Yampa-White-Green Basin Implementation Plan

Prepared For:
Yampa-White-Green Basin Roundtable

July 31, 2014

LIST OF ACRONYMS

AF: Acre Feet
AFY: Acre Feet per Year
BIP: Basin Implementation Plan
BLM: Bureau of Land Management
BRT: Basin Roundtable
CCWWPP: Critical Community Watershed Wildfire Protection Plan
CDPHE: Colorado Department of Public Health and Environment
CDSS: Colorado Decision Support System
CFS: Cubic Feet per Second
CSFS: Colorado State Forest Service
CWCB: Colorado Water Conservation Board
CWPP: Community Wildfire Protection Plan
FSA: Farm Service Agency
GIS: Geographic Information Systems
HUC: Hydrologic Unit Code
IBCC: Inter-Basin Compact Committee
IPP: Identified Project and Process
ISF: Instream Flow Right
IWR: Irrigation Water Requirement
M&I: Municipal and Industrial
NRCS: Natural Resources Conservation Service
P&M: Projects and Methods
PBO: Programmatic Biological Opinion
PEPO: Public Education, Participation and Outreach
RICD: Recreation In-Channel Diversion
ROD: Record of Decision
SSI: Self-Supplied Industrial
SWPP: Source Water Protection Plan
SWSI: Statewide Water Supply Initiative
USFS: United State Forest Service
USFWS: United States Fish and Wildlife Service
USGS: United States Geological Survey
WDID: Water District Structure Identification
WFET: Watershed Flow Evaluation Tool
WUI: Wildland Urban Interface
YWG: Yampa-White-Green
YWG BIP: Yampa-White-Green Basin Implementation Plan

ACKNOWLEDGEMENTS

The Yampa-White-Green (YWG) Basin Implementation Plan (BIP) was developed to inform the Colorado Water Plan, using a grant from the Colorado Water Conservation Board (CWCB). The YWG Basin Roundtable (BRT) is grateful for the opportunity to be a part of the development of Colorado's first Water Plan to incorporate a holistic approach to preparing for a secure water future for the entire State. To facilitate development of the BIP, the BRT engaged the use of a committee (Committee) to work with AMEC. The committee was open to anyone who wished to participate whether on the BRT or simply an interested member of the public. The Committee worked closely with the BRT and the stakeholders to define the policy initiatives and positions that are presented in the BIP. The Committee also kept the greater BRT informed of progress by providing summaries at monthly BRT meetings held throughout the BIP process.

The Committee worked diligently in compiling a document that reflects positions, desires and needs across varied interests throughout the entire YWG Basin. However, given the accelerated timeframe of the process, this document does not entirely address all of the issues facing the Basin in great detail; neither do the current projects and methods portray a complete picture of water supply options. As a result, this draft BIP can be considered a foundation for future water supply planning in the YWG Basin. As the planning process continues, additional refinements will occur and conversations will persist amongst all parties, all with a goal of providing an attainable and sensible water future for municipal, industrial, agricultural, environmental and recreational needs.

In addition to the Committee and BRT, further input was received from interested citizens and stakeholders at BRT meetings and at a variety of public outreach efforts organized throughout the Basin. Without the efforts of so many individuals and organizations, preparation of this document would not have been possible. Sincere thanks are extended to all BIP participants, and encouragement is extended to continue this important work.

EXECUTIVE SUMMARY

Background

The Basin Implementation Plan, developed by the Yampa-White-Green Basin Roundtable, addresses key issues about the most important natural resource in the American West - water. These issues are discussed from a policy viewpoint; the complex issues of water law and environmental concerns will be addressed in greater detail as individual projects and processes are implemented to meet the objectives outlined in this document. In this Basin Implementation Plan, the Basin Roundtable addresses the role of the Yampa and White rivers in meeting Colorado's obligations within the Colorado River Basin as a whole; the need to retain an equitable share of local water resources for existing uses and future development ; the need to conserve the natural hydrology for environmental and recreational use; the need for appropriately located, sized, and operated projects to protect important water uses and the environment-particularly during drought; and finally coordinate these issues with the Yampa-White-Green Basin Roundtable process.

The Yampa-White-Green Basin Implementation Plan was created by the Yampa-White-Green Basin Roundtable to reflect the Basin's goals in the State's water planning process and to satisfy the requirements that the Colorado Water Conservation Board set forth in the Guidance documents for the Basin Implementation Plans. Basin implementation Plans are designed to bring regional water planning to the next level in each of Colorado's nine basins. The Yampa-White-Green Basin Implementation Plan builds on work of the Basin Roundtable to fulfill the legislative mandate of HB05-1177 to propose projects or methods, both structural and nonstructural, for meeting the Basins' needs and utilizing unappropriated waters where appropriate. In addition, the Basin Implementation Plans serve as critical grassroots input to the forthcoming Colorado Water Plan commissioned on May 14th, 2013 by Governor Hickenlooper's executive order D2013-005.

The Yampa-White-Green River Basin has an excellent opportunity to achieve the vision of the Governor's Executive Order to balance future in-basin consumptive, recreational and environmental needs while continuing its historical role as a major contributor of flows to fulfill Colorado's and the Upper Basin States' obligations under the Colorado River Compact. This Basin Implementation Plan includes a needs assessment on where and how water will be used and desired for both consumptive uses, such as for agriculture, municipal use and industrial uses, as well as for environmental and recreational uses, which are non-consumptive uses of water. The following chapters represent the outcome of considerable dialogue on the complexities of water allocation and the potential it has to solve problems, both economic and environmental. In particular, much consideration is given to the importance of the Yampa, White and Green Rivers and the communities they serve while understanding the needs of others. Much effort was made to prioritize and balance local concerns and needs in the face of a looming gap for Colorado and the entire American West. Years of dedication by the volunteer Yampa-White-Green Basin Roundtable members - who represent every constituency in the community- have been devoted to ensuring our most important resource is properly managed for future generations.

Basin Facts, Needs and Vision

While the hope is that this Basin Implementation Plan will provide the foundation for future policies, processes and projects that can be followed and implemented to maintain and enhance the waters of the region, it in no way should be interpreted as an end point; rather it serves as a new beginning. A great amount of additional effort and dedication will be required to continue this work. The Basin Roundtable process offers local communities the ability to have a strong voice in how this important resource will be managed now and in the future. This unique democratic relationship does not exist in other states, where different and sometimes locally alienating processes can dominate. Recreational environmental, agricultural, municipal and industrial interests have come to consensus on goals and measurable outcomes that can represent individual and collective needs through the process of this Basin Implementation Plan.

The Yampa-White-Green Basin Roundtable recognizes that almost any water supply, whether or not it is categorized as an Identified Project and Process, will involve complex and nuanced tradeoffs. Each project will present its own specific set of opportunities and constraints, and what is a constraint for one project might be an opportunity for another. Consequently, at this time, the Yampa-White-Green Basin Roundtable believes it is not possible to develop a comprehensive list of opportunities and constraints. Instead, this Basin Implementation Plan sets out planning "considerations" that will serve to guide the future development and evaluation of water supply and resource projects.

The Yampa-White-Green drainages are relatively undeveloped and have limited existing storage compared to other basins in the State of Colorado. The majority of the existing storage is for industrial and municipal use, although there are some agricultural storage supplies particularly in the Upper Yampa Valley. Recreation is an ancillary benefit of many of the existing storage projects. Supplies on smaller tributary streams where no storage exists are typically inadequate in the late season.

Administration has only occurred on the mainstem of the Yampa and White Rivers under special circumstances, such as protecting reservoir releases in dry conditions. This historical lack of administration is not due solely to the relatively lesser development on these basins, but is a result of a culture of a willingness to share shortages voluntarily and the existence of an undeveloped diversion infrastructure.

Constraints on water development and water management to protect habitat for endangered species are in place in the Green and Yampa River Basins, and similar constraints are being contemplated for the White River Basin. Consequently, this Basin Implementation Plan addresses how the Basin's water needs must be developed in ways that provide collaborative solutions to water supply challenges while maintaining a balanced and diverse economic base long into the future.

How the Yampa-White-Green Basin fits into obligations for water supplies both in and out of the state is an extremely important concern. Interstate compacts require that some of the water originating in the Colorado River Basin flows to downstream States; some water is diverted out of the Colorado River Basin for use in the Front Range urban corridor and eastern plains; and some is used locally. Therefore, the Yampa and White Rivers, as part of Colorado River Basin, are caught between the needs of the downstream States, the needs of the east slope of Colorado, and their own needs. Since there are compact demands downstream to the west and out-of-basin needs to the east, the Yampa-White-Green Basin Roundtable must take a position on each.

The Yampa-White-Green Basin Roundtable recognizes that the overdevelopment of limited Colorado River system water is a serious risk that would impact all users of Colorado River Basin water. Thus, before it could be considered by the Yampa-White-Green Basin Roundtable, any proposed trans-mountain diversion out of the Colorado River Basin must undergo a full operational analysis to determine its impact on the entire river system. The analysis must recognize that, within the Colorado River system, the diversion of any "extra" water available during wet years may occur under certain "trigger" conditions of a full (or nearly full) supply in reservoirs designed to carry the Colorado River Basin through a drought. This analysis must be sufficient to determine that the risks of operating project(s) in a junior manner to identified Colorado River Basin needs are understood by all. Such a project should not be funded by the State of Colorado, but by interests, public and/or private, willing to accept such operational and financial risk. Prior to undertaking development of a new trans-mountain diversion, the Front Range must first integrate all other water supply solutions including conservation, reuse, and maximize use of its own native water resources and existing trans-mountain supplies.

With respect to downstream flows, the Yampa-White-Green Basin Roundtable recognizes that the Yampa and White Rivers play a significant role in providing water for compliance with the State of Colorado's downstream obligations, and that this must be recognized in the Colorado Water Plan. The Yampa-White-Green Basin Roundtable also thinks that negotiated equitable apportionment among Colorado River tributary basins must be included in the Interbasin Compact Committee's agreements and in the Colorado Water Plan, as it was in previous interstate agreements, and envisioned by the HB05-1177 process.

The Yampa-White-Green Roundtable seeks through its Basin Implementation Plan to make certain that existing consumptive, environmental and recreational uses are met, even during anticipated drought periods. This includes drought periods that are in the reconstructed paleo-hydrologic record and might be exacerbated by temperature increases. Additionally, the Yampa-White-Green Basin will also have to accommodate new water uses. While population growth will drive additional municipal needs and additional irrigated agricultural areas have been identified in State-funded studies, the energy sector has the potential to have the greatest additional consumptive water demands in the Yampa-White-Green Basin. Further, traditional uses, particularly agriculture and recreation, could be hindered if large extractive industries emerge to utilize the vast untapped fossil resources in the region. Endangered species, riparian plant communities, sport fisheries, rafting, and ecological integrity are important non-consumptive needs, and these uses

are expected to expand. The Yampa-White-Green Basin's average consumptive use demand may reach approximately 361,000 acre-feet[1] per year by the year 2050 under a dry hydrology scenario.

The Yampa-White-Green Basin Roundtable identified eight primary basin goals to address the Yampa-White-Green Basin's needs.

- Protect existing decreed and anticipated future water uses in the Yampa-White-Green Basin.
- Protect and encourage agricultural uses of water in the Yampa-White-Green Basin within the context of private property rights
- Improve agricultural water supplies to increase irrigated land and reduce shortages
- Identify and address Municipal and Industrial water shortages
- Quantify and protect non-consumptive water uses
- Maintain and consider the existing natural range of water quality that is necessary for current and anticipated water uses.
- Restore, maintain, and modernize water storage and distribution infrastructure
- Develop an integrated system of water use, storage, administration and delivery to reduce water shortages and meet environmental and recreational needs

The Yampa-White-Green Basin goals ultimately seek to promote a healthy and diversified economy long into the future. The principal objective underlying all of the goals is the maintenance and protection of historical water use in the basin as well as the protection of water supplies for future in-basin demands. By maintaining historical water use, the people of the Yampa-White-Green Basin will continue to use the basin's natural resources sustainably and will consequently maintain a balanced and diverse economic base.

Accordingly, the Colorado Water Plan must address how a Colorado River compact curtailment or any other administrative action causing curtailment would be applied, and must recognize the negotiated equitable apportionment to the Yampa-White-Green Basin for existing and future development as mentioned above. The Yampa-White-Green Basin will not consider a new trans-mountain diversion until and unless a satisfactory Intrastate Compact and negotiated equitable apportionment of Colorado River supplies is achieved. The Yampa-White-Green Basin Roundtable will continue its willingness to discuss the preservation of flows that deliver needed water to downstream obligations and can also meet environmental and recreational needs of the Yampa-White-Green Basin, but also stresses the importance of assuring non-curtailment of its existing water use and protecting water for future uses in state-wide discussions.

Much of the information in this Basin Implementation Plan about water needs and projects and methods information was developed through a series of Statewide Water Supply Initiative and Basin-wide studies, particularly the 2014 Project and Methods Study. The 2014 Project and Methods Study is the most recent state-funded study that was largely used to inform this Basin Implementation Plan.

