a priority. Two themes dominated the survey responses with 37% of participants prioritizing high quality streams and critical habitat values, while 34% of participants prioritized those that are most degraded by water depletion or water quality issues. The remainder of respondents offered a mixture of either both those priorities, were uncertain, or suggested priorities should relate to the needs of the users in the basin. Some respondents suggested focusing efforts on headwaters streams to allow benefits to trickle down, while others focused on the main stems that experience heavier use. Balancing these various perspectives will be an important part of future discussions as communities move forward with developing and funding SMPs at the basin and state levels.

Whitewater Park in Salida, Colorado is one of many recreational areas on the Arkansas River. Photo by Galt57/Wikimedia Commons.

Q7 *What are the three highest priority environmental and recreation issues and opportunities for improvement for the stream system where you work or where you are considering an SMP?*



Q8 *What are the three highest priority agricultural and municipal water supply issues and opportunities for the stream system where you work or where you are considering an SMP?*

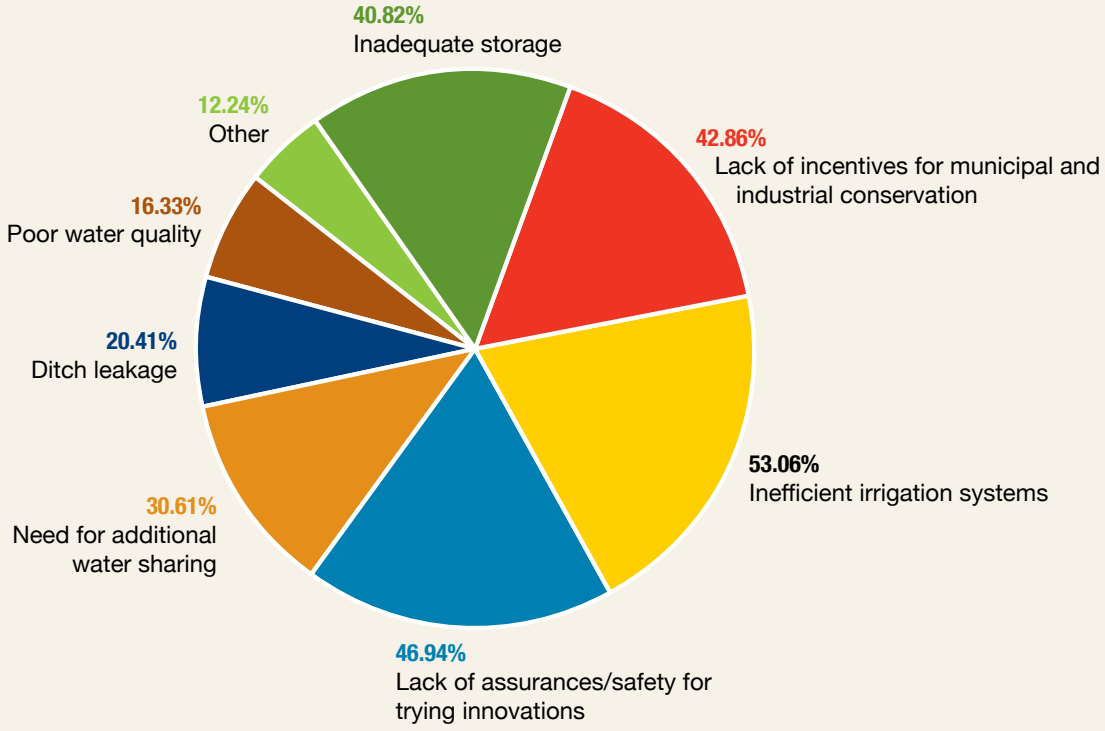


Figure 1. Stream Management Plans – Needs Assessment Survey

Stakeholders and the Crystal River Stream Management Plan

A Description of How the SMP Process Brought a Community Together Around Water Management

Chelsea Congdon Brundige, *Water Program Director, Public Counsel of the Rockies*
Jonathan D. Bartsch, *Principal/CEO, CDR Associates*

Overview

The Crystal River, in the lower Roaring Fork watershed, supports a biologically diverse ecosystem. It supports the water needs of three small municipalities, an extensive hay and cattle ranching economy, as well as increasing recreational and aesthetic uses. Over the past decade, numerous studies and projects have contributed to a piece-meal assessment of the overall health of the river ecosystem. The Crystal River Management Plan (CRMP) developed by Lotic Hydrological, Roaring Fork Conservancy, Public Counsel of the Rockies and CDR Associates is a science-based and stakeholder-driven assessment of the entire watershed that identifies, prioritizes, and guides management actions that honor local agricultural productivity, preserve existing water uses, and enhance the ecological integrity of the river.

Agricultural production has long been the cornerstone of the Crystal River Valley and remains so today. However, growing population and changing demographics in the valley have heightened interest in recreational, environmental, and aesthetic values of the Crystal River Valley. In recent drought years, record low flows fueled concerns and controversy about the health of the river. In response, the Roaring Fork Conservancy provided local capacity to develop the CRMP in a collaborative process to explore and discuss values, resource use priorities, and feasibility constraints around water management alternatives. The stakeholder process represented a significant investment of time, trust, and cooperation throughout the project, and provides a foundation for working together as a community to implement the CRMP recommendations.

Crystal River Management Plan Stakeholder Process

The stakeholder process was one of three components of the CRMP framework (Figure 1), and participants included agricultural producers, State water administrators, local municipalities, natural resource agencies, local and national environmental organizations, recreational advocates, and other water rights holders.

Community outreach to identify objectives and values (SMP Steps 1-3) began during the 2012 Crystal River Snapshot Assessment (S.K. Mason Environmental, LLC, 2013). That project demonstrated the vulnerability of the lower Crystal River to stream health degradation during drought and/or low flow conditions (Figure 2). Project partners shared the findings in conversations with local agricultural and municipal water users to initiate a dialogue about the impacts of water depletions.

Over the 18-month CRMP process, the project team produced quarterly newsletters, held group and individual meetings, and hosted "Crystal River Conversations" to clarify outstanding questions, summarize results from previous studies, refine objectives, and test the feasibility of management alternatives.

In early meetings, agricultural producers, water right holders, and staff of the town of Carbondale revealed strong personal, cultural, and economic values associated with the river. Stakeholders also raised questions about management goals, including:

1. How much water is needed to make a difference for the ecological health of the Crystal River?
2. Where is water needed most?
3. When is water needed most?
4. Are their engineering solutions to the issues in the watershed?

The stakeholder process represented a significant investment of time, trust, and cooperation throughout the project, and provides a foundation for working together as a community to implement the CRMP recommendations.

Figure 1. CRMP planning framework—The values and priorities of stakeholder groups [socio-economics] are characterized in relation to the condition of the riverine resources within the watershed [resource condition], and the physical processes that determine the movement of water, local channel forms, and impacts on aquatic life [physical processes].

Figure 2. The CRMP's catalyst—Streamflows observed on the Crystal River in the late summer of 2012. Green call-outs indicate measured flows. The thickness of the blue and yellow lines indicate the relative magnitudes of observed flows and the CWCB Instream Flow Right.

These questions helped guide planning with respect to Step 4 (establishing realistic goals for flow), Step 7 (selecting quantitative measures to assess progress), and Step 8 (determining new information that was needed). Specifically, the agricultural water users explicitly rejected both the CWCB's generalized ISF right for the river (100 cfs summer/ 60 cfs winter), as well as more targeted evaluations using R2Cross and Wetted Perimeter methods for specific reaches in the lower Crystal. This resistance allowed project partners to understand existing constraints on any proposed flow targets. In response, we developed ecological metrics of aquatic habitat connectivity and quality, riparian recruitment, and channel structure to encompass the key processes crucial to a riverine ecosystem health. These metrics served to guide the evaluation of management alternatives. In addition, these questions demanded deeper discussions on the feasibility of adopting management alternatives.

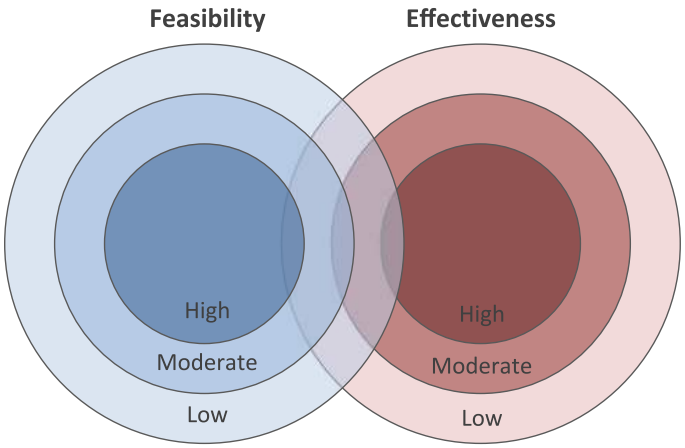


Figure 3. The most effective management options are rarely the most feasible. Optimization of management generally reflects some degree of compromise between the two.

The CRMP process required innovation in Step 9 (quantifying flow recommendation). Due to the prevailing skepticism about the figures and motives of local watershed and conservation project sponsors, the decision-making framework was designed to be *descriptive* rather than *prescriptive*. Integrating an ecosystem functional assessment of the watershed with hydrological modeling of water availability, surface water allocation under State law, and return flows resulted in a very robust tool for evaluating the ecological benefits associated with various levels of flow across a range of drought and flood conditions. This tool (the Ecological Decision Support System or EcoDSS) was designed to allow stakeholders to collaboratively choose flow targets and alternative management practices based on their shared values, priorities, and constraints.

Through several days of facilitated meetings, stakeholders grew familiar with the methodology and results of the descriptive framework and developed confidence in the scientific assessment and hydrologic modeling. However, many expressed frustration with the absence of specific flow recommendations. In response, the project team presented a range of flow targets and the diversion reductions that would achieve threshold ranges of ecosystem benefits on the Crystal River under drought conditions.

Stakeholder input in early group meetings, informal "coffee shop" encounters, and community informational meetings also guided the choice of alternative management practices: market-based incentives for water conservation through bypassed flows; infrastructure improvements and efficiency upgrades; off-stream storage; and habitat enhancement through channel modification. This input illuminated management constraints beyond the ecological and physical processes such as agricultural operations, planting cycles, policies, markets, social attitudes, etc. (Step 10). In the final facilitated stakeholder process, the community contemplated adoption of flow targets to achieve *moderate* ecological benefit (or risk) under drought conditions, and the most acceptable projects or methods for achieving these flow benefits in the River (Step 11).

