

This document was produced through a series of workshops in 2017 utilizing the combined input of over 50 water resources and ecology professionals in Colorado. It is meant as a starting point during the goal setting and scoping process to help SMPs refine their purpose, define tasks and estimate budgets. It is by no means a comprehensive library of questions or approaches that can be asked/used in an SMP process.

GOALS		KEY QUESTIONS			COMMON APPROACHES	INFORMATION GAINED FROM APPROACH
A RECREATION: Fishing, Boating, Hunting etc.		Anticipatory	Reactionary	Exploratory		
#1	Improve trout fishing experiences / opportunities	What effect will future changes to flow or land use from a specific threat(s) have on sport fishing populations/experience?	Why have sport fishing populations or the recreation experience declined over time?	What is the current condition of recreational angling and could it be improved?	Recreational user survey (e.g. CREEL) Fish Survey (e.g., electroshock)	Recreational quality—angler satisfaction as total fishing effort (TFE) and catch/unit effort (CUE) Biological—aquatic: fish per mile for baseline (<i>snapshot</i>) and information on species, relative distribution, abundance, & size
#2	Improve recreational boating experiences/opportunities.	What effect will future changes to flow or land use from a specific threat(s) have on the boating experience?	Why has the boating recreation experience declined over time?	What is the current condition of recreational boating and could it be improved?	Recreation survey (eg American Whitewater user and recreational flow surveys)	Recreational quality— Current river usage, “boatable” days based on flows
#3	Increase economic development potential and quality of life by increasing/improving river recreation access or experience	What effect will future changes to flow or land use from a specific threat(s) have on the region's river recreation economy and/or quality of life?	Why has the economic impact and/or the area's quality of life due to river conditions or access declined/stagnated over time?	Are there opportunities to increase quality of life and/or economic returns from river-based recreation?	Angler/boater expenditures and economic impact assessment (intercept; intercept-based mail follow-up; license mail survey)	Recreational quality-- Expenditures by type of users and demographics
					Inventory of existing access locations, conditions, user groups	Recreational -- Access numbers and conditions, frequency of improvements (ramps, restrooms, parking etc.)
B ECOLOGY: Instream flows, wetland or riparian plants; watershed health; wildlife (see Regulatory for federally protected species)		Anticipatory	Reactionary	Exploratory		
#1	Address seasonal dry-up points and low flows in the river	What effect will future changes in climate, water management practices or land use have on river flows?	How can we address acute/chronic low flows at a specific point in the river?	What is the current condition of river flows and could they be improved? Where are the dry-up points in the river and how often do they occur?	Hydrologic Study (e.g., statistical analysis of flow records; Indicators of Hydrologic Alteration (IHA))	Hydrologic—hydrographs, flow summary (return interval, probabilities),
					Habitat Surveys (e.g., Rapid assessments, Macroinvertebrate and aquatic habitat surveys; R2 Cross; PHABSIM, Instream Flow Incremental Flow; River2D)	Biological/geomorphic—simulation of area of habitat (in riffles) related to varying flows.
					Water Rights Assessment (e.g., State DSS Hydrobase tools and StateMod)	Social/legal—Owners represent potential project partners
#2	Support healthy native fish habitat in river	What effect will future changes in climate, specific water management practices or land use have on native fish populations?	Why have native fish populations declined over time?	What is the current condition of native fish populations and could it be improved?	Habitat Surveys (e.g., Rapid assessments, Macroinvertebrate and aquatic habitat surveys; R2 Cross; PHABSIM, Instream Flow Incremental Flow; River2D); ecological linkages approach; environmental flows analysis	Biological/geomorphic— species, relative distribution, abundance, age, size; limiting factors (biological and physical, e.g., predation, water temperature, spawning gravel quality)
					Flow-habitat relationships, e.g., Habitat Suitability Indices [HSI]	Hydrologic-- flow data in relation to habitat
#3	Protect or restore important wetland and riparian habitat, such as cottonwood galleries	What effect will future changes in climate, specific water management practices or land use have on riparian plan communities?	Why have riparian plan communities declined over time?	What is the current condition of riparian plan communities and could it be improved?	Vegetation inventory & assessments (rapid riparian assessment, GIS desktop analyses)	Biological—patch locations and size, diversity of species, structure, non-native species, stand age
					Groundwater data analysis (e.g., hydrogeologic study of existing groundwater data, water budget estimate)	Hydrologic—depth to groundwater, relation to rooting zones
					Floodplain analysis (2D hydraulic modeling)	Hydrologic- relation of water in channel to floodplain/riparian elevations
#4	Evaluate channel stability and address problem areas	Will future changes in flow or land use cause channel stability problems?	Why does this area have channel stability problems and what are the impacts?	Are there areas where channel stability is causing problems for people or habitat?	Geomorphic Assessments; Rapid Assessments (Rapid bioassessments and stream function assessments); Hydrologic and hydraulic studies (Flow analyses, Indicators of Hydrologic Alteration (IHA) hydraulic modeling;); Sediment transport	Geomorphic – stream channel type, reference condition Hydrologic and hydraulic—environmental flows, inundation elevations