Several Identified Projects and Processes were developed with input from the Basin Roundtable and other stakeholders, taking into consideration information from previously completed studies and the considerations laid out in the preceding paragraphs. The Identified Projects and Processes are dynamic lists reflective of the incomplete current planning process. These lists will continue to be updated with new Projects and Processes as the Yampa-White-Green Basin continues to refine its water needs and its overall understanding of the river operations through its Projects and Processes modeling. Examples of the Projects and Processes that have been identified and included in this Basin Implementation Plan are Elkhead Reservoir Enlargement, Lake Avery Enlargement, Morrison Creek Reservoir, Upper Elkhead Creek Stream Restoration, and assessment of flow regime for endangered fish recovery in the White River from Rio Blanco Lake to Colorado state line.

This Basin Implementation Plan is an ongoing process and this document represents a single preliminary analysis. Water supply planning is dynamic, and the Yampa-White-Green Basin Roundtable will continue working towards balanced future needs of the region. Integrating important considerations such as addressing certainty of existing uses, enabling modest future growth and retaining important recreational and environmental values will continue to be guideposts of the Yampa-White-Green Basin Roundtable. These core ideas will be considered throughout the process, as projects and methods are developed and implemented to ensure reliable water supplies for the region now and into the future.

[1] Projects and Methods StateMod Model, 2014

Next Steps

The Yampa-White-Green Basin Roundtable will continue its efforts in developing the Basin Implementation Plan after July 31, 2014. Specifically, additional effort will occur to refine the Colorado Decision Support Systems' modeling to provide more detailed information regarding the operations of the full suite of current Identified Projects and Processes, and to identify opportunities for additional multi-use projects. It is possible that additional shortage areas will be identified after July 2014 through this follow-on modeling and/or during future updates to the Basin Implementation Plan. Discussions will therefore continue on how to best meet these shortages throughout the Yampa-White-Green Basin while referencing the goals and measurable outcomes identified herein. Information developed as a result of the additional modeling will be incorporated into future versions of the Yampa-White-Green Basin Implementation Plan as opportunities arise. An initial summary of next steps for the Yampa-White-Green Basin Roundtable associated with Basin Implementation Plan development and refinement are presented below.

- Refine the Projects and Methods Study Model and reevaluate scenarios to be addressed with future modeling.
- Add new Identified Projects and Processes to the model and re-assess the results.
- Look for opportunities for multi-purpose projects and operations of projects with willing proponents.
- Facilitate public engagement and education to help build consensus on the Identified Projects and Processes.

Basin Position

- Any development of a new trans-mountain diversion must provide the full analysis outlined in the Yampa-White-Green Basin's white paper and this Basin Implementation Plan. This analysis must be sufficient to determine that the risks of operating project(s) in a junior manner to identified Colorado River Basin needs are understood by all. Such a project should not be funded by the State of Colorado, but by interests, public and/or private, willing to accept such operational and financial risk.
- Prior to undertaking development of a new trans-mountain diversion, the Front Range must first integrate all other water supply solutions including conservation, reuse, and maximize use of its own native water resources and existing trans-mountain supplies.
- With respect to the Colorado River Compact, the Yampa-White-Green Basin Roundtable recognizes that the Yampa and White Rivers play a significant role in providing water for compliance with the State of Colorado's downstream agreements, and that this must be recognized in the Colorado Water Plan. The Yampa-White-Green Basin Roundtable also thinks that negotiated equitable apportionment among Colorado River tributary basins must be included in the Interbasin Compact Committee's agreements and in the Colorado Water Plan, as it was in previous interstate agreements, and envisioned by the HB05-1177 process.

Table of Contents

Section 1.0 Basin Goals and Measurable Outcomes

1.1 Background

1.1.1 Basin Overview

The Yampa-White BRT covers a region that includes Routt, Rio Blanco, Moffat, and parts of Eagle and Garfield counties. The region has a rich agricultural heritage; a strong tourist economy that includes skiing, rafting, kayaking, fishing, and hunting; environmental assets that include wilderness areas, endangered fish species, and vast areas of low population density; and some of the richest deposits of fossil fuels, both tapped and untapped, within the nation.

The Yampa and Green rivers meet in the Northwest corner of the State of Colorado in Dinosaur National Monument; slightly to the south, the White River flows into Utah where it meets the Green River. From the confluence of these rivers, the Green River becomes the chief tributary of the Colorado River. Out of the headwaters of the Yampa, White, and Green and down to their confluences there is relatively little urban development, making the region predominantly rural and agricultural. Land uses tend to be predominantly multi-use, due in large part to federal land ownership. Economic drivers tend to be agriculture, resource extraction, power generation, and recreation. Most economic activity is intimately dependent on adequate moisture and a dependable surface water supply.

For the purpose of local water planning, the Yampa, White and Green basins can be considered independently, as no diversions currently exist between them. Landscapes vary greatly from wet, high-mountain elevations to sagebrush steppes to downstream desert canyons. The Yampa and White basins have headwaters in high-precipitation areas, from the Park Range in the North to the Flattop Mountains and Gore Range in the South. The rivers' hydrology is dominated by snowmelt and, like most rivers in Colorado, flows fluctuate greatly across the seasons--seasonal flow variations on the rivers range from frozen winters to high-flow springs to hot, dry summers--and flows occur with a different timing and amount each year.

The Yampa River is the largest tributary to the Green River with an annual average flow of approximately 1.5 million acre-feet at the confluence. The Little Snake River is a significant tributary to the Yampa River that has headwaters in both Wyoming and Colorado. The Yampa River flows through several municipalities, the largest being Steamboat Springs and Craig. Two large coal-fired thermal electric generating stations use water from the Yampa River and coal from large mines located in the Yampa Basin to serve electrical needs in western and eastern Colorado as well as many other western states. There is irrigated agriculture throughout the basin. The confluence of the Yampa River with the Green River is immediately upstream of the Utah state line.

The White River flows through Meeker and Rangely, Colorado, and into Utah prior to meeting the Green River below its confluence with the Yampa. Average annual flow out of Colorado on the White River is approximately half a million acre-feet. Like the Yampa, there is irrigated agriculture from the headwaters of the White River to the Colorado state line. There is significant energy production in the White River Basin, particularly in the Piceance basin.

The Green River flows into and out of the northwest corner of Colorado. Vermillion Creek is the largest tributary in this area, originating in southern Wyoming; its yield is relatively small compared to the Yampa and White Rivers. The confluence of Vermillion Creek with the Green River lies in Brown's Park Colorado, above the confluence of the Yampa and Green Rivers. Agricultural areas are dispersed throughout the Green basin.

The YWG drainages are relatively undeveloped and have limited existing storage compared to other basins in the State of Colorado. The average historical demand in the Basin for consumptive use (municipal, industrial and agricultural uses) is approximately 282,000[1] acre-feet per year. The majority of the existing storage is for industrial and municipal use, although there are some agricultural storage supplies particularly in the upper Yampa Valley. Recreation is an ancillary benefit for many of the existing storage facilities.

How the YWG Basin fits into obligations for water supplies both in and out of the state is an extremely important concern. Due to the later development of northwest Colorado, water rights in this region tend to be of a later appropriation date than in other regions of the Colorado that use water from the Colorado River Basin. This junior status has created concerns that uses could be curtailed disproportionately by Colorado River Compact administration or any other "demand management" agreement entered into by the State of Colorado. Unless the YWG Basin is afforded a negotiated equitable apportionment of its native flow it could find its current uses curtailed and little opportunity for new development of its native water resources. It is unclear yet how un-appropriated flows can be utilized in the YWG Basin and how the YWG Basin can aid in meeting compact or other "demand management" obligations while preserving the existing decreed uses. This subject is under discussion within the BRT and at the IBCC. A negotiated equitable apportionment of native flow for existing in-basin uses and some increment of new development have been proposed. Other inter-basin methods such as water banks have also been proposed but interstate and inter-basin issues are unresolved at this point. A water bank would not be inconsistent with an intra-state apportionment. The BRT has shown a willingness to discuss the preservation of environmental and recreational flows that also deliver needed water to downstream obligations. As state-wide discussions about future trans-mountain diversions continue, the Colorado Water Plan must allow the YWG Basin assurance of certainty of non-curtailment of its existing water use demands and a reasonable and equitable amount for its in-basin use and future development.

Addressing basin specific needs in a "quest for certainty" for existing uses, future growth, recreational and environmental values forms the core of this BIP. While population growth will drive additional municipal needs and additional irrigated agricultural areas have been identified in State-funded studies, the energy sector has the potential to have the greatest additional consumptive water demands in the Basin. Endangered species, riparian plant communities, sport fisheries, rafting, and ecological integrity are important non-consumptive needs, and these uses are expected to expand. The YWG BRT seeks through its BIP to make certain that existing consumptive, environmental and recreational uses are met, even during anticipated drought periods. This includes drought periods that are in the reconstructed paleo-hydrologic record and might be exacerbated by temperature increases.

Further concerns have emerged that traditional uses, particularly agriculture and recreation, could be hindered if large extractive industries emerge to utilize the vast untapped fossil fuel resources in the region. Balancing traditional economic activities alongside emerging industries and the competing demands for water within the State is one of the greatest challenges facing the Colorado Water Plan.

Additionally the BIP will examine water development and administrative systems so that existing and future consumptive uses can be coordinated with environmental and recreational uses. For example, flow between storage and diversion points might aid in meeting low flow needs on the river. Flows out of the Basin that would aid in interstate compact compliance could be timed to meet flow targets for endangered fish recovery program. Additional storage in the Basin must also be balanced with high spring flows that are needed for recreational needs and ecological processes.

[1] Projects and Methods StateMod Model, 2014

The fact that the water that flows out of the YWG Basin plays a significant role in meeting the obligations associated with Colorado's agreements with downstream states must be recognized in the Colorado Water Plan. The BRT recognizes that the Front Range believes that a trans-mountain diversion is an integral part of its solution to meet its own water gap. However, prior to the development of any trans-mountain diversion, the Front Range must exhaust all other water supply solutions including conservation, reuse, and maximizing its own native supplies. This includes full use to extinction of its existing trans-basin water diverted under existing projects.

Of foremost concern to the Basin is how a Colorado River compact curtailment would be administered. If it is done on the basis of the prior appropriation system across the various basins, the YWG Basin suffers a disproportionate burden because their uses are relatively junior to the uses in the Colorado, Gunnison, and Southwest basins and including the trans-mountain diversions to the Front Range. Further development of Colorado River supplies, particularly a potential new, large, trans-mountain diversion, poses a threat to existing and new uses in the YWG Basin and would undermine the very essence of this BIP. The Basin therefore seeks to protect and provide a greater level of certainty for its existing and new uses of water identified herein. The Basin recognizes that their uses are not solely at risk – other uses in the other West Slope basins are as well, including trans-mountain diversions.

Accordingly, the YWG Basin seeks the development of an Interstate Compact that will achieve a negotiated equitable apportionment of Colorado River supplies within the State of Colorado. Such an apportionment would prioritize the protection of existing uses and the future uses identified in the West Slope BIPs. The Basin requests that the other West Slope and Front Range Roundtables similarly urge an apportionment and requests that the Colorado Water Plan lays out a process for development of such an apportionment.

1.1.2 Process Overview

The YWG BIP was created by the YWG BRT to reflect the Basin's goals in the State's water planning process and to satisfy the requirements that the CWCB set forth in the Guidance documents for the BIPs. BIPs are designed to bring regional water planning to the next level in each of Colorado's nine basins. The plans build on previous work to fulfill the legislative mandate of HB05-1177 to the roundtables to propose projects or methods, both structural and nonstructural, for meeting Basins' needs and utilizing unappropriated waters where appropriate. In addition, the plans serve as critical grassroots input to the forthcoming Colorado Water Plan commissioned on May 14th, 2013 by Governor Hickenlooper's executive order D2013-005.

The YWG BRT is one of nine grassroots water policy forums created by HB05-1177. The same legislation also created the IBCC as a venue for discussion of statewide water policy and management issues. The BIPs now seek to embody the intent of the legislation to "encourage locally driven collaborative solutions to water supply challenges." The BRT serves as a venue for coordinating and supporting the most effective water supply solutions in the Basin.

The structure of this BIP satisfies the requirements that the CWCB set forth in the Guidance documents for BIPs. The BIP begins with the BRT's goals and measurable outcomes described in this section. The goals identify the priorities of the BRT, while the measurable outcomes describe the specific mechanisms and targets for achieving these goals. Section 2 summarizes the identified water supply needs in the Basin. Section 3 then evaluates the constraints and opportunities for meeting those needs, leading to the identification of specific projects and methods in Section 4. More detailed implementation strategies for the most effective projects and methods are further explored in Section 5. Finally, Section 6 ties the selected strategies back to the basin's goals and outcomes to show how well the BIP may meet its identified priorities.

1.1.3 Previous Studies

Table 1-1 provides a summary of the Basin-wide studies conducted for the YWG Basin since the initial SWSI began in 2003. These studies encompass assessments of current and future M&I, energy, agriculture, environmental and recreational needs, and the modeling exercises conducted to evaluate water supply shortages, future water supply projects, climate change and impacts to instream flows.