Conclusion

An effective stakeholder process begins at conceptualization, identifying individuals and organizations, framing questions, understanding stakeholder values and perspectives, building support for the scientific methodology, and clarifying the outcomes and timeframes.

The Crystal stakeholder process included substantial stakeholder engagement, particularly from the ranching community and other water rights holders, largely because the project evolved from a "quiet" or focused dialogue initiated by local conservation groups, and a recognized mutual concern about the river. The conversations that preceded public meetings built trust and collaboration.

The success of the CRMP depends on investment by stakeholders to articulate their *values* around the resource and evaluate and prioritize management alternatives. The CRMP process provided a forum for developing mutual understanding and confidence in data, results and process and fostered collaboration among stakeholder groups. This experience of discovery and trust-building helped the community focus on long-term management options that are both feasible and effective. (Figure 3)

The goal of the CRMP effort was to identify and evaluate management and structural alternatives that honor local agricultural heritage, preserve existing water uses, and enhance the ecological integrity of the river. But in the end it is only a plan. To realize the collective efforts of any SMP process, stakeholders must remain engaged and supported through the implementation process. To the extent possible, early discussion of expectations around implementation including: physical scope, funding, compensation, timeframe, responsibility, and leadership will help secure continued community collaboration to effect long-term change that balances agricultural, municipal, environmental, recreational and other needs.

The Crystal River Management Plan is available at the Roaring Fork Conservancy website: http://www.roaringfork.org/publications/2016-crystal-river-management-plan/

Finding, Analyzing, and Presenting Data for Stream Management Plans

A Practical Resource Guide to Types and Sources of Public-Access Data

Steve Malers, *Founder and Chief Technology Officer, Open Water Foundation*

Much of the data needed for an SMP is available through a clearing house of accurate, user-friendly databases maintained by the Colorado Division of Water Resources, and other publicly available sources such as the United States Geological Survey (USGS).

Colorado's Decision Support Systems (CDSS, http://cdss.state.co.us/Pages/CDSSHome.aspx) is the product of twenty-years of collaboration and refinement that has ultimately resulted in an approach the CDSS team refers to as "data-centered". In this approach, a collection of curated data is used with automated data processing to implement analyses that are self-documenting, repeatable, and transparent. The data-centered approach required investing in data processing tools and standard procedures. Significant up-front effort to scrutinize data and define processes resulted in efficiency gains as analysis and modeling efforts were scaled from prototypes to full implementation.

The primary requirement for maintaining and enhancing natural stream function is ensuring adequate water supply for environmental flows. Determining environmental flows is complicated by many factors including: site-specific conditions, requirements of different species, seasonal flow requirements, and the impact of steam channel geometry on depth and flow. Innovative approaches are needed to efficiently perform baseline analysis and explore options to understand environmental and recreational requirements.

CDSS as a modeling platform is intimidating in its complexity because the model datasets are virtual representations of complex physical and legal systems. The learning curve to effectively and efficiently use CDSS models is steep, more so for practitioners that do not work with the models or datasets on a regular basis. CDSS models' consideration of environmental and recreational (E&R) concerns is limited. The challenge and opportunity is to leverage CDSS and its data-centered approach as a platform to support SMPs and enhance CDSS tools to better serve E&R purposes. Cultivating this "virtuous cycle" can result in more robust data and tools for SMP development and updates. The remainder of this article explores a number of tangible areas where CDSS and other technologies can benefit SMPs.

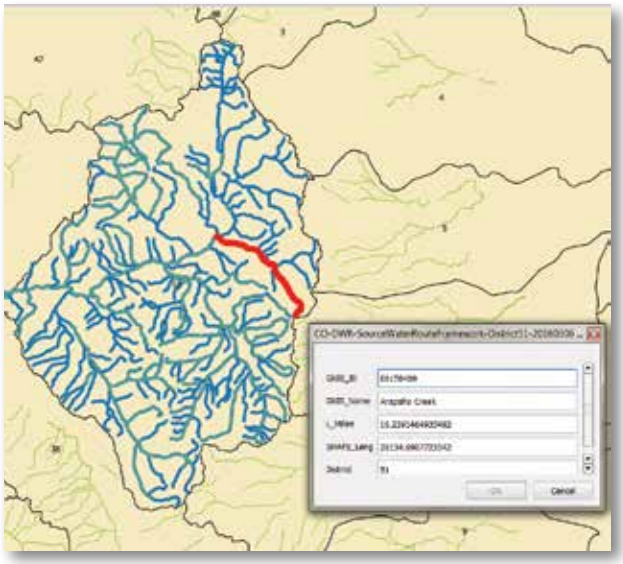


Illustration of spatial datasets created by Austin Severin of OWF from the state of Colorado datasets to facilitate use. Layers include streams from DWR's Source Water Route Framework (blue) and CWCB instream flow reaches (green). The SWRF layer allows users to manually select streams to see the full extent while the State is working to reference other data to this layer using stream mile. Courtesy of Steve Malers.

Time Series Data

Time series data for streamflow, diversions, reservoir releases, climate, and other data types are available from various sources, including the CDSS and other web services. Software that accesses machine-readable formats facilitates automated processing. SMPs can benefit from streamflow and other data at various time steps available

Spotlight on CSU Team and Large Wood Management in Streams

The Open Water Foundation works with CSU on collaborative research projects and also provides paid student internships to work on challenging water issues. These projects focus on developing data visualizations for complex water issues using cloud-hosted datasets and tools, which will be available on data.openwaterfoundation.org.

Current CSU Interns include:

- **Katherine Bagnuolo**—CSU undergraduate majoring in Environmental Sociology and minoring in Business Administration. Katherine is helping to create an asset map of water organizations (including environmental NGOs) throughout the state of Colorado, to identify resources and opportunities to address complex water issues.
- **Kory Clark**—CSU undergraduate majoring in Computer Science and minoring in Global Environmental Sustainability. Kory is helping to develop a standard approach for implementing WaterML 2.0, which is an open data standard for sharing hydrologic time series data between software tools.
- **James Hansen**—CSU Graduate student in Civil Engineering with an emphasis in water resources—James is using Esri's ArcGIS and open source software to create animations of irrigated land and urban growth management areas.
- **Austin Severin**—CSU undergraduate in Watershed Science. Austin is automating processing of public spatial datasets to create more value and improve access to datasets.

from the USGS National Water Information System (http://waterservices.usgs.gov/), State of Colorado web services (http://water.state.co.us/DataMaps/WebServices/Pages/WebServices.aspx), and other sources. However, the data may be difficult to normalize into a consistent format for analysis. For example, handling metadata such as units, spatial data, and data flags is often beyond the ability of simple formats such as comma-separated-value (CSV) and Excel tables. Time series utilized in a platform should include basic attributes such as location ID, data type, units, and data interval. The TSTool software developed for CDSS can be used to automate download and process time series data. Other tools such as R for statistics, geographic information system (GIS), Excel, and various models can also be utilized.

Spatial Data

Spatial data for water resources have in the past typically been available as geodatabases, ESRI shapefiles, and KML. Using these formats is straightforward with GIS software. However, spatial data are increasingly being used for web visualizations that use open data formats such as GeoJSON (http://geojson.org/), and well-known-text (WKT, https://en.wikipedia.org/wiki/Well-known_text) formats. These formats facilitate open data exchange and can be converted to other formats as needed. For example, the open data portal Socrata software used to implement the https://data.colorado.gov/ website can provide GeoJSON datasets, and the Open Water Foundation is providing value-added datasets in GeoJSON format (http://openwaterfoundation.org/), including instream flow reaches for each water district and division in Colorado, with water right water district identifier corresponding to case number added to allow joining to the State's HydroBase database.

Analysis Platform/Framework

SMPs could benefit from the use of an analysis platform with shared software, standard data processes, and consistent conventions. A software platform can help ensure that a common core approach is implemented and will allow enhancements to be built as the process develops. The platform may use a tightly integrated set of tools and shared data management solution (such as CDSS and the HydroBase database) or a loosely integrated set of tools that relies on open data formats to allow components to share data. One example of such a platform is how CDSS data and software were used for the South Platte Basin Implementation Plan (BIP) where E&R data were associated with stream layer data to produce a "Stream Mile Representation Framework" with 0.10 mile stream segments, which allows for additional analysis of time series data at locations associated with the stream segments.

Cache la Poudre Watershed (District 3) Irrigateds Agriculture

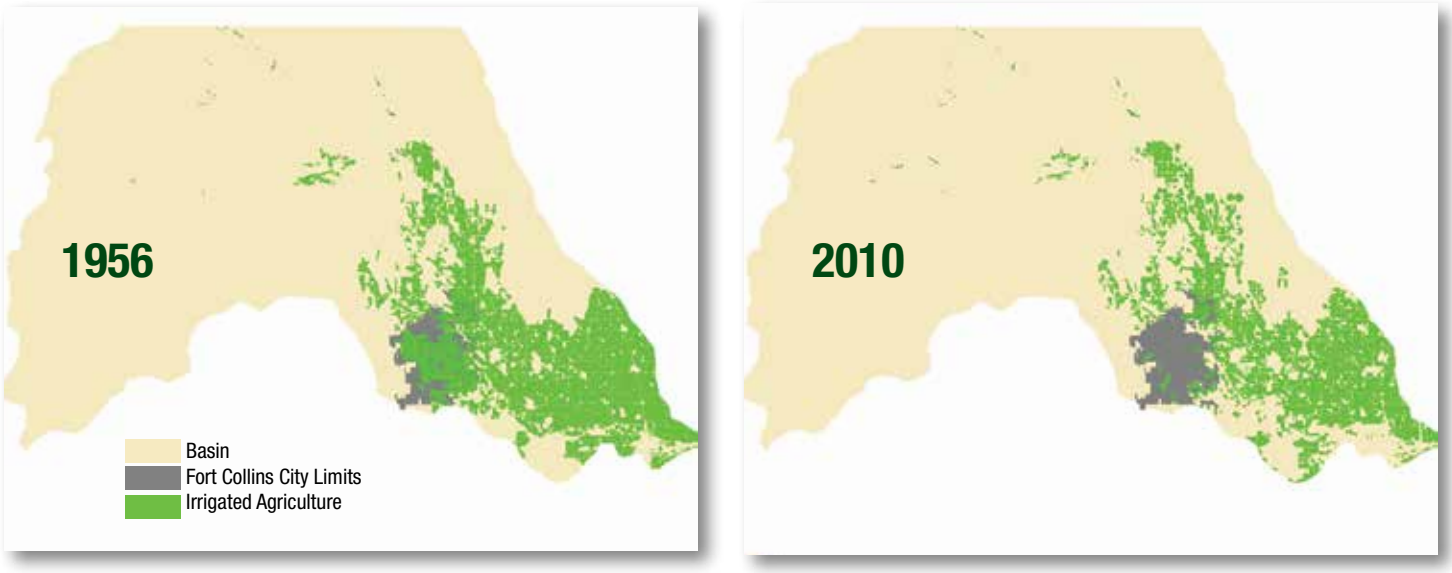


Illustration of spatial datasets created by OWF. Examples of irrigated areas along Cache la Poudre River from 1956-2010. Files are the result of James Hansen's efforts and illustrate changes in irrigated agricultureover time. Courtesy of Steve Malers.