Goals and Associated Approaches for Stream Management Plans

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GOALS		KEY QUESTIONS			COMMON APPROACHES	INFORMATION GAINED FROM APPROACH
#5	Remove non-native/invasive species and/or reduce their habitat suitability	How will future water management or land use changes affect non-native or invasive species?	What can be done about known populations of non-native or invasive species?	Are there problematic populations of non-native or invasive species?	Biological inventory; vegetation mapping; various rapid assessment methods; stream function assessment (e.g., FACstream), PHABSIM or 2D modeling using species-specific Habitat Suitability Indices (HSI).	Species inventory, distribution, relative abundance; habitat suitability & use; relative effectiveness of control or eradication methods; ancillary effects on non-target species (e.g., natives)
C REGULATORY—water rights, permitting, federally protected species, water quality		Anticipatory	Reactionary	Exploratory		
#1	Address specific water quality challenges (eg: metals, c. coli, temperature, etc)	Will known future changes in flow or land use cause water quality to degrade?	Why has water quality degraded over time?	Are there water quality problems that should be addressed?	WQ sampling & analysis program (e.g., field testing of water temperature and/or laboratory analysis for other pollutants; Macroinvertebrate surveys); Review of existing data	Water quality— Existing conditions (short-term) or Long-term trends
#2	Protect habitat for listed and/or potentially threatened or endangered species	How will future water management or land use changes affect known habitat for T&E species?	What can be done to protect potentially T&E species from further decline?	Is there habitat for listed or potentially T&E species in this area?	See Ecology above depending on if habitat or flow focused	See Ecology above depending on if habitat or flow focused
#3	Identify target ecosystem flows in anticipation of future reduced flows (climate change, new projects, population growth, etc)	What should target flows be given proposed/ anticipated changes in water management or climate?	How can we address acute/chronic low flows at a specific point in the river?	How have flows changed over time and are those changes detrimental?	Scenario development process; environmental/ecological flow needs analysis	Future flow scenarios
#4	Explore Wild & Scenic Rivers designation or a community-driven alternative	Are there segments that could be found eligible for WSR designation?	What are the positive or negative impacts to a segment that has been found eligible for WSR designation?	Are there segments that could be found eligible for WSR designation?	Existing document review; Stakeholder inventory and survey	Existing situation, draft suitability
#5	Identify methods to more regularly meet junior consumptive or in-stream flow water right volumes	Will future changes in water management exacerbate known shortages?	What can be done to alleviate known shortages for junior water rights holders, both consumptive and in-stream flow?	Are there unmet consumptive water use needs or in-stream flow reaches?	Water Rights Assessment (e.g., State DSS Hydrobase tools and StateMod)	Social/legal—Owners represent potential project partners
D INFRASTRUCTURE—reservoirs, dams, diversion structures and operations		Anticipatory	Reactionary	Exploratory		
#1	Build/modify infrastructure to operate efficiently and minimize waste at a range of flows	Will changes in water management harm existing infrastructure's ability to divert?	How can we address known problems with specific structures?	Are there concerns about the function of existing diversion infrastructure?	Diversion infrastructure assessments Interviews with water users Interviews with water commissioners	Potential water conservation/repair opportunities
#2	Identify in-river infrastructure that could be improved/modified to enhance ecosystem function or create safer/better recreational experiences	Will changes in water management increase existing infrastructure's impact on ecology and/or rec?	How can we address known problems with specific structures?	Are there concerns about the recreation or ecology impacts of existing diversion infrastructure?	Diversion infrastructure assessments Interviews with recreational users	Potential restoration/retrofit opportunities
#3	Address head-cutting and/or bank erosion causing headgate operational issues	Will future changes in flow or land use cause channel stability problems?	How can we address known problems with specific structures?	Are there areas where infrastructure is causing channel stability problems for people or habitat?	Diversion infrastructure assessments Interview with water users See Channel Stability above	Potential restoration/retrofit opportunities
#4	Reduce risk of flood damage to priority areas	Will changes in climate, water management or land use increase the risk of flooding damage to important human or natural areas?	How can we improve the resilience of important human or natural areas from future flooding?	What is the risk to important human or natural areas from flooding?	FEMA flood hazard mapping and Colorado hazard mapping USGS 3D Elevation Program (3DEP, formerly National Elevation Dataset (NED)) Colorado LiDAR imagery repository Remote desktop surveys using aerial imagery to estimate floodplain extent or features limiting floodplain connection	Inundation extent at different flows/return intervals Maps of structural features that limit floodplain connection Estimates of historical and current floodplain extent