Table 1-1 Table of Previous Studies

Year Study Completed	Study	Summary	Study Web link
2004	SWSI	Identified Colorado's current and future water needs and examined a variety of approaches Colorado could take to meet those needs. SWSI implemented a collaborative approach to water resource issues by establishing SWSI roundtables. SWSI focused on using a common technical basis for identifying and quantifying water needs and issues.	http://cwcbweblink.state.co.us/WebLink/ElectronicFile.aspx?docid=144066&searchid=2c16c041-d0b2-4ec5-ac42-8b95aa0c04e3&dbid=0
2008	Energy Development Water Needs Assessment Phase I	Developed future demand estimates through the 2050 planning horizon for the oil shale, natural gas, coal, and uranium energy sectors.	http://www.crwcd.org/media/uploads/Energy_Development_Water_Needs_Assessment_Phase_1_Report_Rec_4196.pdf
2010	Updated SWSI	Updated the original SWSI to include new data and develop projections through a future planning horizon of 2050.	http://cwcb.state.co.us/water-management/water-supply-planning/documents/swsi2010/appendix%20l_swsi%202010%20municipal%20and%20industrial%20water%20conservation%20strategies.pdf
2010	Nonconsumptive Needs Assessment Focus Mapping Report	Development of environmental and recreational focus maps and attribute tables to further characterize the environmental and recreational needs within the State's Basins.	http://cwcbweblink.state.co.us/weblink/0/doc/143889/Electronic.aspx?searchid=a05c7436-830c-490a-a93b-a24fe22bf46e
2011	Basin Needs Assessments	Summarizes information developed through the SWSI process for the Yampa/White/Green Basin.	
2011	Energy Development Water Needs Assessment Phase II	Updated the oil shale demand from the Phase I Energy Development Water Needs Assessment.	http://www.crwcd.org/media/uploads/Energy_Development_Water_Needs_Assessment_Phase_II_Final_Report.pdf
2011	Yampa/White Agricultural Water Needs Assessment Report	Refined and updated previous estimates of current agricultural uses and supplies, evaluated future agricultural demands, assessed climate change and energy development sector impacts on agricultural water availability, and developed alternatives to satisfy shortages.	http://cwcbweblink.state.co.us/WebLink/0/doc/155776/Electronic.aspx?searchid=aa2fb556-c075-4ddd-bc30-ffadd57830af

Year Study Completed	Study	Summary	Study Web link
2012	Colorado River Water Availability Study	Provides a common platform to determine consumptive and nonconsumptive uses throughout the western slope. StateMod models developed under the CDSS for the Colorado River main stem, Gunnison River, Dolores/San Juan/San Miguel Rivers, and the YWG Rivers were used in the development process. Current demands, operations, and historical hydrology as well as a suite of climate change demands and hydrologies were used to determine the current and potential future state of water availability along the western slope of Colorado.	http://cwcb.state.co.us/technical-resources/colorado-river-water-availability-study/Pages/main.aspx
2012	Yampa-White BRT Watershed Flow Evaluation Tool Study	Applied ecology-flow metrics to identify environmentally and recreationally significant areas and determine the risk levels associated with those areas. The associated risk metrics characterize the impacts of increased water use within the basin on trout, warm water fish, cottonwoods and boating.	http://www.conservationgateway.org/Files/Pages/yampawhitewfet.aspx
2013	CWCB Nonconsumptive Use Toolbox	Provides a framework to evaluate existing information and identify opportunities and challenges regarding implementation of environmental and recreational projects.	http://cwcbweblink.state.co.us/weblink/0/doc/170187/Electronic.aspx?searchid=ee0c3336-ec13-43aa-8b81-460b87f065af
2014	YWG Projects and Methods Study (Draft Final February 27, 2014)	Evaluates the M&I, energy, agricultural and environmental and recreational needs and shortages in the YWG Basin using the StateMod model.	http://cwcb.state.co.us/water-management/basin-roundtables/Documents/YampaWhite/YampaWhiteProjectsMethodsStudy_DraftFinal02272014.pdf
2014	Yampa Basin Alternative Agricultural Water Transfer Methods Study	Identified several locations where alternative agricultural transfer methods meeting the needs of both the environment and consumptive uses could be implemented. These temporary water leasing arrangements could offer substantial benefit to both consumptive and nonconsumptive interests if their associated challenges can be overcome.	https://dl.dropboxusercontent.com/u/77289895/FINAL%20Yampa%20ATM%20Report%203-28-14_with%20apps.pdf
2014	Energy Development Water Needs Assessment Update Phase III	Assess current and projected energy water demands provided in the Phase I and Phase II Energy Development Water Needs Assessment. Where appropriate, estimates will be revised to reflect the most up-to-date data trends. Emphasis is placed on updating the natural gas and oil shale demands.	The report has been finalized but has yet to be approved by the Colorado and YWG BRTs

1.2 Description of Goals and Measurable Outcomes

1.2.1 Context for Basin Goals—Maintenance of Historical Use, Protection of Water Supplies for Future Demands, and Environmental Protection

The YWG BRT identified eight primary basin goals. The principal objective underlying all of the goals is the maintenance and protection of historical water use in the Basin as well as the protection of water supplies for future in-basin demands. The Basin goals ultimately seek to promote a healthy and diversified economy long into the future. By maintaining historical water use the citizens of the YWG Basin will continue to use the Basin's natural resources sustainably and consequently will maintain a balanced and diverse economic base. To most effectively address future uncertainties the YWG BRT supports the use of a scenario planning approach for regional and statewide water supply planning.

Any development of a new trans-mountain diversion must include a prerequisite requirement that the Front Range first exhaust all other water supply solutions including conservation, reuse, and maximize its own native water resources and existing trans-mountain supplies before such a diversion can be decreed or constructed. Furthermore, the Colorado Water Plan must address how a Colorado River compact curtailment or any other administrative action causing curtailment would be applied, and must recognize the negotiated equitable apportionment to the YWG Basin for future development as mentioned above.

Risk management criterion must be developed to prevent harm to existing water rights and prevent the impairment of the development of new in-basin water development under in-basin negotiated equitable apportionment.

To provide a concrete measurement of success in meeting existing and future water needs each goal is paired with measurable outcomes. Each of the goals includes a brief narrative description, process for achieving the goal, and specific measureable outcomes. In order to ensure that each measurable outcome is attainable and realistic each goal includes a process for achievement. The goal processes include tasks, items for inclusion in the YWG BIP, and other steps or mechanisms necessary to help achieve the goal, and ultimately the measurable outcomes. The YWG BRT has sought to define measurable outcomes that avoid arbitrary targets or unrealistic objectives.

1.2.2 Yampa-White-Green Basin Goals (Order does not indicate priority)

- Protect the Basin from curtailment in all circumstances of existing decreed, in-basin absolute water rights and uses, and allocate a negotiated equitable apportionment of native flows over and above existing uses for anticipated and unanticipated future water uses in the YWG Basin. The allocation for future uses on the Yampa River must be inclusive of the total allocations permitted by the USFWS under the Yampa River PBO for the endangered fishes, which has a future potential depletion of approximately 30,104 AF in Colorado, over and above depletions from existing uses.
- Protect and encourage agriculture uses of water in the YWG Basin within the context of private property rights.
- Improve agricultural water supplies to increase irrigated land and reduce shortages. The agricultural needs study of the YWG BRT identified an additional 14,805 acres of potential new agricultural production in the future.
- Identify and address municipal and industrial water shortages.
- Quantify and protect environmental and recreational water uses at the locations and nodes identified in the non-consumptive needs study of the YWG BRT.
- Maintain and consider the existing natural range of water quality that is necessary for current and anticipated water uses.

- Restore, maintain, and modernize water storage and distribution infrastructure.
- Develop an integrated system of water use, storage, administration and delivery to reduce water shortages and meet environmental and recreational needs.

1.2.3 Protect existing decreed and anticipated future water uses in the Yampa-White-Green Basin.

The vitality of the YWG Basin depends on maintaining the historical water uses that have come to define the basin since its settlement. Anticipated and unanticipated future uses require recognition in the Colorado Water Plan of an additional increment of native flow apportioned to the basin for in-basin future demands. A minimum guideline on the Yampa River for such purposes would be the allocation of additional future depletions increment identified and quantified in the USFWS PBO on the Yampa for the endangered fishes. The protection of these present and future uses was identified by the YWG Basin as the most important issue in the basin. This report helps to identify the baseline of current water use along with important projected and unanticipated needs in Sections 2 and 3. It is important to note that even existing uses may not be static with the potential impacts of future water shortages from drought and climate change. In other words, a hotter climate could increase crop and landscape irrigation consumptive use and consequently demands related to historical water rights. Therefore, this report provides an assessment of water supply impacts under different hydrologic scenarios in Section 3.

To maintain existing uses, it is also critical to prevent the abandonment of pre-compact water rights. The YWG BRT will encourage water rights owners to take actions to prevent pre-compact water rights from being placed on the Colorado Division of Water Resources Division 6 abandonment list and encourage their participation in the protest process where appropriate.

Processes:

- Document existing baseline of major decrees, environmental compliance agreements including the Yampa and White PBOs, water rights administration protocols, and related operations including documentation of permitted future depletions in such basins under such PBO's.
- Detail the projected effects of water shortages (from drought and climate change) that may require additional water storage development to satisfy existing and future uses.
- Review Division 6 water rights abandonment list and educate pre-compact water rights owners on how to maintain existing decreed water rights.
- Periodically update and refine estimates for anticipated and unanticipated future water uses.

Measurable Outcomes:

- Obtain negotiated equitable apportionment of native flow of Yampa and White rivers for existing and future anticipated and unanticipated in-basin water demands and uses within the YWG Basin which must be assured by legal process prior to the development of any new Colorado River trans-mountain diversion.
- Maintain existing and future PBO depletion allowances and recognize those are for in-basin needs.
- Minimize and mitigate the risk of a Colorado River compact shortage.
- Prevent pre-Compact water rights from being abandoned or placed on the abandonment list.

1.2.4 Protect and encourage agricultural uses of water in the Yampa-White-Green Basin within the context of private property rights.

While it is common for agricultural areas in Colorado to be water-short, agricultural shortages represent a real need and opportunity for improvement. In addition, the YWG Basin is the only basin in the State projecting an increase of up to 14,805 irrigated acres. The analysis undertaken in the BIP seeks to better define the "ag gap" in the YWG Basin. This fits with the CWCB's emphasis on extending the SWSI analysis to include agricultural and environmental and recreational gaps to complement the municipal and industrial gap identified in previous studies.

Existing and proposed projects and other site-specific solutions will be matched with water availability to identify and recommend the most effective projects. An emphasis on multiple-purpose projects will be carried throughout the analysis, where applicable. While the YWG BRT opposes the dry-up of agricultural land in the basin, it also recognizes the importance of private property rights in the successful operation of Colorado's long-standing water rights system. Therefore, the YWG BRT is committed to encouraging the preservation of agriculture through any effective voluntary means. To further that goal, future education efforts of the YWG BRT may also focus on encouraging the preservation of agricultural land in the basin. Of particular interest are projects that can utilize senior agricultural water rights that may be at risk of abandonment.

Processes:

- Identify agricultural water shortages and evaluate potential cooperative and/or incentive programs to reduce agricultural water shortages.
- Identify projects that propose to use at-risk water rights, alternative transfer methods, water banking and efficiency improvements that protect and encourage continued agricultural water use. Identify projects that will bring new irrigable lands in the basin into production using new water diversions.
- Encourage and support M&I projects that have components that preserve agricultural water uses.

Measurable Outcomes:

- Preserve the current baseline of approximately 119,000 protected acres and expand by 12.4% by 2030.
- Encourage land use policies and community goals that enhance agriculture and agricultural water rights

1.2.5 Improve agricultural water supplies to increase irrigated land and reduce shortages.

Processes:

- Identify specific locations in the YWG Basin where agricultural shortages exist and quantify the shortages in times, frequency, and duration. Consider the potential effects of climate change, drought and compact shortages in these analyses. Identify projects that will bring new irrigable lands in the basin into production using new water diversions.
- Recommend possible site-specific solutions in collaboration with local water users. Recommendations include an initial analysis of hydrology (water variability), cost, financing, and permitting. Recommended projects could include new storage, enlargement or repair of existing reservoirs, infrastructure to improve irrigation system efficiency, etc.
- Evaluate multiple objectives of recommended solutions.
- Develop methods to assist with streamlining permitting in a cost-effective manner.

Measurable Outcomes:

- Reduce agricultural shortages basin-wide by 10 percent by the year 2030.
- Preserve the current baseline of 119,000 irrigated acres and expand by at least 14,805 acres.

1.2.6 Identify and address M&I water shortages.

As the YWG Basin continues to grow, its M&I water needs must be identified and addressed. We reiterate that the relatively later nature of development of the YWG Basin compared to the Colorado River Basin as a whole is of concern. The rights used to fill reservoirs for municipal use are generally adequate with respect to in basin uses, but junior to many adjudication dates within the Colorado River Basin and San Juan River Basin in Colorado. Gaining sufficient certainty for these uses against curtailment is an important point in our BIP. Population growth and future anticipated and unanticipated needs are also concerns. The population of the YWG Basin is projected to nearly triple by the year 2050 (SWSI 2010). In fact, the population of the West Slope will continue to grow at a faster rate than the Front Range of Colorado (SWSI 2010). Because the major driver for additional water use in most of the State is population growth, M&I water usage is also expected to nearly double, even with savings from passive conservation. Municipal water demands in the YWG Basin are estimated to increase from 12,000 AFY to 31,000 AFY by 2050, requiring an additional 19,000 AFY to meet the basin's water municipal water needs in 2050. Adequate storage, along with strong municipal conservation measures, must be coordinated with drought plans to adequately address the situation. Additionally redundancy of supply sources in order to deal with potential watershed impacts due to fire is an important consideration for municipal users in the Basin. Projects useful for both drought and supply redundancy planning should be sought.