Value-Added Datasets

Organizations publish data to meet their mission or statutory requirements, but often stop short of "connecting the dots" for more complex issues. Value-added datasets may involve joining datasets to create a new dataset, joining data across jurisdictional boundaries, providing a time-stamped archive of dataset versions, or reformatting data to facilitate use. Without such datasets, analysts and modelers must recreate the datasets themselves. Cloud-hosted data platforms facilitate data storage and access. For example, https://data.colorado.gov/, CDSS map viewer, and https://databasin.org/ include basic and value-added datasets. Value-added datasets produced to support SMPs could be provided in the cloud to facilitate collaboration.

Process Automation and Scaling

Process automation is a key aspect of the data-centered approach and requires: (1) machine-readable data formats (avoid PDFs or obscure file formats) – for example, CSV, Excel tables, XML, JSON; (2) sufficient metadata for datasets (data units, handling of missing data, and data flags); (3)unique real-world identifiers for data objects, for example location identifiers, and standard identifiers for static data such as E&R attributes; (4) software tools that can represent analysis steps as a workflow; and (5) software tools that allow linking to other tools, to allow flexibility in addressing complex problems.

The CDSS TSTool and StateDMI software are examples of tools that meet the above criteria, and Python is often used with GIS processing. TSTool can be used to automate large processes involving many types of data. TSTool can be used to prototype a process and then scale to large systems, perhaps by combining GIS/Python, TSTool, and Excel. The effort of defining well-documented automated processes helps ensure that processes use good science and can be repeated.

Visualization

Data visualization will increasingly be a component of many projects, extending beyond basic Excel graphs and GIS maps. Cloud visualization tools such as Tableau, ArcGIS Online, custom web visualizations, and many other technologies allow a web browser to become a visualization platform. Collective investment in useful SMP visualization techniques could result in shared tools that are applied efficiently and consistently across basins. With some effort, it is possible to enable interactive data sets that provide context and understanding of important water issues.

Publishing Results

Complex studies and models often suffer at the end of projects in that resources run out and work products default to "engineering reports" provided as PDFs. Platforms can help in this area because documentation for the platform is handled by the maintainer of the platform and projects can focus more on publishing data and documentation specific to the project. One approach is to plan at the start of a SMP project how all data and work products will be published and actively do so throughout the project.

Development of SMPs for Colorado's river basins will require extensive use of data and analysis tools. There is an opportunity to develop a data-centered platform that leverages CDSS and other tools, resulting in self-documented, repeatable, and transparent analysis products that quantify environmental flows and other measureable outcomes.

Stream Management Planning

Establishing Targets and Metrics for Flow

Meg White, *Freshwater Scientist, The Nature Conservancy*

Completion of the Colorado Water Plan (CWP) sets in motion an implementation phase emphasizing the protection of our rivers, acceleration of urban conservation, improvements to aging agricultural infrastructure and on-farm irrigation efficiency, as well as improved flexibility to manage water to meet the needs of both people and nature. These activities have grassroots support. The 2016 State of the Rockies poll found that 77% of Colorado voters prefer using current water supply more wisely to address the state of Colorado's water needs rather than diverting more water from rivers.

SMPs are an opportunity to come together to seek better solutions in a process that is:

1. science-based and data-driven;
2. collaborative and stakeholder-driven;
3. focused on flows and opportunities to improve or protect environmental and recreational values; and
4. adaptive and scalable.

Because SMPs are only as powerful as they are specific, defining the main goals for the flows is critical, as is an emphasis on those measures that are quantitative, or measurable.

Deciding where to start in synthesizing flow data in an SMP can be overwhelming. While there is no single "right way" to approach an SMP, some key steps to strengthen the process and potential for success include: (1) defining a framework for stream management decisions and learning; (2) establishing quantifiable (and ideally scalable) goals and measurable outcomes; (3) determining data needs and gaps in knowledge; and (4) generating key actions and recommendations. The rest of this article walks through these steps and data sources available or needed to design a successful, and quantifiable, SMP. (These steps are embedded in steps 4, 8, and 11 of the SMP process described in the CWP.)

Defining a Framework for Stream Management Decisions and Learning

Freshwater conservation is often a moving target, and as water demands increase and supplies diminish, pressures continue to increase on water resources management for people and nature. How much protection is enough? Which approaches are the most effective? How do we know if costly projects and plans are actually working? Answering these questions is fundamental to successfully designing and implementing SMPs. As with any other complex challenge, a systematic approach is needed to assess the effectiveness of planning and management actions and introduces adaptive learning and management—one that helps organizations determine what works, how management can be improved, and directs actions for better outcomes.

The Open Standards Conservation Planning Approach ensures selected strategies will result in effective outcomes that are tied to priority issues. Photo courtesy of Marion Tiemann.

One such established framework that is simple and presents a five-part project management cycle that can be applied across a wide spectrum of projects is the Open Standards Practice of Conservation (Open Standards; http://cmp-openstandards.org/) developed by a coalition of conservation groups called the Conservation Measures Partnership. *Open Standards offers* a framework, focused on conservation, that aims to bring together project design, management, and monitoring to help practitioners create a common terminology across initiatives and improve the efficiency and effectiveness of projects. Defining a framework for your SMP, like Open Standards, can serve as a powerful foundation to develop measurable outcomes, identify knowledge gaps and data needs, and generate recommendations for conservation success.

Establishing Measurable (and Scalable) Goals

Measurable goals serve as a way to articulate, in quantifiable terms, the desired state of a river and river flows. By framing the goals in a quantifiable way, stakeholders

Roundtail Chub illustration by Joseph R. Tomelleri.

can to identify specific outcomes and track measures of success for across multiple scales, and clearly identify ways in which the goals are linked. A strong outcome statement should be specific, measurable, and realistic such as: "*Sustain, or improve, flow conditions in 10 different river locations to support populations of roundtail chub*" or "*Increase X acres of wetlands for shorebirds and waterfowl by 2017*". Ideally, the outcomes will be scalable (i.e., identified at local and regional scales) and developed in a process that is stakeholder driven. There are abundant examples of groups and processes that have identified measurable goals including: the Colorado Natural Heritage Program, American Whitewater Flow Surveys, The Nature Conservancy, Colorado's Wildlife Action Plan, and the Upper Colorado River Endangered Fish Recovery Implementation Program.

Identifying Flow and Data Gaps

Once measurable goals and outcomes have been created, the next step is to determine what types of flow data and knowledge exist for the specific river or region. By conducting an inventory of existing data and data gaps, stakeholders can outline specific steps to fill those data needs in order to understand baseline conditions. Baseline data, such as streamflow, water quality, and the extent and condition of riparian habitat, are often not available and the collection of additional field information may be required to establish baselines and outcomes. An example of an action step from this process could be: "*Based on analysis of existing flow dynamics, currently only three river segments can sustain 3 (of the 10) critical populations of roundtail chub. As a result, we need to conduct flow gap analyses in X regions and identify seven additional stream segments to improve flows to sustain these important roundtail populations.*" Steve Maler summarizes the data sources that can help establish flows and flow targets in this issue. They include: Colorado Natural Heritage Program for biodiversity data (http://www.cnhp.colostate.edu); U.S. Geological Survey (USGS) stream gage data for historic and current conditions (http://waterdata.usgs.gov/nwis/rt); Colorado's Decision Support Systems (CDSS; http://cdss.state.co.us/Pages/CDSSHome.aspx).

Quantifying Specific Recommendations/Actions for Habitat and Flow Conditions

Once goals have been established and flow needs identified, the last step in designing a successful SMP is to identify action steps and recommendations. As mentioned above, an explicit statement that highlights a key action might be: "*From the flow gap analysis results, X section of river needs environmental flows to maintain roundtail populations and will require reservoir reoperation to achieve this outcome.*" In order to generate these statements, there are a number of tools available to quantify and model flow needs across multiple scales to develop data-driven and science-based recommendations. Broader scale tools can be helpful in understanding baseline conditions and prioritizing implementation, but may not indicate what should be done in a particular location. Site-specific, local tools are needed for these purposes. Some of these broader scale tools include: (1) the Watershed Flow Evaluation Tool, which models and evaluates risk based on potential flow changes; (2) Colorado Wetlands Inventory, which provides comprehensive information on the extent and distribution of wetlands; and (3) StateMod (as part of CDSS), which is a monthly and daily surface water allocation and accounting model capable of simulating various historical and future water management policies. Local scale tools provide more explicit information and include: (1) Physical Habitat Simulation (PHABSIM), which predicts aquatic habitat changes associated with flow alterations; and (2) River 2D, which is a hydrodynamic model emphasizing fish habitat; and R2Cross, which models instream hydraulic parameters focusing on riffle habitat.

Using these steps to guide the SMP process provides an opportunity to establish a framework that is science-based, data-driven, actionable, and focused on water needs/flows for environmental and recreational outcomes. It should be noted, however, that SMPs may (and perhaps should) also include social and economic outcomes. While stakeholders can develop an SMP independently of watershed master plans, or even when planning for economic development, a more comprehensive approach would be to develop stream and watershed plans conjunctively.

Environmental Flow Methods and Planning Approaches

An Introduction to the Four Broad Classes of Flow Evaluation Tools and Summary of their Advantages

Claudia Browne, *Water Resource Specialist & Bioregion Team Leader, Biohabitats*

How much water does a river need to support a healthy ecosystem while meeting human water needs? When and where are streamflows needed, and of what quality? These are the questions at the heart of determining environmental flows, which SMPs are designed to help to address.