SSI water demands, largely driven by needs for energy development, are estimated to significantly exceed municipal demands, requiring between 22,080 AFY to 67,280 AFY.

This report documents the planned efforts and related water availability of major water providers in the basin to meet needs projected through the year 2050. An emphasis on multiple-purpose projects is carried throughout the analysis, where applicable. Water conservation efforts are also included as an important component of meeting municipal demands in the basin. Projected population and water use data are pulled from SWSI 2010, with updated project information from water providers where available. The M&I water supply gap in the basin is not recalculated for this report, but will be updated during the forthcoming SWSI 2016 effort. These updated projections will continue to be based on refined economic modeling projects performed by the Colorado State Demography Office.

Processes:

- Identify specific locations in the Basin where municipal and industrial shortages may exist in drought scenarios, quantify the shortages in time, frequency, and duration.
- Identify impacts throughout the Basin in the context of water shortages (drought and climate change), wildfire and compact shortage on municipal and industrial demands.
- Identify projects and processes that can be used to meet M&I needs.
- Encourage collaborative multi-use storage projects.
- Support efforts of water providers to secure redundant supplies in the face of potential watershed impacts from wildfire.
- Encourage municipal entities to meet some future municipal water needs through water conservation and efficiency.

Measurable Outcomes:

- Reliably meet 100% of municipal and industrial demands in the basin through the year 2050 and beyond.

1.2.7 Quantify and protect non-consumptive water uses

Environmental and recreational water uses are critical to the economy and way of life in the YWG Basin. The economic values of the relatively natural flow regimes of the Yampa and White river systems are recognized and this BIP addresses how to protect these values, along with the economic values of consumptive water use.

A PBO on the Management Plan for Endangered Fishes in the Yampa River Basin was issued in 2005 and addresses the flows needed for endangered fish recovery on the lower Yampa and Little Snake rivers. Releases from Elkhead Reservoir for augmentation of endangered fish flows are sometimes necessary to supplement low natural flows. In assembling the draft SWSI 2010 YWG Basin Report, the YWG Basin deferred finalization of the sections on non-consumptive needs and projects to meet them until the completion of the 2012 WFET, a P&M Study (forthcoming 2014), and an Alternative Transfers Method Study (forthcoming 2014). These follow-up studies incorporate the YWG Environmental and Recreational Non-consumptive Focus Mapping (2010). This focus mapping and follow-up studies identified important non-consumptive needs in the YWG Basin that are referenced in this report. Additional appendices to the statewide update of non-consumptive needs in 2010 also cataloged completed, ongoing, and planned non-consumptive projects for the Yampa and White Basins (see Table 15 to Non-consumptive Needs Assessment Phase II Update and Appendix F to Colorado's Water Supply Future). Many of these projects were then mapped along with the non-consumptive needs in Figures 3-1 through 3-4 of the SWSI 2010 Report as an initial analysis of where identified non-consumptive needs are most effectively addressed. As noted in Chapter 4.0, the Basin Roundtable inventoried and mapped a new set of environmental and recreational projects for this Basin Implementation Plan.

This report seeks to further refine the analysis of non-consumptive needs in the YWG Basin and will examine the CWCB's new approach for assessing the gaps between nonconsumptive needs and the projects and methods to meet these needs. The report will also include recommendations for non-consumptive projects by themselves or as components of multipurpose projects. An emphasis on multiple purpose projects is carried throughout the analysis, where applicable.

Data is pulled from SWSI 2010, with selective updates on recreational flows and the economic benefits of non-consumptive uses.

Processes:

- Identify specific locations in the YWG Basin where identified non-consumptive needs are not being met. Apply the findings and results on flow alteration risks and non-consumptive needs from the Watershed Flow Evaluation, Alternative Transfer Methods, and Projects and Methods studies for the YWG Basin and compare those with the hydrologic, operational and depletion assumptions for the PBO and proposed BIP projects. Otherwise, quantify flow needs in time, frequency, and duration at the nodes identified in the study.
- Recommend potential site-specific solutions and projects in collaboration with local water users. Recommended solutions may include an initial analysis of the hydrology (water flow variability); the impact of climate change and interstate compact equities and risk to the hydrology in the YWG Basin, cost, financing, and permitting.
- Perform analyses to maximize the effectiveness of recommended solutions for meeting multiple objectives (i.e. consumptive and non-consumptive). The findings of the P&M Study will again be

considered and applied in assessing the impacts of projects to meet consumptive needs, and in optimizing projects for multiple benefits.[2]

- Recognize that floodplains, riparian areas, and wetlands are natural storage reservoirs, and implement restoration projects to maintain and improve these storage reservoirs. Rehabilitation of degraded riparian areas and reconnection of floodplains in degraded stream systems allows spring floods recharge groundwater tables for slow release to the stream system later in the summer which supports low flows and helps maintain non-consumptive benefits.

Measurable Outcomes:

- To the extent that non-consumptive needs can be specified and projects can be analyzed, there will be projects for non-consumptive attributes within the existing legal and water management context.
- Multi-purpose projects and methods will be researched and designed to meet the other goals enumerated here.
- The PBO and its depletion coverage for the Yampa River Basin for existing and future anticipated and unanticipated depletions will meet base flow targets in critical habitat areas and assist with endangered fish recovery.
- A new PBO is agreed upon for the White River Basin that provides certainty for existing and future anticipated and unanticipated depletions and that assists with endangered fish recovery.
- The flow protection and any water leasing or re-operation of projects needed for native warm water fish, for cottonwoods, and for recreational boating on reaches with greater and overlapping flow alteration risks are integrated with the flow protection for endangered fish recovery and with projects to meet in-basin, consumptive needs. The flow needs of these non-consumptive attributes are otherwise met, including the avoidance or offset of the loss of minimum or optimal boating days that are related to multi-purpose projects and unrelated to drier or wetter hydrology.
- The flow needs for all other non-consumptive attributes are quantified, integrated with projects to meet in-basin consumptive needs, and otherwise met through non-consumptive IPPs. Multipurpose projects will be researched and designed to improve riparian or aquatic ecology and bank stability without changing the existing flow regime while voluntarily modernizing irrigation diversion systems and reducing bedload. Similar projects will be researched and designed to improve recreational boating for existing flows while voluntarily modernizing irrigation systems.
- The economic values of the relatively natural flow regimes of the Yampa and White river systems are recognized and protected, along with the economic values of consumptive water use.
- Acres of restored riparian areas, degraded streams, and wetlands to restore natural water storage capacity, and improve water quantity and quality for non-consumptive needs
- Assess and quantify impact of IPP's on peak flows and ascertain whether further non-consumptive IPP's need to be identified.

1.2.8 Maintain and consider the existing natural range of water quality that is necessary for current and anticipated water uses.

The quality of water in the YWG Basin reflects the health of the natural environment that the western slope of Colorado is known for. Water quality and quantity are intrinsically linked in that quality directly affects the value of a water right for all uses; municipal and industrial, agriculture, recreation, and environmental. As demands for use of this resource increase, water quality management becomes more critical.

[2] Examples of projects include the appropriation of new in-stream flow water rights; water rights and storage leasing; diversion, headgates, structures, and river improvement to allow irrigation efficiencies; and riparian restoration and habitat improvement to improve specific and general watershed health for consumptive and non-consumptive uses alike.

Processes:

- Encourage and support water quality protection and monitoring programs in the sub-basins of the YWG through watershed groups, municipalities, land management agencies and other efforts.

Measurable Outcomes:

- Consider and maintain the existing water quality necessary for current and future water uses when reviewing IPPs.
- Support the Implementation of water quality monitoring programs to create quality-controlled baseline data for all sub-basins of the YWG.

1.2.9 Restore, maintain, and modernize water storage and distribution infrastructure

To preserve critical historical water rights and use, as well as watershed health, existing infrastructure in the YWG Basin must be restored, maintained, and modernized. Gravel pushup dams sometimes are required to maintain agricultural diversions in dry years. Where no storage exists smaller tributary streams are typically inadequate in the late season.

It is particularly important to preserve infrastructure that enables the use of water rights that predate the Colorado River Compact. In many cases restoration or modernization efforts serve to address multiple purposes, such as improved diversion reliability and accuracy, the addition of hydropower generation, and improved fish and boat passage. There is a nexus between infrastructure improvement and watershed health which should be further explored.

Processes:

- Identify opportunities and constraints for agricultural water efficiency improvements (that do not cause injury to other water users or environmental values). This may include interviewing agricultural producers to understand the efficiency, conservation and/or preservation expectations for the YWG Basin.
- Identity specific locations in the Basin where infrastructure requires improvement or replacement to preserve existing uses. This should include identifying locations for small scale agricultural water storage projects throughout the basin and the potential for value-added multi-purpose to be included. I.e. hydropower to finance agricultural storage; reservoir operations.
- Recommend potential solutions in collaboration with local water users. Evaluating solutions to infrastructure needs includes an initial assessment of cost, financing, permitting issues, and potential impacts to other water users. An example may include lining of earthen delivery systems and taking inventory of the capacities of existing reservoirs and repairing storage-limited older projects. Research opportunities and constraints to increase/ expand and maintain the existing water storage capacity in the basin.
- Research potential grant programs for infrastructure improvements.
- Identify and include collective partnerships for infrastructure improvements which may provide multi-use benefit, i.e., fish passage.
- Evaluate appropriate measuring infrastructure for improved administration of the river
- Conduct a headgate study in all three river basins which compiles efficiency and effectiveness of existing structure, accessibility to diversion point, and use.

Measurable Outcomes:

- Increased percentage of operable headgates;

- When applicable, the reduction in the loss of water through less wastage or seepage of water through leaky ditches/ headgates / storage ponds.
- Increased agricultural water storage in combination with multi-benefit opportunities when possible
- Implement at least one project every year in the YWG Basin focusing on the restoration, maintenance, and modernization of existing water infrastructure.

1.2.10 Develop an integrated system of water use, storage, administration and delivery to reduce water shortages and meet environmental and recreational needs.

The YWG Basin has the opportunity to create a system of coordinated operation to meet multiple goals stated for the Basin. An appropriately planned system of storage, use and administration will be conceived to optimize river operations in a manner agreed upon by Basin interests and within the context of private property rights. This system can make these rivers firm for delivery of needed water for municipal and industrial systems, reduce agricultural shortages and decrease low flow threats to environmental needs. With good design and operation, concerns about significant reductions of high flow processes can be mitigated or eliminated. The YWG BRT will utilize modeling to understand the synergy between storage deliveries and return flow delay by agricultural use and conservation. This system can be envisioned with full recognition of existing uses, future depletion allowances determined by PBO negotiations, and obligations of the State to the Colorado in its compacts with downstream states.

Processes:

- CDSS modeling to evaluate storage operation, delivery locations and river flows.
- Evaluate contracting possibilities with existing and proposed storage options.
- Discuss river administration opportunities
- Review needs for infrastructure improvements
- Encourage cooperative partnerships

Measurable Outcomes:

- Success in permitting and constructing in-basin storage projects
- Reduction in consumptive shortages in drought scenarios
- Reduction in identified non-consumptive shortages in drought scenarios
- Administration and infrastructure improvements making decreed amounts of water available to diversion structures with less need for seasonal gravel dams in the river
- Reduce the potential incidence of severe low flows in order for water users to exercise their water rights.

Table of Contents

SECTION 2.0 CONSUMPTIVE AND ENVIRONMENTAL & RECREATIONAL NEEDS

This chapter provides an overview of the Yampa-White-Green Basin's M&I, energy, agricultural and environmental and recreational needs. The majority of information presented in this chapter was developed through a series of State and Basin-wide studies. A summary on each of these studies is provided in Appendix A along with a comprehensive overview of the 2014 Projects and Methods Study (P&M Study), which is the most up-to-date study conducted on the Yampa-White-Green Basin (YWG Basin). The P&M Study incorporates current and future water demand projections to evaluate water supply needs, shortages, in-stream flows and impacts that Identified Projects and Processes (IPPs) may have on the Basin. A large portion of information presented in this chapter and in the BIP originates from this study. This chapter summarizes the most up-to-date information on the Basin's water needs.

2.1 M&I NEEDS

To portray the water needs of growing populations, the municipal and industrial (M&I) demand forecast reflects typical municipal system water needs. Large industrial or self-supplied industrial (SSI) water usage depicts economic growth within the state. M&I and SSI demand terminology used throughout this report is defined in Table 2-1 below.

Table 2-1 Definitions of M&I and SSI Demand Terms

Demand Terminology	Definition
M&I Demand	Water use of typical municipal systems: residential, commercial, light industrial, landscape irrigation and firefighting
SSI Demand	Large industrial water users that have their own water supplies or lease raw water from others: mining, manufacturing, snowmaking, thermoelectric power generation (coal and natural gas facilities) and energy development
M&I and SSI Demand	The sum of M&I and SSI demand

Source: Yampa-White Basin Needs Assessment Report, 2011

A variety of studies have been completed that analyze M&I and SSI water needs in the YWG Basin. These studies evaluate current and forecasted water use and assess water supply gaps. These studies include:

- SWSI 2003 and 2010
- 2011 Basin Needs Assessment
- 2012 Colorado River Water Availability Study
- 2014 P&M Study
- 2011 Energy Development Water Needs Assessment Phase II and 2014 Update

Most of these studies have evaluated M&I and SSI water needs on a county or regional basis. The most recent study, the P&M Study, provides a summary of the YWG Basin's M&I and SSI consumptive needs using the previous reports, but it also evaluated M&I and SSI demands on a more detailed scale, i.e., on a model node basis rather than county level. The discussion that follows regarding M&I and SSI needs, both current and future, will focus on results of the P&M Study.

2.1.1 Current M&I Needs

The YWG Basin is characterized by large areas that are rural and agricultural in nature, with low population density. Therefore, M&I demands are smaller compared to agricultural demands in the YWG Basin. Municipal demands are

focused near the population centers of Craig (Moffat County), Meeker (Rio Blanco County), and Steamboat Springs (Routt County). The SWSI 2010 and Basin Needs Assessment Report county-level values that formed a basis for the P&M Study's more detailed analysis are shown in Table 2-2. These values reflect M&I demands (as of 2008).

Table 2-2 Current M&I Demands, County-level

County	Water Demand (AFY)
Moffat	3,200
Rio Blanco	2,000
Routt	6,500
Total	**12,000**

Source: Yampa-White Basin Needs Assessment Report, 2011; SWSI, 2010

As described in more detail in Appendix A, the P&M Study used the SWSI 2010 and Basin Needs Assessment Report county-level demands and applied them to specific model nodes in the 2009 release of the Yampa and White Basins StateMod models. Table 2-3 presents current M&I demands at each model node, grouped by county[1].

Table 2-3 Current M&I Demands, Model node

Diversion Name	Current Average Annual Water Demand (Diversions)[1] (AFY)
Moffat	
Craig Water Supply Plant (440581)	2,200
District 44 Existing M&I (44_AMY001)	740
District 55 Existing M&I (55_AMY003)	10
Moffat County Total	**2,950**
Rio Blanco	
Rangely Water (430889)	1,710
Meeker Demand (950810)	370
District 43 Existing M&I (43_AMW001)	1,100
Rio Blanco County Total	**3,180**
Routt	
District 57 Existing M&I (above Craig) (57_AMY001)	480
District 58 Existing M&I (Steamboat Springs) (58_AMY001)	1,340
Fish Creek Municipal Intake (580642)[2]	2,910
Routt County Total	**4,730**
Total	**10,860**

Source: P&M Study, 2014
[1]Amounts presented are diversion amounts.
[2]The Fish Creek Municipal Intake (580642) includes Fish Creek direct flow rights (1892) that are pre-1922 with Fish Creek Reservoir storage rights (1946, 1964, 1996) and Yampa wellfield rights (1977, 1992) that are post-1922 and that seasonally pump about 600 AFY.

[1] Future BIP work will include understanding how baseline demands were developed for the P&M Study.

Figure 2-2 below shows a spatial representation of the current M&I demands, and thermoelectric water demands, on a model node basis as presented in the P&M Study.

2.1.2 Future M&I Needs

To estimate future M&I needs, SWSI 2010 used a water planning horizon extending to 2050. The SWSI 2010 and Basin Needs Assessment Report estimates also include passive conservation, and were developed for low, medium and high demand categories. Passive conservation mainly reflects water demand reductions due to policy measures such as those requiring manufacture of more efficient toilets, washing machines and dishwashers and the subsequent installation, or retrofit, of these appliances into existing housing and commercial buildings.

The YWG Basin BIP Subcommittee chose the high demand, low supply scenario from the P&M Study to be analyzed; therefore, only the future high demand results are discussed below. As shown in Figure 2-1, for the high economic growth scenario, the population in the YWG Basin is expected to more than triple by the year 2050. The high population growth scenario includes a 550,000 barrel per day oil shale industry (State of Colorado 2050 Municipal & Industrial Water Use Projections, 2010). Population growth attributed to the oil shale industry is especially evident in Rio Blanco County after 2035. The oil shale industry is discussed further in Section 2.2 SSI Needs.

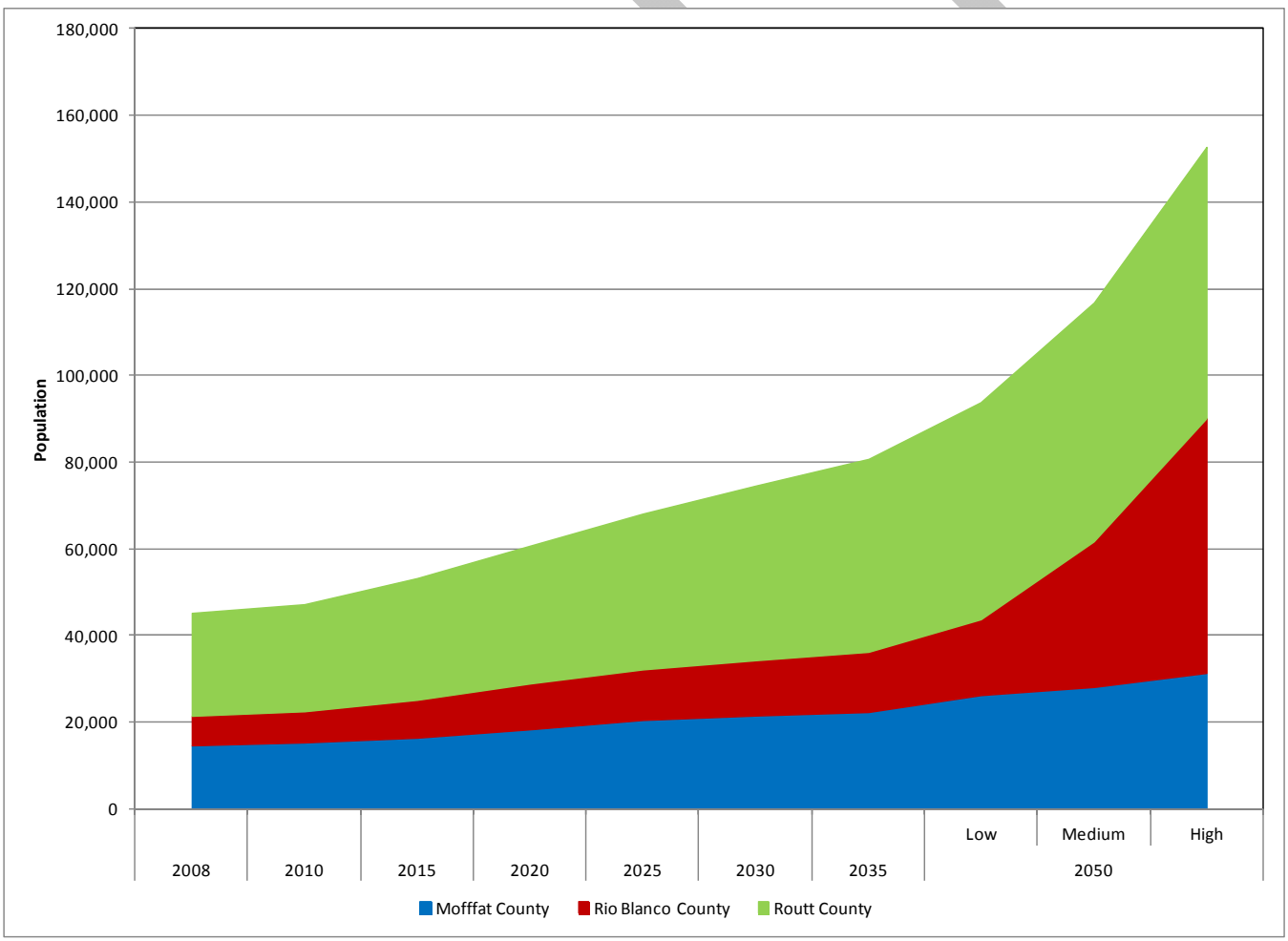

Figure 2-1 Population Projections through 2050

Source: State of Colorado 2050 Municipal & Industrial Water Use Projections, 2010.

As shown in Table 2-4 below, even with passive conservation, the M&I demands are predicted to more than triple as well.

Table 2-4 Future M&I Demands, County-level

County	Current Population	Current Water Demand (AFY) 2008	Future Population 2050 High	Water Demand with Passive Conservation (AFY) 2050 High[1]
Moffat	14,600	3,200	31,000	6,400
Rio Blanco	6,700	2,000	59,000	17,000
Routt	23,800	6,500	63,000	16,000
Total	**45,100**	**12,000**	**153,000**	**39,400**

Source: P&M Study, 2014; Yampa-White Basin Needs Assessment Report, 2011; SWSI, 2010

Table 2-5 presents future M&I demands at each model node, grouped by county.

Table 2-5 Future M&I Demands, Model node

Diversion Name	Future Water Demand (AFY) 2050 High
Moffat	
Craig Water Supply Plant (440581)	5,350
District 44 Existing M&I (44_AMY001)	740
District 55 Existing M&I (55_AMY003)	10
Moffat County Total	**6,100**
Rio Blanco	
Rangely Water (430889)	10,610
Meeker Demand (950810)	2,290
District 43 Existing M&I (43_AMW001)	4,120
Rio Blanco County Total	**17,020**
Routt	
District 57 Existing M&I (above Craig) (57_AMY001)	4,250
District 58 Existing M&I (Steamboat Springs) (58_AMY001)	11,770
Fish Creek Municipal Intake (580642)[1]	2,910
Routt County Total	**18,930**
Total	**42,050**

Source: P&M Study, 2014.
[1]Data do not reflect expected future increase in Steamboat Springs municipal diversions – from 2,900 – 3,000 AFY currently to 4,500 – 6,000 AFY by 2050 depending on population growth projections. This will be addressed in future BIP work.

Figure 2-3 below shows a spatial representation of the future M&I demands, and thermoelectric demands, on a model node basis, as presented in the P&M Study.

2.2 SSI NEEDS

Water is a necessary component for self-supplied industries in Colorado such as mining, manufacturing, food processing, power generation and energy development and is therefore an integral part of these important drivers of the state economy. In fact, the YWG Basin is the only basin in the state where SSI water needs exceed M&I water needs. The SSI subsectors are diverse and are categorized in the following groups for the BIP:

- large industrial
- thermoelectric power generation
- energy development

SSI needs have been analyzed in the same reports mentioned above for M&I and results indicate that currently, the largest SSI water demand in the YWG Basin is for thermoelectric power. However, due to the potential for energy resource development in northwest Colorado, and the concern that traditional water uses in the YWG Basin such as agriculture and recreation could be impacted if large energy industries develop, specific studies have been completed that analyze associated energy water needs in the area. Previous studies developed for the Colorado and YWG Basin include:

- Energy Development Water Needs Assessment Phase I
- Energy Development Water Needs Assessment Phase II
- Energy Development Water Needs Assessment Update (in progress)

The P&M Study represents the most recently completed analysis of current and future SSI water needs and is discussed below. Results from the recently completed Energy Development Water Needs Assessment Update will also be presented and discussed.

2.2.1 Current SSI Needs

Large Industrial

Large industrial demands in the Basin, such as snowmaking demands for the Steamboat Springs ski area, Twenty-mile Mine in Routt County, Trapper Mine in Moffat County, and golf courses in Routt County compose a sizable portion of the demands outside of the typical municipal demands and are therefore categorized separately. For example, Rollingstone Ranch Golf Course (a.k.a. Sheraton Starwood) diverts an average of 115 AFY (max 144 AFY) under a limited lease on a fraction of the Mt. Werner Water District's 5.8 cfs Hoyle & Knight water right (1892). Large industrial demands from SWSI 2010 and the Basin Needs Assessment Report are shown in Table 2-6 below.

Table 2-6 Current Large Industrial Demands, County-level

County	Water Demand (AFY)
Moffat	2,600
Rio Blanco	0
Routt	3,500
Total	**6,100**

Source: Yampa-White Basin Needs Assessment Report, 2011; SWSI, 2010

The P&M Study did not present results for current large industrial demands based on model nodes. This will be addressed in future BIP work[2].

Thermoelectric Power Generation

Despite a mandate requiring 20 percent of the state's electricity to be provided by renewable energy resources by 2020, demand for coal-fired and natural gas energy production will continue into the foreseeable future. In the YWG Basin, two thermoelectric power generation facilities exist – the Craig Station in Moffat County operated by Tri-State, and the Hayden Plant in Routt County operated by Xcel Energy. The current county-level water demands for thermoelectric power generation from SWSI 2010 and the Basin Needs Assessment Report are presented in Table 2-7.

Table 2-7 Current Thermoelectric Power Generation Demands, County-level

County	Water Demand (AFY)
Moffat	17,500
Rio Blanco	0
Routt	2,700
Total	**20,200**

Source: Yampa-White Basin Needs Assessment Report, 2011; SWSI, 2010

In the P&M Study, the county-level demands were distributed to the two existing thermoelectric power generation facilities in the basin, using a methodology similar to that used for M&I demands (described in more detail in Appendix A)[3]. These results are shown in Table 2-8.