A Global and Local Challenge

Throughout the world, interest in providing water for ecosystems is gaining momentum. With intensifying water demands, diminishing supplies, and uncertainty about climate change, water resource managers are being driven to find innovative water solutions to support native ecosystems. In Australia, the "*National Principles for the Provision of Water for Ecosystems*" was introduced in the late 1990s to define water requirements for various ecosystems. Since then, numerous countries have established similar policies, including the European Union's "*Water Framework Directive*" to highlight the importance of integrating ecosystem function into water management.Some of the challenges of managing rivers for multiple objectives and user groups date back hundreds of years. In the early 1800s, the United Kingdom established a Compensation Flow Policy which was applied early on when mill users were impacting downstream users and later when pollution impacts were required to be mitigated by dilution. During the late 1940s, in the western United States, Environmental Flow Requirements (EFRs) began to be a part of management of dam projects and continued to evolve through the 1970s as the environmental movement and concern about freshwater fisheries grew.

Colorado's existing water management framework, much like the rest of the western United States, was not designed to take into account ecosystem needs and flow variability. The beneficial use tenet of state water rights means that water is allocated for human uses that are first in time. Rights are primarily defined in terms of agricultural, potable, and industrial uses. The prior appropriation doctrine further establishes that water is delivered to senior water right owners before being distributed to junior right owners. In the 1970s, the State's Instream Flow Program was established to provide a mechanism

Ecological needs often go beyond minimum fish flows and managers need to consider riparian forest ecosystems and the species that live in these habitats that are increasingly at risk.

for protecting aquatic habitat and preventing cessation of flow in some river reaches by protecting minimum flows. The application of the instream flow program is limited, however, and more holistic strategies are also needed such as those highlighted in the 2015 Colorado Water Plan (CWP). More recently, Colorado's Statewide Water Supply Initiative recommended protecting environmental flows and pursuing water management strategies that provide sufficient water for temperature needs and lifecycle cues for both aquatic and riparian species. Ecological needs often go beyond minimum fish flows and managers need to consider riparian forest ecosystems and the species that live in these habitats that are increasingly at risk (as highlighted in David Merritt's article). To successfully manage rivers, a range of hydrologic conditions must be considered. Ensuring water for riparian and wetland areas is particularly important in Colorado, because these areas cover less than 3% of the land area but provide critical habitats for 80% of wildlife species. In addition to habitat values, these wetlands and riparian areas offer other ecosystem services such as improved water quality and flood attenuation.

Flooded with Tools

Over 200 environmental flow management tools have been developed through the years in over 40 countries to address flow challenges. Some focus on only one type of output such as hydrologic or hydraulic results, while others look at habitat simulation, and still others are more holistic or blend combinations of methods. Some tools are used to set environmental flow requirements based on thresholds and some EFRs are more incremental or dynamic. Below are brief descriptions of general flow evaluation tool categories.

Thinking Outside the Channel
Flows for Riparian Habitat

Interview with David Merritt, Riparian Plant Ecologist, National Stream and Aquatic Ecology Center USDA Forest Service, & CSU Affiliate Faculty, Department of Forest & Rangeland Stewardship
Jessica Hardesty Norris, *Ecologist and Technical Writer, Biohabitats*

An SMP will be more robust if it looks beyond a single species and beyond the channel. The riparian habitat along river banks is created and maintained by hydrology, which means that these areas can flourish or wither in accordance with the stream management.

Flows that are defined only in relation to single fish species, will not capture the needs of the adjacent flood plain and riparian habitat, and could result in a piecemeal approach to stream management, according to David Merritt, a Riparian Plant Ecologist with the U.S. Forest Service and CSU Affiliate faculty member in the Department of Forest and Rangeland Stewardship. We ignore them at our peril. "Wetlands and riparian areas have a disproportionately important role in landscape function relative to the acres they occupy," Merritt adds.

Historically, we have approached modeling riparian vegetation as a function of hydrology and have used models that focus on aquatic species and occasionally one or two plants. The designated species might be selected to represent a larger group or because they are particularly popular, like cottonwoods. The specifications about how much water a species can tolerate and how often can be complicated, and it just is not feasible to create a single model that can handle all 300 species that may be found within a riparian forest.

Merritt and his colleagues, on the other hand, have developed groups or guilds of riparian species that have similar hydrologic adaptations, using a lumping technique that can transform the list of 300 species and convert it into nine functional guilds.

This idea of functional types is innovative in stream modeling, but it is hardly a novel concept. When Merritt's lab first got involved with helping managers support riparian habitat in the Grand Canyon, they presented their approach to a large stakeholder meeting. Merritt described to the public how their approach would separate the species from their taxonomic species names, and instead would look at their form and function and then group them according to their likenesses and similarities. "The representative from the Hopi tribe spoke up and said that the tribe supported that approach, and that their people for a very long time had looked at the world in a similar way, where, instead of genus and species, you look at how the plant acts and how it responds to its environment." So there is an "ancient and deep philosophy" that supports this broader way of looking at ecosystem interconnections.

1. Hydrologic Methods

- An index approach that provides simplified rules of thumb based on historic data for annual average stream flow (AAF). Most common is Tennant (Montana) Method from 1976 which established thresholds as % of annual flow for fish:
  - 10% of AAF = Minimum flow for short-term fish survival
  - 30% of AAF = Fair
  - 60%+ of AAF = Excellent to outstanding (optimum)
- Has been used by 25 countries
- Since 1990s, methods have expanded added flow variability, such as range of variability approach (RVA) based on 32 indicators of hydrologic alteration, and analysis of possible scenarios
- Can provide very preliminary estimates, but needs to be modified to account for monthly flows

2. Hydraulic Rating Methods

- Methods based on field observations at riffles (shallow sections)
- Wetted-perimeter method relates the river width to discharge. Produces environmental flow regimes that are based on "breakpoints" of habitat decline for fish and macroinvertebrates For example, a "Habitat retention" criteria may be based on maximum allowable percent change in wetted area
- R2CROSS, Colorado's standard method is used to establish requirements for instream flow rights looking at depth, percent of bankfull wetted perimeter, and average water velocity

3. Habitat Simulation Methods

- Similar to hydraulic methods but ties hydraulic properties to specific species
- IFIMs—Instream Flow Incremental Method
  - Includes US Fish and Wildlife Service PHABSIM physical habitat simulation
  - Usually specific to *single species*
  - Establishes suitable habitat cross-sectional velocities
  - Results in effective habitat over time
- Approx. 60 methods developed worldwide, but many only used a few times. Computer-aided simulation model for instream flow requirements (CASI-MIR) used in Europe
- Methods are widely used and advancing in complexity

4. Holistic Methods

- Refers broadly to methods ranging from prescriptive to conceptual that address ecosystem as a whole not just hydraulic parameters or biologic needs of single species
- Often utilize team of experts
- Building Block Method (BBM) most commonly used of holistic methods
- South Africa and Australia are most frequent users

Since the late 1990s, holistic flow assessments appear to have gained momentum. Indicators of Hydrological Alteration (IHA) was one of the first flow assessments that identified the collective importance of key components of flow variability: magnitude, timing, frequency, duration, and rate of change. Building on the IHA method, the natural flow regime, linked temporal flow components to ecological responses and introduced an important framework for describing riverine processes. In 2010, CSU professors LeRoy Poff, Brian Bledsoe, and David Merritt and other individuals built on their earlier work and proposed the Ecological Limits of Hydrologic Alteration (ELOHA) approach based on understanding the following: 1) the hydrologic framework; 2) the regional classification of the river system; 3) the degree of alteration; and 4) flow-ecology relationships.

Indicators of Hydrological Alteration (IHA) was one of the first flow assessments that identified the collective importance of key components of flow variability.

The recent developments in environmental flow tools all highlight the need to evaluate flow regimes based on a variety of ecological functions. Depending on the circumstances, these functions may include not only minimal baseflows to support aquatic species, but flows to moderate temperature, flood flows of inundation periods for native species recruitment and riparian vegetation distribution, effective discharge for sediment transport and channel maintenance, and surface water and groundwater interactions associated with alluvial storage.

Choosing which flow evaluation tool(s) to use for a SMP process will depend on the availability of existing data and questions that need to be answered in a specific stream system, which is why it is so important to shape the process and conversation around a results based process tailored to the local setting and stakeholders as described in Meg White's article and elsewhere in this newsletter issue.

Developing a Scientific Foundation to Assess and Improve a Community River

Case study from the Cache la Poudre River in Fort Collins, Colorado

Daniel W. Baker, *Civil & Environmental Engineering, Colorado State University*
Jennifer Shanahan, *Watershed Planner, Natural Areas Department, City of Fort Collins*

The Cache la Poudre River is a hard-working river. Not only does it provide much of the irrigation and drinking water for the northern portion of the Colorado Front Range, but it also serves as a beloved ecological, aesthetic, and recreational asset to the communities it flows through. When the 2010 update to the Fort Collins City Plan (http://www.fcgov.com/planfortcollins/pdf/pfc-summary.pdf) adopted the goal of managing a healthy and resilient Poudre River, city staff asked themselves a series of reflective questions:

- What is a healthy and resilient river?
- Is the Poudre River currently healthy and resilient?
- If not, what can be done to make the Poudre River move the Poudre toward this goal?

These questions also catalyzed a series of applied research projects to provide the data and tools to better understand, communicate and plan for the future of the Poudre River.

Need For Assessment and Decision-Making Tools

Sometimes the hardest part of solving a problem is deciding on the first step. While a mottled history of data existed for various aspects of the river's condition, the data components had never before been pulled together into a single conceptual framework. Thus, in 2011, the conceptual backbone of the Poudre River Ecological Response Model (ERM; http://www.fcgov.com/naturalareas/eco-response.php) was created using existing data and scientific knowledge of ecological functions of the river. The ERM was a collaboration between scientists from the city of Fort Collins, Colorado State University, the U.S. Forest Service (USFS), The Nature Conservancy, and the U.S. Geological Survey (USGS). Early in the process it became clear that the best model structure would need to allow the team to incorporate both quantitative and qualitative information. This was necessary because comparable data were not available for each topic (for example flow data are abundant and temperature data scarce).