Table 2-8 Current Thermoelectric Power Generation Demands, Model Node

Diversion Name	Average Annual Simulated Diversion (AFY)
Moffat	
CRAIG STATION D & PL (Units 1&2) (440522)	8,040
Tri-State (Unit 3) (440522b)	4,020
Moffat County Total	**12,060**
Routt	
COLO UTILITIES D & PL (Hayden Station) (570512)	4,890
Routt County Total	**4,890**
Total	**16,950**

Source: P&M Study, 2014.

Figure 2-2 shows a spatial representation of the current M&I and thermoelectric water demands on a model node basis as represented in the P&M Study.

[2] Future BIP work will include understanding whether baseline large industrial demands were included in the P&M Study model.
[3] Discrepancies between model node and county-level data will be addressed in future BIP work.

Figure 2-2 Baseline M&I and Thermoelectric Power Generation Demands

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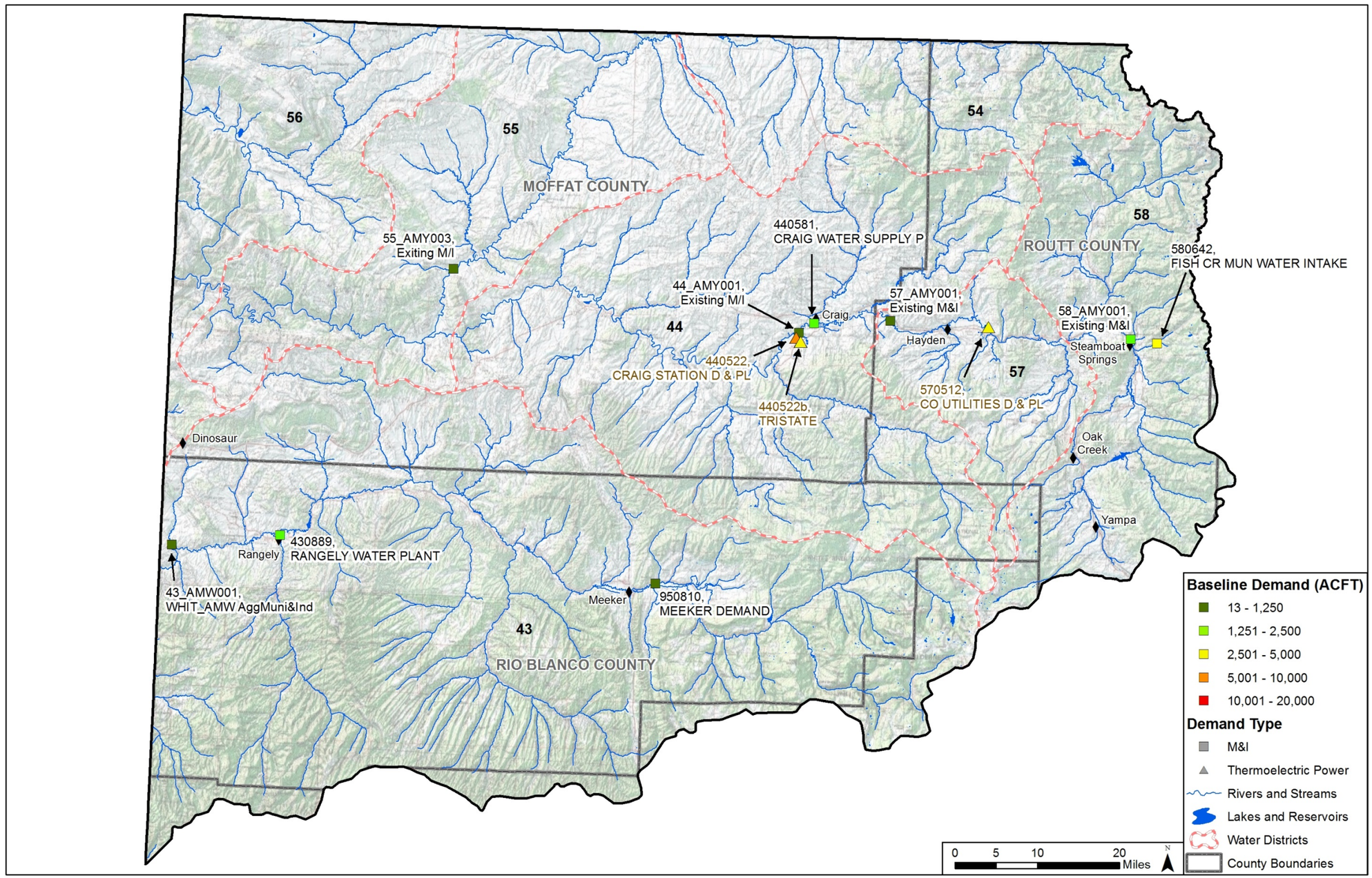

Source: P&M Study, 2014.

Energy Development

Studies have been completed that evaluate the current and future water requirements of various energy development sectors in northwest Colorado, in particular for the natural gas, uranium, coal and oil shale industries. Some components of the water needs are included in the M&I and thermoelectric power generation demands discussed above, but direct demands for oil shale development, which includes the water required for construction, operation, production and reclamation, are included in a separate category. Future work with the BIP will address whether or not current demands for these categories were evaluated in the P&M Study[4].

2.2.2 Future SSI Needs

Large Industrial

The P&M Study did not appear to evaluate future large industrial needs as a separate category as previous reports have. This will be addressed in future versions of the BIP[5].

Thermoelectric Power Generation

Since thermoelectric power demands are related to needs of the population served, it will trend in a similar manner to changes in population and the associated M&I demands. As stated for M&I demands, the BIP is presenting the high demand, low water supply scenario results from the P&M Study. County-level thermoelectric future (high demand) needs from SWSI 2010 and the Basin Needs Assessment Report are shown in Table 2-9.

Table 2-9 Future Thermoelectric Power Generation Demands, County-level

County	Current Water Demand (AFY) 2008	Water Demand with Passive Conservation (AFY) 2050 High
Moffat	17,500	26,900
Rio Blanco	0	0
Routt	2,700	17,100
Total	**20,200**	**44,000**

Source: Yampa-White Basin Needs Assessment Report, 2011; SWSI, 2010

Results for future thermoelectric demands from the P&M Study based on model nodes as shown in Table 2-10.

[4]Future BIP work will include understanding how baseline demands were accounted for in the P&M Study or if they were left out due to small volumes of depletions.

[5] Future BIP work will include understanding whether future large industrial demands were included in the P&M Study model.

Table 2-10 Future Thermoelectric Power Generation Demands, Model node

Diversion Name	Future Water Demand (AFY) 2050 High
Moffat	
CRAIG STATION D & PL (Units 1&2) (440522)	17,930
Tri-State (Unit 3) (440522b)	8,970
Moffat County Total	**26,900**
Routt	
COLO UTILITIES D & PL (Hayden Station) (570512)	17,100
Routt County Total	**17,100**
Total	**44,000**

Source: P&M Study, 2014.

Figure 2-3 below shows a spatial representation of the future M&I demands and thermoelectric demands on a model node basis.

Figure 2-3 Future M&I and Thermoelectric Power Generation Demands

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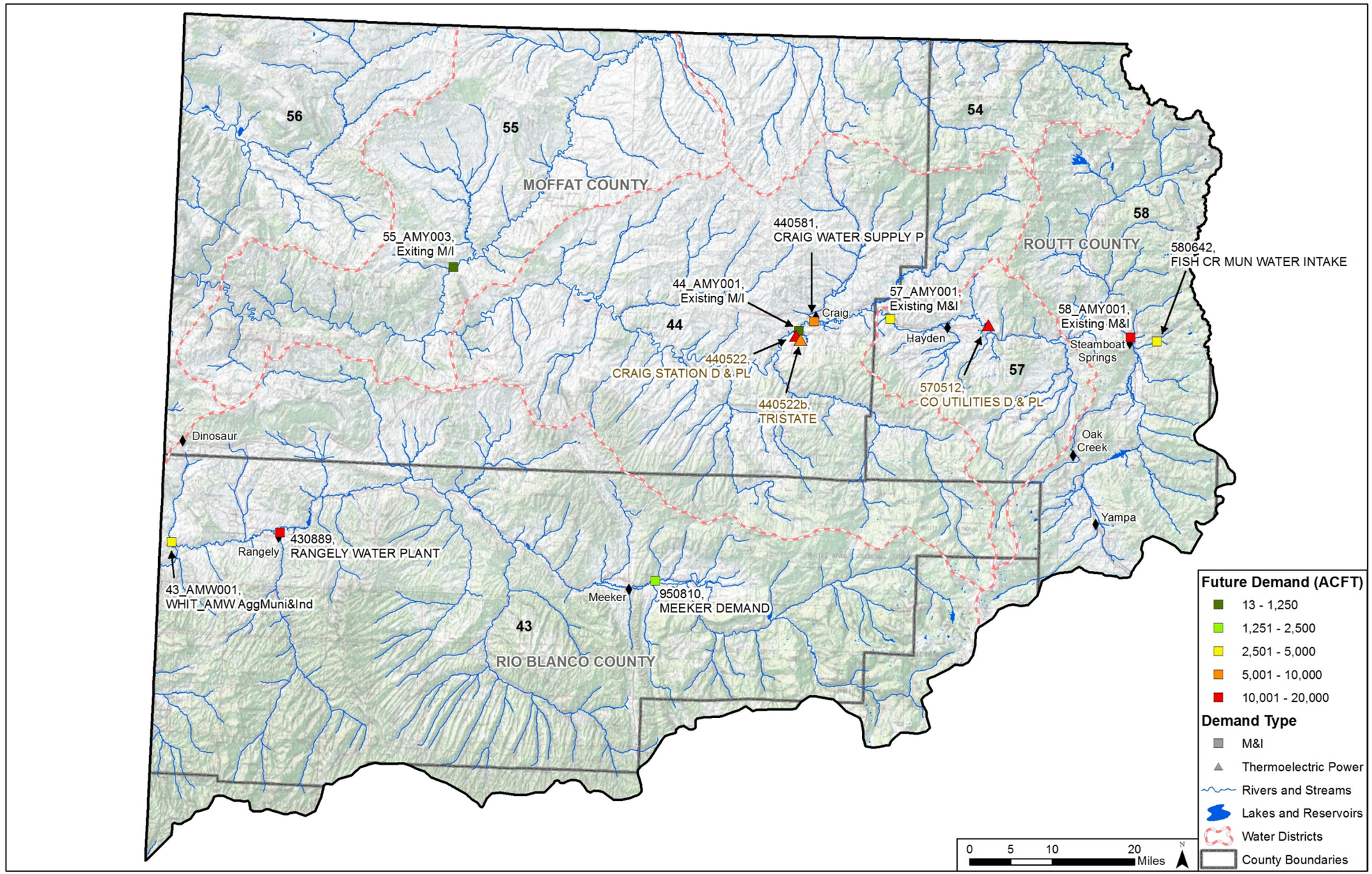

Source: P&M Study, 2014.

Energy Development

The Energy Development Water Needs Assessment Studies estimated water uses associated with the development of the four energy sectors of natural gas, oil shale, coal, and uranium (URS 2008; AMEC 2011; and AMEC 2014). The water uses include direct demands, water supplies serving the operations, construction, processing, and reclamation purposes; indirect demands, attributed to the municipal and domestic water supplies required by the growth in population associated with the development of the resources; and water uses for thermoelectric power generation, power supplies for the new population growth and a portion of the industrial power requirements. The Energy Development SSI water uses includes only the direct uses associated with each energy sector. The indirect uses are included in the M&I estimates and the thermoelectric demands are included in SSI thermoelectric demands as discussed above.[6]

The recently completed Energy Development Water Needs Assessment Study Phase III reviewed and updated the direct water uses for energy development. The Phase III study carries forward the Phase I water use estimates for the coal and uranium sectors (because there is no new information or development prospects in those sectors) and updates water use estimates for the oil shale and oil and gas sectors. Since the Phase II report was published, both Chevron and Shell have ended their oil shale research projects in Colorado. The National Oil Shale Association markedly reduced water use estimates mainly because the large in situ projects proposed by Chevron and Shell were discontinued. Therefore, the Phase III reports new water use estimates for oil shale. Additionally, the Phase III report updates the direct water uses associated with oil and gas well drilling and completions since new information on drilling activity and resource development planning is available since 2008.

The BIP is focusing on the high demand, low supply scenario; correspondingly the high production level and water use estimates for the four energy sectors are presented in Table 2-11.

Table 2-11 Future Energy Sector Development Direct Demand Forecast

Energy Sector	Water Demand Levels (AFY) 2050 High Production
Natural Gas and Oil	6,000
Uranium	130
Coal*	6,000
Oil Shale	76,000
Total	**88,000**

Source: Phase III Energy Water Development Needs Study, 2014.
*Updated with information from Peabody Coal feasibility planning for Peabody-Trout Creek water supply project.

The P&M Study did not include evaluation of the small and nearly insignificant water demands associated with uranium development. For the water supplies associated with oil and gas, the P&M Study stated that "demands will not be met through direct diversion rights" and did not model those uses. Nonetheless, water supplies for drilling and well completion will, in part, come from tributary sources (AMEC 2014).