The group adopted a probabilistic modeling framework that integrates many different subjects into a common unit. Next, all of the available hydrologic, geomorphic, water quality, biotic, and riparian data were evaluated and incorporated into the model. Finally, a spectrum of past, present, and future flow scenarios was created and run through the model to determine the effects of each flow scenario on the condition of key indicators of river health. As a scientific tool to holistically evaluate likely trends in *future* river condition, the ERM model worked well, though the knowledge gained from this modeling process was not specific enough to be directly applicable to boots-on-the-ground projects that require an immediate understanding of *current* conditions, both locally and at the landscape scale.

Flooding in the riparian area along the Cache la Poudre River in Fort Collins, Colorado. Photo courtesy of the City of Fort Collins.

Build an Assessment Framework and Form City Goals

The next big step in the process was to apply the knowledge gained from the ERM into an ecological assessment and communication tool. Thus, in 2014 the city of Fort Collins launched the River Health Assessment Framework (RHAF; http://www.fcgov.com/naturalareas/riverhealth.php). This project served three goals:

1. create a scientifically based framework to be able to assess current and monitor future ecological function;
2. identify thresholds and recommended ranges for ecological indicators to more clearly define the City's aspirations for river health; and
3. provide a scientifically based yet readily understandable communication tool.

Meeting these goals would in turn help guide and inform the City's river related initiatives. The RHAF was organized around ten indicators that represent the essential physical, chemical, and biological elements of the river and the method uses a standard A to F grading scale. Also, as with the ERM, the RHAF team sought to communicate the functioning condition of the interrelated and interdependent parts of the ecosystem. This integration within a single project differs from the more traditional approach of studying and managing rivers in fragments and unnatural political jurisdictions. Therefore the team selected a methodology that allows for the use of existing technical information and also provides the opportunity to fill data gaps using a rapid-assessment style evaluation.

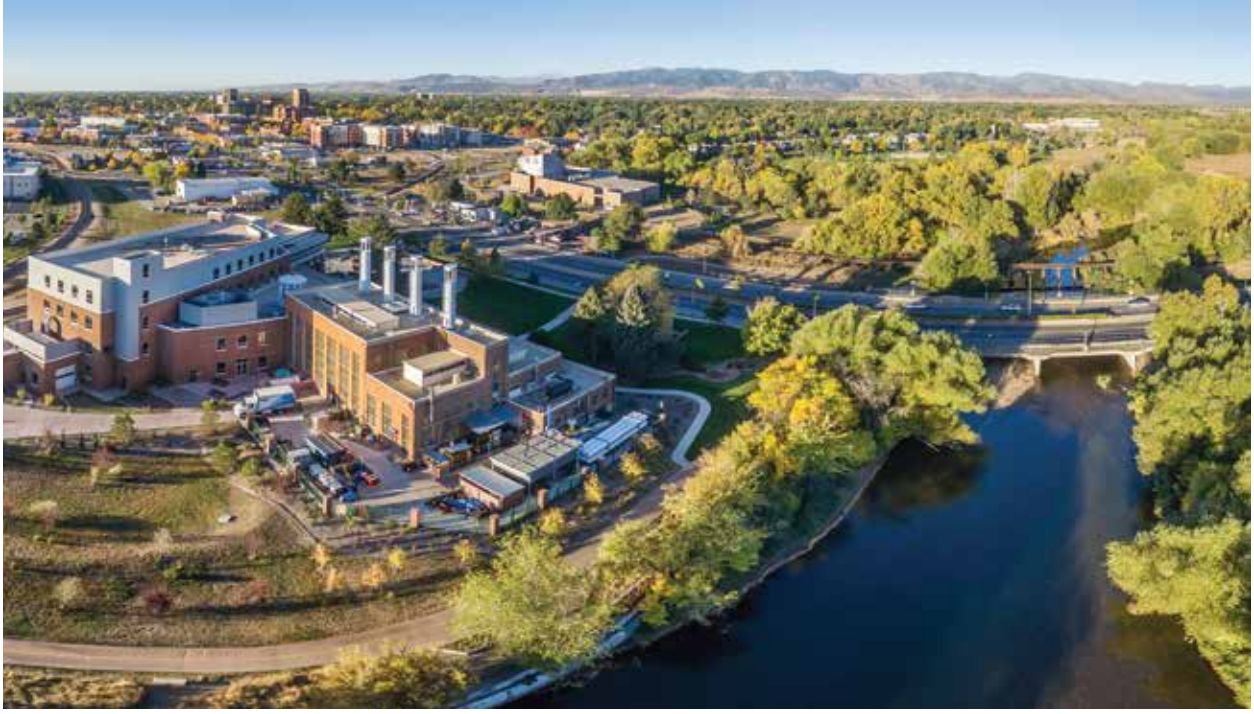
Assess and Report River Condition

With the River Health Assessment Framework serving as the scaffolding, in 2016 the city of Fort Collins is now in the process of conducting its first comprehensive ecological assessment (for defined reaches of the Poudre). The outcome of this effort will be presented in the City's inaugural State of the Poudre River report in early 2017. This project will assess current conditions of the river as a baseline for future change and supports decision making. As well, the summary will be in the form of a "River Report Card", which will serve as a tool for informed engagement by non-technical audiences such as city leaders and the Fort Collins community. By fostering this involvement and in turn considering the broader perspectives brought by diverse stakeholders, discussions and project prioritization of Poudre River management efforts will have greater chances of success, buy-in, and fiscal sustainability.

The RHAF was organized around ten indicators that represent the essential physical, chemical, and biological elements of the river and the method uses a standard A to F grading scale.

Find Operable Solutions to Meet City Goals

The final step in the process is to find boots-on-the-ground solutions to meet the City's goals. Currently, the city of Fort Collins is working with various interdisciplinary and interagency teams to continue to understand and improve the valued Cache la Poudre River. Projects range from fish passage to recreational improvements to studies that are diving deeper into the



The City of Fort Collins, Colorado is working with various interdisciplinary and interagency teams to continue to understand and improve the valued Cache la Poudre River. © iStock.com

complex hydrology and exploring innovative solutions to meet flow-related river health goals. Solutions are often multi-pronged, as reinforced by lessons learned in a riparian restoration project in the McMurry Natural Area, where an extensive new generation of native cottonwoods has recently established due to the combined effects of the physical lowering of a the floodplain with a well-timed moderate natural flood event. Hence, solutions are often complex, but no more complex than the lengthy and layered history that has caused the degradation of Front Range Rivers.

Lessons Learned

This process of going from data to modeling to problem solving has created a highly valuable ongoing dialog. The key lessons learned include:

» A community cannot wait for all possible data to become available before rivers ecosystems can be modeled, assessed and planned: hence build a flexible model framework which can adapt to new information.

» Methods should be able to incorporate technical data *and* utilize local knowledge or rapid style evaluation to produce a holistic ecological assessment that is achievable within reasonable cost and time.

» A model without buy-in from stakeholders won't get the job done, in the case of the Poudre it was necessary to have a multiple steps after the initial model development to build buy-in, produce an applicable product and determine feasible solutions.

» Solutions are often as complex (or more so) than the causes of degradation.

Maps from Models

One trick to bringing people together around shared science is building confidence in the modeling process itself. "Skepticism about modeling just comes from people not understanding it and thinking that itis hocus pocus. Seeing an equation or p-values, that can be intimidating," says David Merritt, who models riparian vegetation for the United States Forest Service (USFS). He has found that mapping helps create consensus.

"One of the most important things we've been doing is working with spatial models that show the results on a map. You can see where this types of vegetation is today, and then show different scenarios of where the forest would be under proposed conditions." He finds that the best way to overcome any skepticism about the models is to show how well they do at predicting what is there now. His models of riparian vegetation by functional type can show what is bare, what mature forest is, and where scrub shrub dominate. Once stakeholders see how accurate the model is in mapping the current landscape, they are willing to put more faith in the predictive models.

Science-Based Strategies

The Critical Role Quantitative Methods and Simulations Play in Successful Integrated Management Planning

Lessons from the Crystal River Management Plan on a Framework for Using Quantitative Methods and Simulations to Build Consensus

Seth Mason, *Lotic Hydrological*
Bill Hoblitzell, *Lotic Hydrological*

Selecting the most appropriate stream management alternative is often a fraught process, because it is often difficult to reach consensus about existing conditions or predict the impact of management actions. In the face of this uncertainty, flexible tools that can quantify management targets and evaluate benefits of different alternatives can meet the needs of stakeholders and practitioners alike. This article shares the approach we developed for the Crystal River Management Planning process.

For example, robust cost-benefit analyses and consensus-building exercises must consider the inherent economic, social, environmental, and recreational pros and cons of the various management approaches available. These activities require strong quantitative foundations to ensure the credibility and viability of the resulting policy or management decisions.

To understand how management choices affect the ecological function of aquatic resources, practitioners can use science-based tools to connect the dots between cause and effect. Scalable, integrated, quantitative methods and simulation modeling approaches are commonplace in traditional water resource management decision-making processes. These approaches are likely to see increasing use in integrated SMPs within Colorado due to the complex nature of the problems these planning efforts consider. For example, complications frequently arise when characterizations of aquatic resource health—amidst the many positive and negative feedbacks that exist between patterns of land and water use, geomorphological processes, riparian corridor health, and aquatic habitat—rely solely on expert opinion. Such qualitative evaluations, while important in their own right, do not lend themselves well development of benchmarks to reference future planning successes or failures against. In a similar manner, considering the impacts of agricultural efficiency improvements on groundwater recharge and late season return flows, or attempting to predict the aquatic or riparian habitat benefits associated with several possible channel designs, must be based on a rigorous assessment of predicted mechanistic or ecological changes to the system. Using a three-tiered hierarchical framework to analyze the spatial and temporal effects of river management provides a useful paradigm for integrated resource planning and construction of quantitative investigations:

- Assess 1st—order effects: Management changes to the hydrologic regime control the magnitude, frequency, and duration of various ecologically relevant flow indicators.
- Assess 2nd—order effects: The interplay between hydrology, channel structure, and flow regime impacts channel hydraulics and water quality characteristics.
- Assess 3rd—order effects: Channel hydraulics and water quality intersect with the processes and conditions most relevant to recreational uses, channel dynamics, aquatic habitat and/or riparian biota.