P&M modeling included a water supply project for the coal energy sector based on updated information developed in the Peabody-Trout Creek water supply feasibility studies. The work focused on a water storage project on Trout Creek upstream of the confluence with the Yampa River. This project will be developed to help Peabody Energy meet 6,000 AFY of energy development demands as part of the Peabody-Trout Creek Project. The BIP will adopt the existing analyses and update as may be determined later in this process.

[6] Oil shale development direct demands include water supplies for electrical generation as required for the electrical heating in situ commercial technologies.

The P&M Study did not re-evaluate or model direct water demands associated with a commercial oil shale industry. The P&M Study carried forward the evaluations of oil shale water supplies developed in the Energy Development Water Needs Assessment Phase II report. The Phase II report scenarios and results are discussed further in Section3.

2.3 AGRICULTURAL NEEDS

2.3.1 Current Agricultural Needs

Irrigated Acreage

Irrigated acreage in the YWG Basin has varied over the past several decades, fluctuating between approximately 86,000 and 119,600[7] acres in the Yampa and Green basins while irrigation in the White Basin has remained relatively stable. Figure 2-4, shows the total irrigated acres in the YWG Basin. The most recent estimates of irrigated acreage indicates that there is a total of 100,900 irrigated acres in the Basin, of which 27,500 acres are in the White Basin, and 73,400 acres are in the Yampa and Green basins.[8] Almost all of the acreage is irrigated with surface water; groundwater pumping in the Basin is minor relative to surface water diversions. The irrigation demands in the Agricultural Water Needs Study and the P&M Study were based on the irrigated acreage from 1993 totaling 119,607 acres, however.

[7] Source: Agricultural Needs Assessment, 2010.
[8] This is based on the CDSS 2005 spatial GIS coverage of the irrigated areas in the Basin.

Figure 2-4 Current Irrigated Acres

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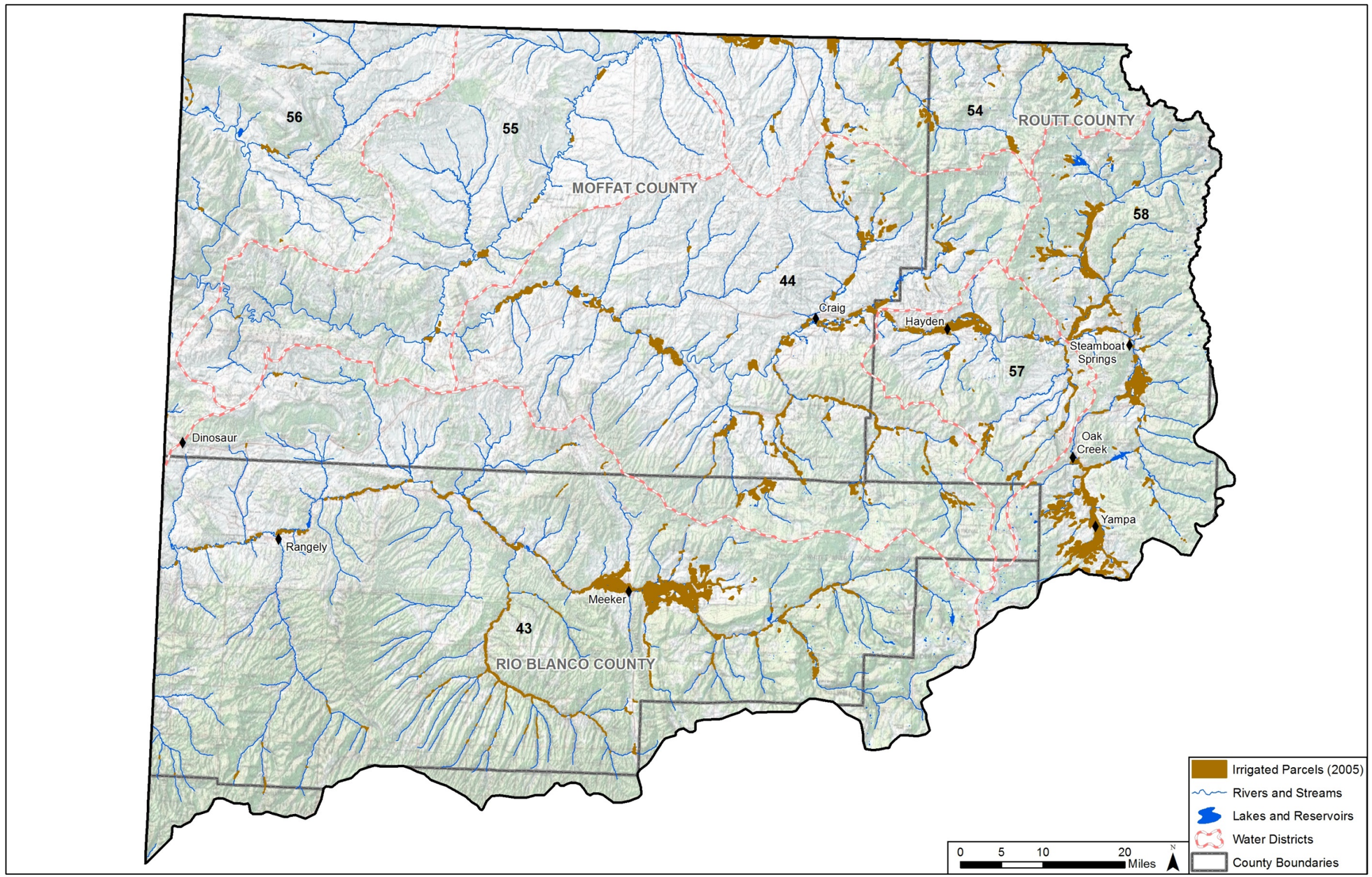
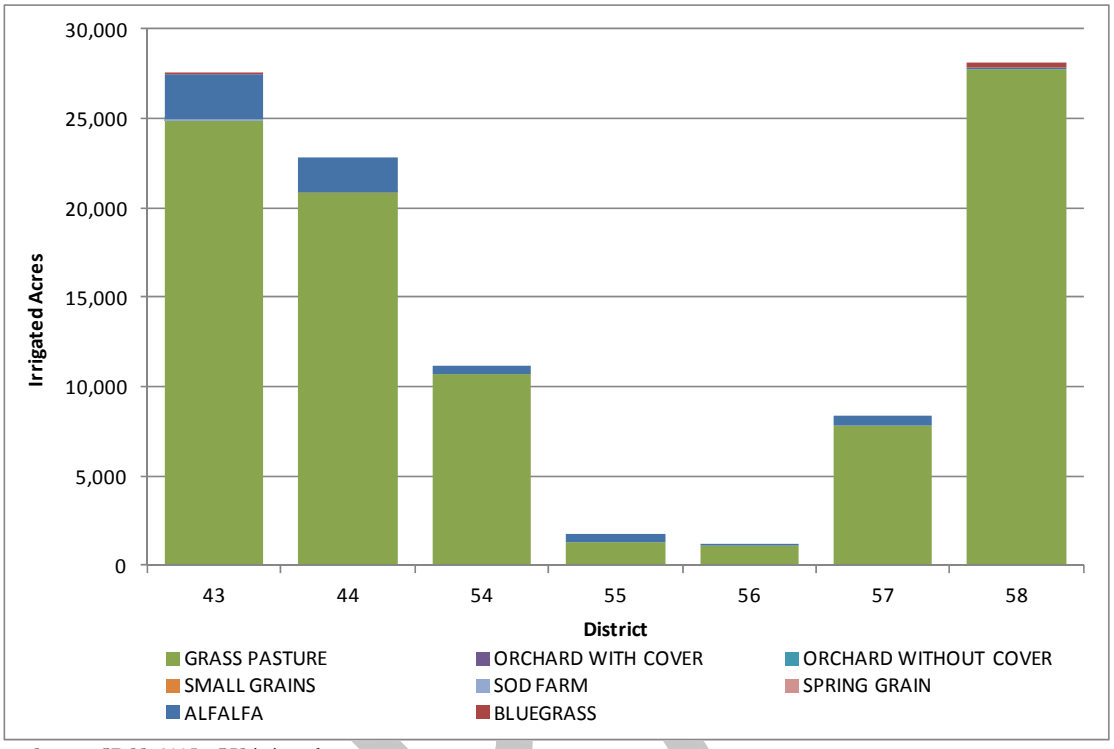


Source: CDSS, 2005. GIS irrigated acres.

Figure 2-5 shows the irrigated acres by crop type for each water district. District 58 has the greatest amount of irrigated acres followed by District 43 and District 44. The majority of crops grown in the Basin are grass/pasture and hay. A small amount of alfalfa is grown in District 43, 44, 54, 55 and 57 while District 58 grows a small amount of bluegrass.

Figure 2-5 Current Irrigated Acres by Water District



Source: CDSS, 2005. GIS irrigated acres.
Note: The bluegrass component represents the acreage of golf courses and recreational parks.

Current Irrigation Demands

The current irrigation headgate demands are shown in Figure 2-6. These irrigation demands account for estimates of irrigation system efficiency, representing the amount of water diverted from the stream to meet the irrigation water requirement (IWR) by hydrologic unit code (HUC).[9] The largest amount of irrigation water diverted from the stream at the ditch headgate (this includes water used to meet the consumptive IWR in addition to diversions and irrigation losses) occurs in District 58 upstream of Steamboat Springs in the Yampa Basin and in District 43 upstream of Meeker in the White Basin. These areas are shown as red in Figure 2-6.

The current average annual consumptive IWR for the Basin used for this BIP is taken from the Agricultural Water Needs Study and is 229,018 acre-feet. This total consumptive demand in irrigation is broken down by sub-basin and compared with other recent estimates in Table 2-12.

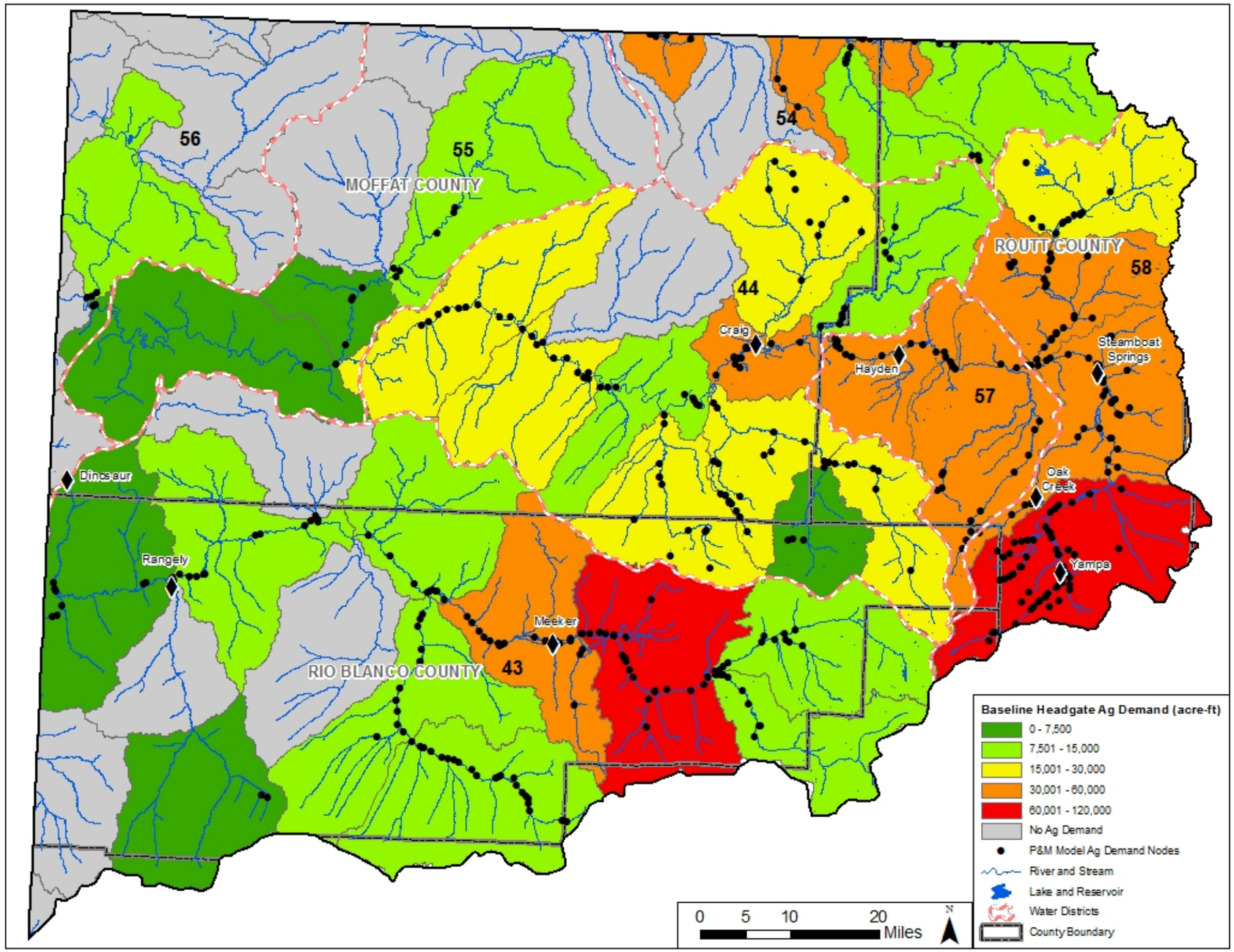
[9] The IWR is defined as the potential crop evapotranspiration minus effective precipitation (amount of precipitation that is used by the crop). The IWR does not include losses incurred through ditch seepage and through application onto the field.