The selection of specific quantitative or modeling approaches for evaluating each tier will likely be informed by the specifics of local management issues, stakeholder

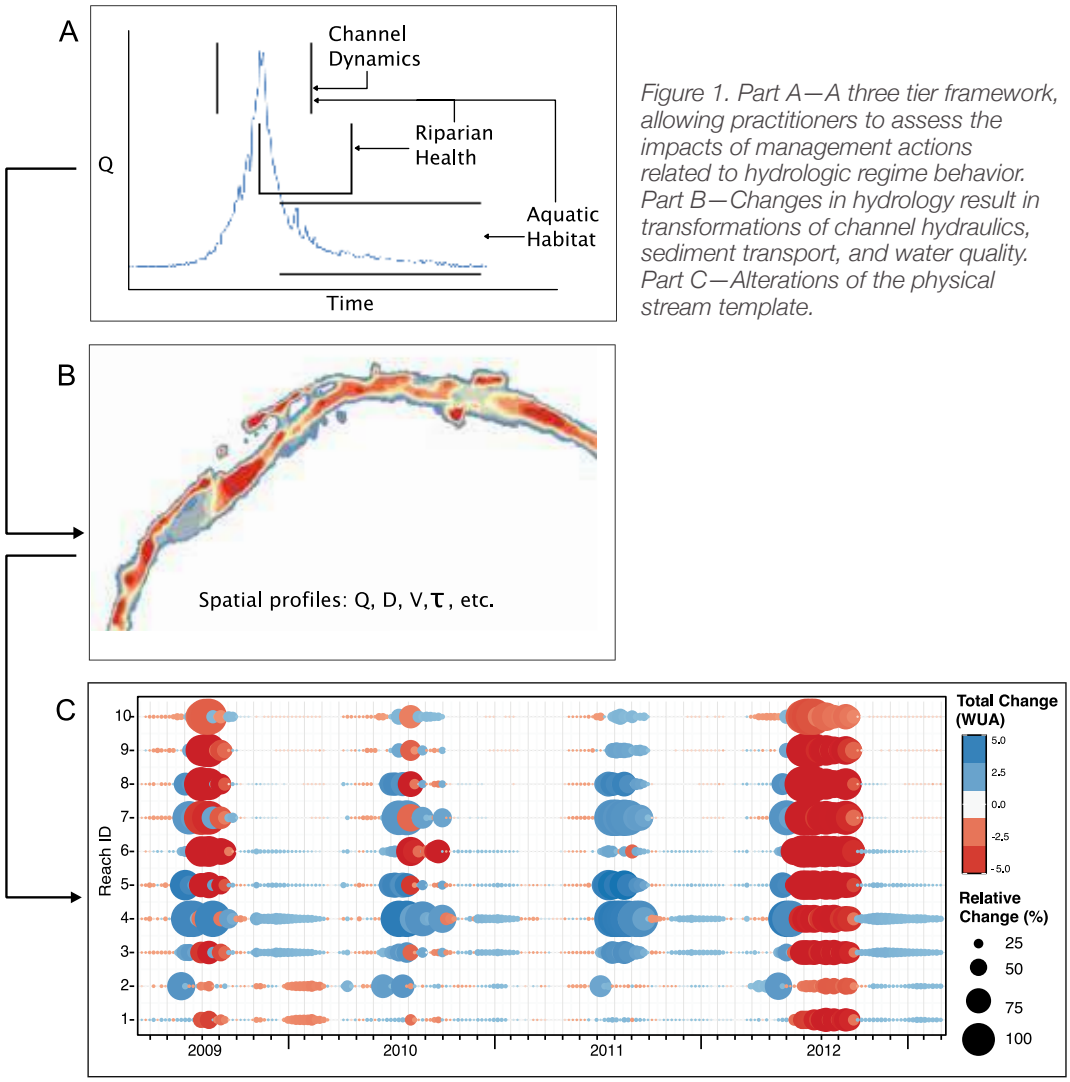


Figure 1. Part A—A three tier framework, allowing practitioners to assess the impacts of management actions related to hydrologic regime behavior. Part B—Changes in hydrology result in transformations of channel hydraulics, sediment transport, and water quality. Part C—Alterations of the physical stream template.

acceptance/consensus, budget, and the geographic and jurisdictional scale or scope of a given planning exercise. Practitioners may apply a wide array of available scientific methods and software models to help understand impacts to non-consumptive use needs from changing water management, infrastructure efficiency, or channel structure (Table 1). Implementing the framework in its entirety may produce a collection of loosely coupled simulation and statistical models to 1) predict and simulate rainfall-runoff processes contributing streamflow to the segments of interest; 2) allocate and account for 'paper' and 'real' water along the segment according to Colorado Water Law; 3) estimate spatially distributed channel hydraulics or water quality conditions corresponding to a range of hydrological conditions, water conservation scenarios, or physical channel modifications; and 4) quantify ecological responses or perceived recreational quality to changing streamflow, water quality, or streambed topography on adjoining reaches of the river. Depending on the individual needs of a basin or community, a partial implementation of the framework may be a viable alternative. Integrated SMP efforts that utilize the framework will be adept at: (1) describing how water rights administration affects stream flows at the reach level; (2) clarifying how flow changes influence physical channel structure and processes; (3) quantitatively linking hydrologic and hydraulic changes to ecological and recreational attributes of interest; and (4) successfully communicating results to decision makers and stakeholders in a fashion that allows for values-based planning and negotiation.

When executed well, integrated management plans should provide the documentation and decision support tools necessary for negotiating and implementing management decisions that reflect local needs and values. They can serve as master plans for how to manage water in times of scarcity, blueprints for restoring or rehabilitating a degraded river system, or pre-emptive protection for a basin likely to face increasing pressures from population growth, climate change, or shifting social values. The final form of any planning exercise will necessarily reflect the individual needs and concerns of the community and river system that produces it. However, those plans founded on strong scientific and quantitative methodologies are likely to enjoy a broader base, reduce the opacity of planning outcomes and recommendations, and improve repeatability and transferability of the adopted approach.

Fish Passage on the Front Range

Research and Application of Fishways to Improve Habitat Connectivity for Fish

Tyler Swarr, *Master's Candidate, CSU Fish Physiological Ecology Laboratory, Department of Fish, Wildlife, and Conservation Biology, Colorado State University*
Christopher Myrick, *Professor and Director, CSU Fish Physiological Ecology Laboratory, Department of Fish, Wildlife, and Conservation Biology, Colorado State University*

The Orangespotted Sunfish (Lepomis humilis) is a native Great Plains fish species. Adults do not grow much larger than 4 in, but display brilliant colors when they are ready to spawn. They are closely related to Bluegill and Pumpkinseed, both of which are not native to Colorado. Photo by Jonathan Wardell.

Along Colorado's Front Range, our ability to control and manage our waterways has led to greater flood control, improved irrigation, and improved delivery of domestic water, but the physical changes pose significant and in some cases insurmountable challenges for some species of fish. Therefore, supporting and restoring fish passage is often a habitat goal for SMPs.

Irrigation diversions and grade control structures often incorporate vertical drops that can block the upstream and sometimes the downstream movement of our native fishes. Fish biologists have long recognized that the marquee anadromous species like Atlantic and Pacific Salmon need to be able to migrate up rivers to reach their spawning grounds, but only more recently have we come to understand that the need to move freely up and down a stream or river is shared by most stream and river dwelling fishes.

Because of their smaller size and lack of sport or commercial uses, the habitat needed to accommodate movements by of many of our native stream and river fishes is often underestimated. Even at adult sizes of nine inches or less, they can travel incredible distances in a short period of time. Research conducted at CSU on the swimming abilities of Great Plains fishes shows that some of these species will travel over 30 miles in three days without stopping. Our native fishes migrate using the longitudinal connectivity of streams to reach spawning grounds, to avoid severe environmental conditions (e.g., drought or extremely high flows), or to reach ideal rearing habitats where food is plentiful and potential predators are not. Unfortunately, the structures that allow us to divert or store water, reduce erosion, and prevent flooding in our urban areas can disrupt this connectivity. An estimated 82% of Great Plains fish species are in decline due to reduced stream connectivity and habitat alteration.

Removing the barriers and other instream structures that reduce stream connectivity would benefit the native fish communities of the Front Range, but it is not always feasible because of the economic and societal functions of active structures. However, such structures can be made more "fish-friendly" by installing fish passage devices (fish ladders), which restore connectivity while retaining the hydrologic function of the structure. A large body of research has been completed on the development and design of fish passage structures in the Pacific Northwest, but these designs are generally optimized for large, strong swimming, or jumping species like salmon and steelhead.

The CSU Fish Physiological Ecology Laboratory (FPEL) has shown that the small fish species native to the Front Range are very good swimmers, relative to their size, but they are at best mediocre jumpers, which is not surprising given that they did not evolve in stream systems where vertical obstacles were common. The FPEL applies

The CSU FPEL experimental rock ramp fishway, which was built to better understand the needs of small-bodied fishes as they attempt to traverse fish passage structures. The CSU FPEL plans to use the results of the experimental fishway in future recommendations to improve other field designs. Photo by Tyler Swarr.

that research in collaboration with Colorado Parks and Wildlife to tailor fishway designs to our small fishes with good swimming ability.

Rock ramp (or natural) fishways consist of a sloped portion of channel that has rocks scattered throughout to provide refuge for the fish as they ascend the fishway. To better understand the needs of fish in terms of slope and cover as they traverse the fishway, the FPEL designed and constructed a full-scale indoor experimental rock ramp fishway with funding from the federal Great Plains Landscape Conservation Cooperative. A fishway that is passable by the slowest members of the fish community (e.g. small, bottom-dwelling fish like darters that are not very strong swimmers), stands a good chance of providing passage of most other fish species over the barrier.

The ultimate goal of the FPEL's work on fish passage, including the new experimental fishway, is to provide information that can improve practical applications, so the CSU researchers have worked in concert with Colorado Parks and Wildlife researchers and biologists, and with private and public stakeholders on the development and design of rock ramp fishways across the Front Range. The newest was recently installed on the Fossil Creek Diversion on the Cache la Poudre River in Fort Collins, Colorado. In the near future, the applied research on rock ramp fishways will also include determining the optimal slope for fish passage, adding bends to fishways, evaluation of recently installed fishways, and optimizing the geometry and spacing of the rocks.

Over coming years, we expect to see fishways integrated into more of Colorado's diversion structures, restoring the stream connectivity that will allow our streams to continue to harbor a colorful and thriving community of tough plains fishes.

Spotlight on CSU Team and Large Wood Management in Streams

Many CSU professors and students are working in multiple departments, studying biological, physical, and engineering aspects of river management. One notable effort was just published in the April 2016 issue of the Journal of the American Water Resources Association (JAWRA). The paper highlighted the collaborative efforts of Professors Ellen Wohl (Geosciences), Brian Bledsoe and Michael Gooseff (Civil and Environmental Engineering), Kurt Fausch and Senior Research Scientist Kevin Bestgen (Department of Fish, Wildlife, and Conservation), and PhD Candidate Natalie Kramer (Geosciences), developing a framework for assessing the hazards and benefits of large wood in streams. The CSU team proposed a decision-making approach for large wood management using a series of stepwise tools. The process includes: an initial assessment checklist to evaluate threats to public safety, recreational users, property and infrastructure, private structures, and legal issues, followed by use of additional more refined tools as warranted. Given the significant benefits to aquatic habitat as well as influences on flows and storage in the alluvium, retention, and addition of large wood can be an important stream management strategy. Though the framework is still under development, stream management plans (SMPs) may benefit from considering the range of issues offered by the CSU team and perhaps the development of a large wood program in could be included in recommended actions for some SMPs.

The Future of Water Markets

Opportunities for Innovation in the SMP Process

A Review of Current Water Markets and Water Sharing Strategies and a Description of the Potential of SMPs to Further Such Innovations

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MaryLou Smith, *Policy and Collaboration Specialist, Colorado Water Institute*

As is always the case with matters concerning water, scarcity dictates the need for collaboration and innovation. That being said, conflicting interests can be caught in seemingly constant opposition that gridlocks common sense approaches to complex problems. But finding our way out of such gridlock is possible. Any SMP will benefit environmental and recreational water use, but their comprehensive and stakeholder driven approach offers greater potential. The SMP process has the potential to serve as a proving ground for innovative approaches to water sharing and water market development.

Water Markets in Context

The purpose of SMPs as explained in the Water Plan is to protect or increase stream flows for environmental and recreational water uses on a watershed scale. But finding more water in already resource strapped watersheds is easier said than done.

Increasing efficiency among large water users can, in certain circumstances, reduce diversions from streams, while stream bed and riparian improvements can make the most of water that is already there. Both of these options should be implemented where appropriate. The conversation, however, would be incomplete without considering water sharing mechanisms that allow temporary transfers from high yield, senior water rights—namely agriculture—to environmental and recreational uses.

The divisive reality is that water-sharing mechanisms are un-proven and often require farmers to take on disproportionate risk. Opponents in the agricultural sector have grounded fears: the threat of "buy and dry" and the loss of sustainable agricultural communities, unintended impacts on water rights ownership in light of the prior-appropriation doctrine, and re-timing or loss of return flows relied upon by downstream irrigators. Put simply, an agricultural operation cannot afford to jeopardize its most valuable asset.

The purpose of SMPs as explained in the Water Plan is to protect or increase stream flows for environmental and recreational water uses on a watershed scale. But finding more water in already resource strapped watersheds is easier said than done.

In an effort to mitigate this potentially challenging impasse, organizations like the Colorado Water Trust, Trout Unlimited, and the Colorado Water Conservation Board have partnered to implement market-based allocation programs that protect and preserve water rights in agriculture, while allowing arm's length market-based transactions between recreational/ environmental groups and agriculture. The SMP process may have the necessary components to transform the methods used in these independent projects into integrated, watershed-wide markets that efficiently direct water towards its highest and best use.

Non-diversion agreements provide compensation to agricultural or other types of water users who reduce their water diversions. © iStock.com

Existing Water Sharing Methods

Current mechanisms are available that provide partial solutions to this supply and demand challenge. All of these mechanisms promote the idea of redirecting the water supply through market based transactions that will not permanently dry up existing farmland or negatively impact agricultural water rights.

» *Temporary CWCB ISF leases*: The Colorado Water Conservation Board (CWCB) is working in conjunction with the Colorado Water Trust to enter into short-terms loans and leases of direct flow or stored water rights for use in Colorado's Instream Flow Program. These contracts can transfer full or partial rights with the approval of the State Engineer's Office, and have historically provided ecosystem functionality benefits as they shepherd leased water through instream flow reaches, particularly in dry years.

» *Non-diversion agreements*: These agreements provide compensation to agricultural or other types of water users who reduce their water diversions. The agreements require no regulatory approval, but they do not provide a mechanism to shepherd water past downstream junior diversions, making them less effective in some scenarios.

» *Permanent split season irrigation*: In efforts like the Colorado Water Trust's (CWT) McKinley Ditch project, Water Court-approved split-season irrigation will enable sharing between agriculture and environmental use. An irrigation water right can be changed, in coordination with the Colorado Water Conservation Board, to benefit instream flows, allowing typical agricultural practices during early summer but then protecting water in the river at the end of the summer when stream flows drop. Admittedly, these types of projects are complex to facilitate, but they provide a permanent solution to inadequate stream flows.

The Colorado Water Conservation Board (CWCB) is working in conjunction with the Colorado Water Trust to enter into short-terms loans and leases of direct flow or stored water rights for use in Colorado's Instream Flow Program.

» *Colorado Agriculture Water Protection Act (CAWPA)*: As an alternative to historic "buy and dry" practices, this bill was signed into law earlier this year and is still in the early stages of implementation. CAWPA allows the owner of an irrigation water right to change the right through Water Court to allow leasing for other beneficial uses, without the need to first identify a lessee. Farmers and ranchers can keep and use their land and water, and with the approval of the State Engineer, lease their water when market conditions are favorable.

All of these tools can provide wet water for recreational and environmental uses, and they have a shared benefit: they put money in the water users' pockets, compensating them for any water they might furnish.

The purpose of SMPs as explained in the Colorado Water Plan is to protect and/or increase stream flows for environmental and recreational water uses on a watershed scale. © iStock.com

A successful water market must include willing sellers, willing buyers, and the ability to efficiently deliver water on demand from those sellers to the buyers.

While the benefits are numerous, these tools also have shortcomings and face formidable hurdles. Transaction costs vary between relatively simple non-diversion agreements to complex and costly water right change cases in water court. Organizations like the Water Trust do try to defray these costs for water users participating in their projects. The agricultural community also remains skeptical about the feasibility of leasing given the costs of fallowing land, the need for long term planning and forecasting, and the lack of necessary infrastructure to convey and store water to meet market demands.

The Future of Water Markets

Real potential exists through the SMP process to produce viable water markets, leveraging the existing water sharing tools into functional and efficient systems that satisfy all parties.

A successful water market must include willing sellers, willing buyers, and the ability to efficiently deliver water on demand from those sellers to the buyers. Stakeholder engagement in the SMP process already brings the market participants together, creating opportunities for streamlined discussions and negotiations between sellers and buyers. Basin-wide analysis necessary for these projects could reveal opportunities to utilize existing infrastructure that allows a market to function efficiently through water banking or other storage based systems. This comprehensive process may also uncover the best opportunities for leasing – opportunities that justify transaction costs based on their impact. And, where multiple parties participate and benefit, the costs of implementation can be shared and scaled to larger projects with bigger and more lasting impacts.

Moreover, the potential for functioning water markets may attract new sources of funding. Some impact investors want to solve big water problems and see the development of water markets as a sustainable solution. Instead of the old model of continuously throwing money at an unsolved problem through grants, they are instead seeking to deploy capital into projects with an expectation of a social and financial return. An active market may create predictable and sustainable revenue that attracts this kind of investment.

Innovation and flexibility offer the greatest hope for the development of viable water markets, values that intersect with the SMP process. While water is scarce, it can stretch further if all parties are willing to contribute their abundance of experience and ideas in collaboration for a universal solution.

Building Consensus

Grand County's Stream Management Planning Process — A Case Study

A Retrospective Analysis of Grand County's SMP Experience: Lurline Underbrink Curran

***Jessica Hardesty Norris**, Ecologist and Technical Writer, Biohabitats*

Stream planning in Grand County, Colorado began earlier than most other watersheds, putting it on the forefront of SMPs within the state. Grand County is the most impacted county in the state when it comes to trans-mountain diversions, and their planning process was spurred by specific drivers in regional water planning. In the early 2000s, Denver Water and the Northern Colorado Water Conservancy Municipal Subdistrict initiated "firming" projects, designed to firm up the yield from existing water rights in the Upper Colorado River. As they developed the concepts, Denver Water and Northern Colorado Water Conservancy Municipal Subdistrict came to Grand County to ask what mitigation projects the county would propose. "When you get asked what you want, you have to be sure that your wants are the same as your needs," says Lurline Curran, who was the Grand County Manager throughout their planning process through 2015 and still works with the county on water issues. In those early days, there was consensus over neither.

One of the fundamental questions was identifying the desired level of flow for each reach. The interested parties had a wide range of definitions for optimal, and there was little agreement on the underlying science, either. The county decided to invest in putting a foundation of shared information and goals in place. They decided to hire a consultant to assess the entire system of reaches and propose a set of indicators to establish a common definition of stream health. Funded entirely by the County, Tetra Tech undertook a million dollar, year-long process to complete Phase I and offer a definition of stream health for all parties to share.

"Fish were the indicator that everyone could get behind," says Curran. They could all agree that managing for Rainbow or Brown Trout would encompass multiple considerations into a holistic view of the system. The fish relied on specific parameters of flow, sediment transport, temperature, aquatic invertebrates among others. Furthermore, the needs changed throughout the year and as you move downstream.

The Phase 1 planning project was not small. They started by examining the full extent of the Frazier and the Colorado Rivers from the Fraser headwaters to its confluence with the Colorado downstream to where the river exits the county. Each reach underwent a complete analysis, and then the reaches were divided into categories according to basic stream health factors such as riparian cover, geomorphology, and flows.

The resulting SMP was the foundation for the Colorado River Cooperative Agreement (CRCA) negotiation with Denver Water and the Windy Gap IGA with the Municipal Subdistrict of the Northern Colorado Water Conservancy District. Mid-negotiation, before a signed agreement was even in place, the County worked with CDOT and Denver Water to address one pressing issue. The County placed a detention pond high in the watershed, at the diversion, with CDOT removing the sand every year. About 650 tons of sediment have been taken every year for the last three years, and the downstream evidence of success is measureable. "Today, the spring flows are able to move the sediment downstream," says Curran, which directly improves stream health.

The stream management plan gave the County a basis for discussing the enhancements in the CRCA and Windy Gap IGA. It also gave information to discuss proposed mitigation with the lead agency for each project.

Overall, the experience of stream planning in Grand

In the Grand County experience, continuity has been key, and in large part a result of the Learning by Doing model of the CWCA.

Country was exceptional in its large scale, early timing, and the financial support for the work. However, some of the lessons learned are applicable to every SMP, no matter the scale.

The Power of Science

"Once you get agreement over the science, with parties representing different interests, you take the argument over data out of it," says Curran. Establishing a common set of facts and the authority on interpreting them was crucial to the eventual success of the process.

Curran is quick to point out that agreement over the science is not agreement over everything. However, subsequent arguments become grounded in data, and the standards for supporting claims are more rigorous and clear.

A Foundation of Trust

One key point was that the SMP contractors be allowed to work independently in the data collection phase, uninfluenced by the political, financial, or other interests of the County or, conversely, of the utility companies. Grand County began by finding contractors that had not worked for Denver Water or Northern Colorado Water Conservancy District in the past.

Then, throughout the Phase I data collection, the county set a moratorium on technical communication between the consultants and the County or utilities until the report was released. This avoided any future suspicion or complaints about the data collection and prioritization process. There are, after all, value judgments inherent in even the earliest stages of the planning process. But in the case of Grand County, the consultants alone were responsible for explaining and justifying such decisions. Although the County's experience was special in having such large and interested parties watching the process closely, this is a lesson that can be applied even to the planning of a single reach. Bringing people together in the appropriately neutral settings with a set of information that everyone can agree on is key.

The Force of Habit

One common challenge in stream planning processes is the variability in political will as elected officials come and go. When budget balances and political leaders shift, entire planning efforts can sometimes be scrapped or put on a shelf until they are too dated to guide decisions. In the Grand County experience, continuity has been key, and in large part a result of the Learning by Doing model of the CWCA. Curran emphasizes that it has to become habit for implementing organizations to participate on a regular basis.

The Timelines of Progress

Finally, Grand County's successes did not develop overnight, nor are they an accomplishment of the past. The planning and stewardship are continual processes.

The process, though, has changed views on all sides. "What we would have said we needed would not have been correct," says Curran, because no one could look at the whole system collectively. We were able to look at the health of the whole system and planning a phased implementation of projects moving downriver. Previously, the County had had the experience of fixing something in one reach and seen that the project had negative effects upstream.

One of the biggest surprises was simply how valuable this tool was, and how it has shaped not only the CRCA and the Windy gap IGA, but also influenced the approach of the Basin Roundtable. Colorado's Water for the 21st Century Act (House Bill 05-1177), established the Round Tables as place for Coloradans to come together to discuss and move forward on meeting multiple water needs. SMPs can offer important contributions to the dialogue.

The confluence of the Fraser and the Colorado rivers near Granby, Colorado. Photo by Jeffrey Beall.

Reach Description			Restoration Opportunities										
River	Section description	Ranking	Applyenhancement flowstolowflows	Applyenhancements toflushingflows	In-streamhabitat features	Channel bank revegetation	Channel restoration	Enhancefishpassage	Irrigationdiversionand pumpintakes	OverbankBMPs	SedimentBasin	RampingGuidelines	Notes
Colorado River	Windy Gap to Williams Fork	-6	√	√	√		√	√	√				Highly impacted reach; recommendations include both enhancements and physical restoration
Fraser River	DW Diversion to WPWSD intake	-3	√	√						√	√		Flow enhancements, sediment basin, passage of spawning gravels and Moffat tunnel discharge treatment are recommended
Colorado River	Granby Reservoir to Windy Gap	-3	√	√	√				√	√		√	Previous and ongoing restoration is extensive. Additional study is recommended. Flow enhancements for CR4 will improve CR3
Fraser River Trib	Ranch Creek ds of gage to confluence	-2	√	√	√	√	√						F-RC2 benefits from flow enhancements recommended for F- RC1
Fraser River Trib	Ranch Creek to ds of gage	-2	√	√									Investigate culvert capacities downstream to accommo-date increased flushing flows
Fraser River	WPWSD intake to Town of WP	-2								√			Recommendations in F2 will provide benefits in F3
Muddy Creek	Wolford to Colorado River	-2	√	√			√	√		√		√	Allow stream to stabilize before developing restoration recommendations
Fraser River	Town of WP to Town of Fraser	-2			√					√			Recommendations in F2 will provide benefits in F4
Colorado River	North Fork to Shadow Mountain	-1											Additional study required in conjunction with Red Top diversion changes
Colorado River	KB Ditch to Blue River Confluence	0			√				√				Recommend additional study to address grade control structures
Colorado River	W illiams Fork to KB Ditch	0			√				√				CR5 benefits from flow enhancements in CR4
Fraser River	Fraser CWWTP to Ranch Creek	0				√	√			√			Partner on existing projects
Fraser River	Ranch Creek to mouth of Canyon	0			√	√							Consider public access and trail enhancements
Fraser River	Canyon	0											Consider public access
Fraser River	Canyon to Granby	1					√						Partner on existing projects
Blue River	Green Mountain to Colorado River	1				√						√	Develop ramping and flow management strategies to support spawning
Colorado River	Blue River to County line	1											Maintain target flows and support recommendations from W ild and Scenic alternative
Fraser River	Town of Fraser to Fraser CWWTP	2								√			
Fraser River	Granby to Colorado River at Windy Gap	2						√					
Fraser River Trib	St. Louis Creek	4					√						Support efforts to restore native cut throat populations
Fraser River	US 40 to DW Diversion	5								√			
W illiams Fork	Below reservoir to Colorado River	7										√	Monitor for and address low DO levels
Fraser River Trib	Vasquez Creek	*						√					
Fraser River	Jim Creek	*											No recommendations made at this time
Willow Creek	Reservoir to Colorado River	*											No recommendations made at this time
Muddy Creek	Inflow to Wolford	*											No recommendations made at this time
Fraser River	Tenmile Creek	*											No recommendations made at this time
Colorado River	Shadow Mountain to Granby Reservoir	*											No recommendations made at this time
Colorado Trib	Hwy 40 to confluence	*											No recommendations made at this time
Colorado Trib	Cty Rd 33 to confluence	*											No recommendations made at this time

Grand County Stream Management Plan Summary of Restoration Opportunities, August 2010.

Laying the Groundwork for Stream Management Planning and Implementation

Interview with Nicole Silk Executive Director of River Network
Jessica Hardesty Norris, *Ecologist and Technical Writer, Biohabitats*

Colorado's Water Plan promotes watershed health and supports the development of watershed coalitions that address the needs of a diverse set of local stakeholders (Chapter 7, Colorado Water Plan (2015). Watershed coalitions who can unify diverse interests, establish priorities for improving river health (e.g., through the creation of a stream management plan (SMP)), and implement projects that contribute to river health can play an important role in Colorado's water future. Whether local watershed coalitions have a lead role or a supporting role in SMPs, the SMP process is an exceptional opportunity to become engaged in efforts to restore and protect water essential to healthy rivers and the future of Colorado.

Institutional Capacity

SMPs will be important to the future of Colorado's river for many reasons. Among them, the SMP process has the power to enlarge the pipeline of groups who are ready and able to plan and implement solutions for river health. Ideally, leadership of the SMP requires mature organizations with longevity, dedicated full-time staff, annual work plans, independent audits, and an outside Board of Directors or similar governance. The leading organization also must be able to have the trust of the community and be respected as an honest broker of the conversations. Organizations that do not meet these criteria can also have important role in SMPs as contributors and collaborators. The opportunity to lead a SMP opportunity may also serve as an incentive for some groups to invest in themselves and in the professionalization of their efforts.

Community Partners

At the heart of the team building needed for SMPs is the ability to look both upstream and downstream. Often local watershed organizations and coalitions emerge due to a particular concern on one stretch of a river. The reality is that rivers are always on the move, connecting headwaters springs and snowmelt, and rain to farms and cities, fish and fisherman, energy production, and industry as they head downstream on their gravity-fed journey toward the sea. Any stretch of river exists within a networked system of tributaries, ponds, wetlands, precipitation patterns, and patterns of water extraction and return that fuel a wide range of livelihoods and economic activity. And this stretch is connected to the next stretch that also has its own set of unique patterns. Each also exists within a complex combination of water authorities, water managers, political boundaries, and water rights. Taking a systems approach both to understand the ecological function of a river and to understanding the array of water utilities, municipal governments, other NGOs, community groups, and private citizens with aligned interests in healthy rivers is an important precursor to identifying (and eventually implementing) creative community supported solutions for river restoration and protection.

Understanding

To be effective, the SMP team needs a foundational level of understanding of not only how freshwater systems function and the river's unique hydrologic regime, but also a sophisticated understanding of when that river is out of balance

Fly-fishing in the Blue River, Summit County, Colorado. © iStock.com

> The reality is that rivers are always on the move, connecting headwaters springs and snowmelt, and rain to farms and cities, fish and fisherman, energy production, and industry as they head downstream on their gravity-fed journey toward the sea.

within specific reaches and what can be done to bring water back to these areas. Being able to define a river's water budget and its unique environmental flow regime is an important skill set. Additionally, they need the skills necessary to build a vision for their watershed, unite their community to solve water problems, define science needs, identify and pursue projects to achieve a healthy watershed that are adequately funded and adaptively managed, and, when relevant, become sustainable organizations themselves. Although experts and consultants can help design and run models helpful to understanding current conditions and opportunities for progress, the local organization or coalition is essential in building local ownership, keeping up the momentum necessary to see these projects through, and defining a future for our communities that involves healthy rivers. The prioritization process made possible through developing a SMP helps make this future possible.

If You Plan It, They Will Come

No planning process begins with all the answers in hand. But by engaging in planning, and creating an open and welcoming place for local knowledge and interested partners to come together , clarity can emerge around what is possible, as well as certainty for how to move toward that dream, plus how to engage local human and financial resources to achieve success. For example, the Cache la Poudre Natural Areas Conservation Action Plan process began without dedicated funding for implementation, but within five years of starting the planning, several of the highly ranked projects had been implemented. https://www.rivernetwork.org/our-work/strong-champions/best-practices/

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Wood toe under construction for stabilization and improved fish habitat along Taryall Creek in Park County, Colorado. Photo courtesy of Biohabitats