Table 2-12 Average Annual IWR in Different Model Versions (acre-feet)

Basin/Stream (Water District)	SWSI	CDSS 2008	Agriculture Needs and P&M Study*
White (43)	32,634	39,465	45,740
Green (56)	2,878	2,759	3,516
Yampa *(Sub-basins in italics below)*	104,248	170,207	179,762
Study Area	**139,760**	**212,431**	**229,018**
Lower Yampa (44)	*37,924*	*49,828*	*55,003*
Slater/Timberlake (54)	*19,673*	*32,160*	*33,401*
Little Snake (55)	*2,529*	*2,407*	*2,869*
Middle Yampa (57))	*10,136*	*14,449*	*16,556*
Upper Yampa (58)	*33,986*	*71,364*	*71,933*

Source: Agricultural Water Needs Study, 2010. Note: The demands presented in this table are IWR demands which do not include system losses from the headgate diversion to the field. Figure 6 provides the headgate diversions for the 2014 P&M Study.

Figure 2-6 Baseline Headgate Agricultural Water Demands



Source: 2014 P&M Study. Modeling Results.

Other Current Agricultural Water Demands

In addition to irrigation water demands, statewide planning efforts (SWSI 2010) have estimated non-irrigation agricultural demands. These include livestock consumptive use and stockpond evaporation[10] and are provided in Table 2-13. These non-irrigation agricultural demands are relatively minor when compared to the irrigation demands discussed above and were not incorporated into the P&M Study.

Table 2-13 Non-Irrigation Agricultural Demands

Water District	Livestock Consumptive Use (acre-feet)	Stockpond Evaporation (acre-feet)*	Total (acre-feet)
Lower Yampa (44)	306	2,493	6,728
Slater/Timberlake Crks (54)	102	not provided	2,921
Little Snake River (55)	186	619	1,072
Green River (56)	121	not provided	418
Middle Yampa (57)	65	not provided	1,422
Upper Yampa (58)	149	not provided	5,485
Total	**929**	**3,112**	**18,046**

Source: CWCB SWSI, 2010
*Estimates of stockpond evaporation were not provided for Water Districts 54, 56, 57, and 58 in SWSI 2010.

2.3.2 Future Agricultural Needs

Future Irrigated Acreage

SWSI lists a variety of factors that could impact the future development and/or reduction of irrigated acres in the Basin. These include the following:

- Urbanization and transfers from agricultural to M&I
- Water management decisions
- Demographic factors
- Biofuels production
- Climate change
- Farm programs
- Subdivision of agricultural lands and lifestyle farms
- Yield and productivity
- Open space and conservation easements
- Economics of agriculture

SWSI 2010 developed estimates of the decrease in irrigated acres as a result of urbanization and municipal to agricultural transfers, assuming 119,000 acres of current irrigation.[11] These estimates indicate that in the YWG Basin 1,000 to 2,000 acres (approximately 2%) may be removed from irrigation as a result of land acquisition and development in urban centers throughout the regions. This is relatively low when compared to other basins in the State. SWSI also indicated that an additional 3,000 to 64,000 acres may be taken out of agricultural production in the

[10] SWSI 2010 also provided estimates of incidental losses which occur along canals and tailwater areas. These losses are incorporated in the irrigation water demands at the model models in the P&M Study and therefore are not included in Table 2-13.
[11] This based on CDSS's 1993 irrigated acres GIS coverage.

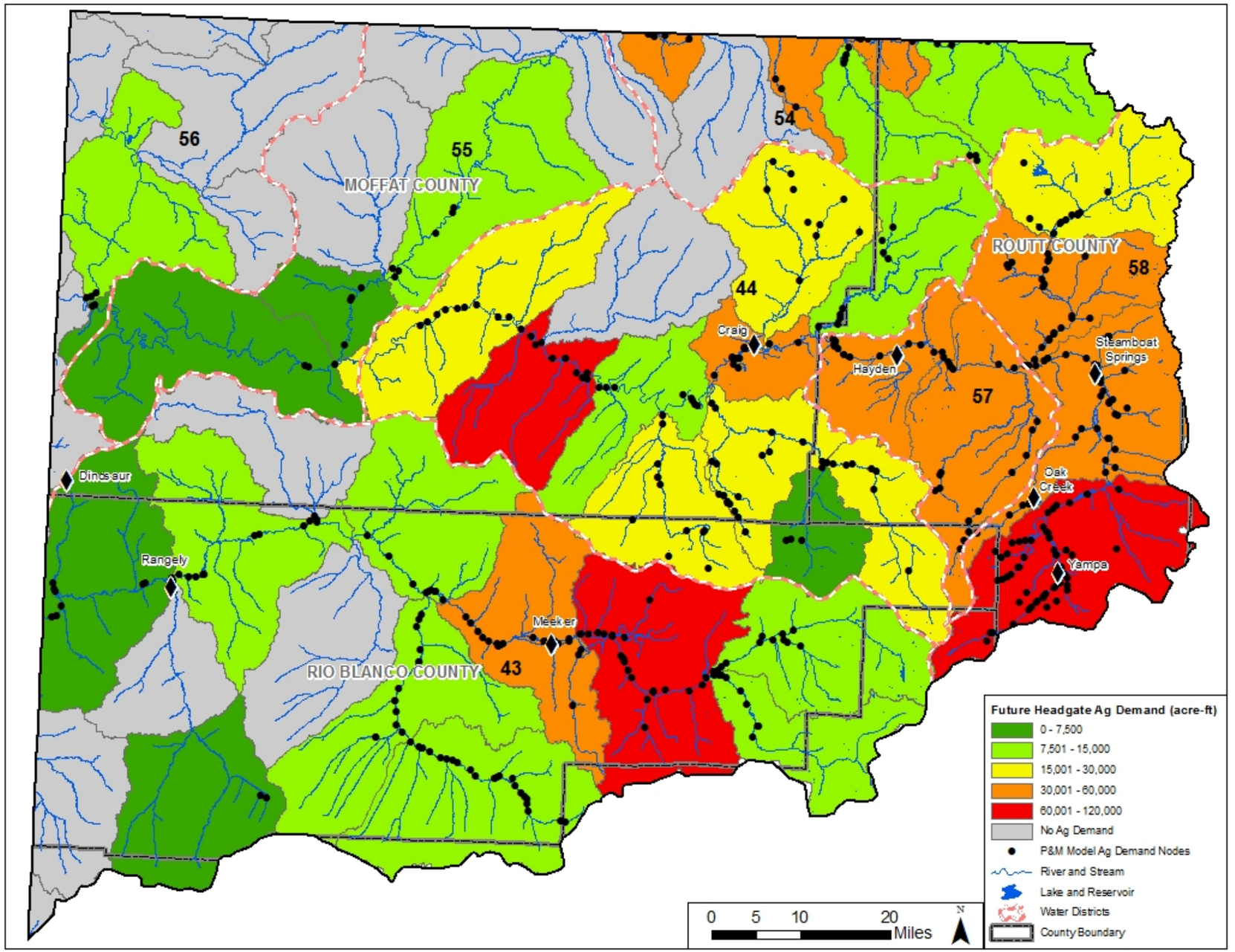
Basin due to in-basin agricultural to municipal water transfers needed to meet growing M&I water demands, but some of the growing demands may be supplied by new appropriations. These results suggest that the total irrigated acres in the YWG Basin could range from 53,000 to 115,000 acres by 2050. Irrigated acres are also anticipated to increase in certain areas of the Basin. The P&M Study and Agricultural Water Needs Study estimate that 7,400 to 14,805 acres may be developed along the oxbows of the Yampa River, yet does not assume any reduction in irrigated acres. This is further described in the next section.

Future Irrigation Demands

The YWG Basin's future irrigation demands at the ditch headgate are shown in Figure 2-7 by HUC. These demands were developed using the StateCU model for the Agricultural Water Needs Study and P&M Study. Figure 2-8 shows the future irrigation demands relative to current demands. The demand projections assume that 14,805 acres[12] of irrigation is developed on the Yampa oxbows and the remainder of the Basin continues to irrigate at current levels based on the acreage reported by CDSS in 1993. The reduction of 1,000 to 2,000 irrigated acres due to urbanization or the reduction of 3,000 to 64,000 acres due the transfers to meet a municipal gap estimated for SWSI 2010 was not included in this estimate, given the uncertainty on the amount of reductions and where they would occur in the Basin. This is reflected in Figure 2-7 and Figure 2-8, where the irrigation demand increases in the downstream portion of District 44, yet no additional changes occur elsewhere in the Basin.

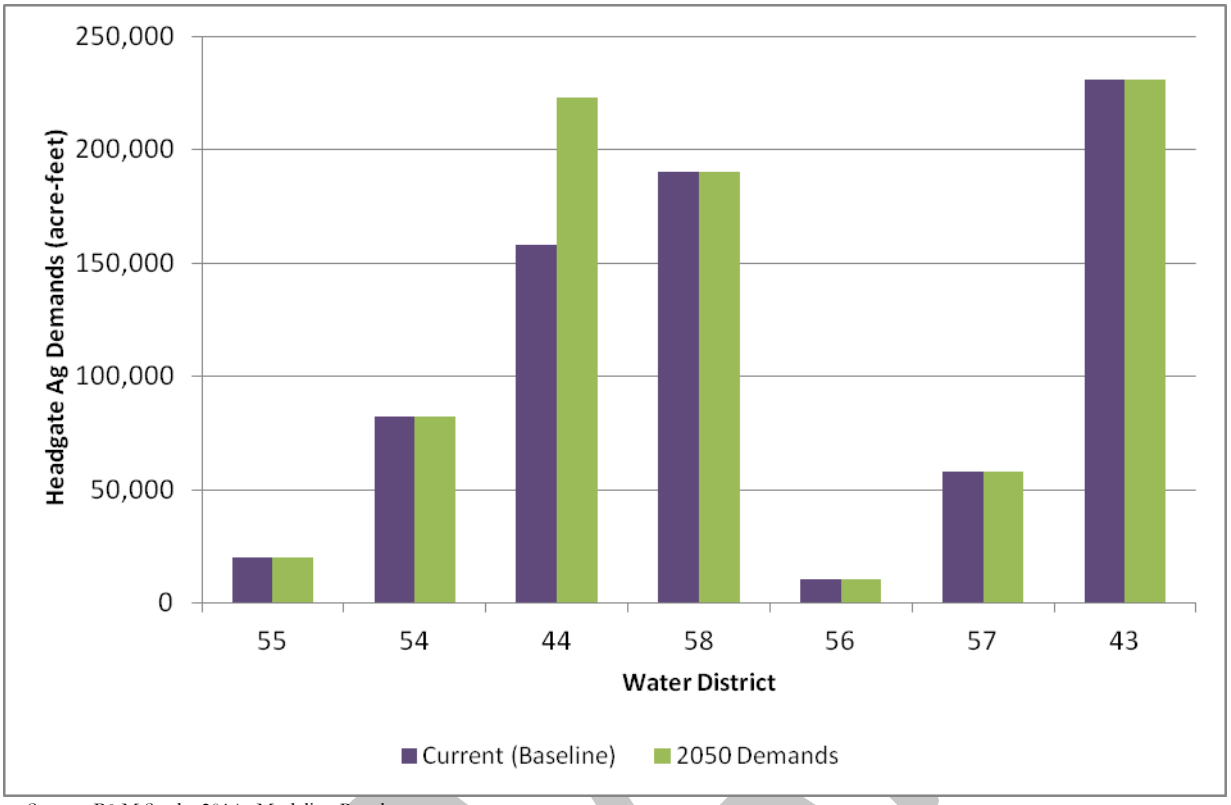
[12] As part of the Agricultural Needs Assessment, SWSI identified a total of 14,805 acres of potentially irrigable acreage that can be developed in the future along the oxbows of the Yampa River.

Figure 2-7 Future Headgate Agricultural Water Demands



Source: P&M Study, 2014. Modeling Results.

Figure 2-8 Current and Future Headgate Agricultural Demands (acre-feet)



Source: P&M Study, 2014. Modeling Results.

2.4 ENVIRONMENTAL AND RECREATIONAL NEEDS

One of the many attractive attributes of the YWG Basin is the outdoor environment and recreational opportunities. Many popular recreational activities including skiing, hunting, bicycling, camping, hiking, reservoir-based recreation, fishing, wildlife viewing and boating depend on the health of the environment and/or are water based activities. The recreational and environmental needs identified in this BIP are intended to maintain or improve the natural flows supporting environmental attributes and recreational activities.

2.4.1 Focus Areas and Environmental and Recreational Attributes

Through a variety of State and Basin-wide planning efforts, the YWG Basin developed a map of environmental and recreational focus areas.[13] These focus areas are depicted in Figure 2-9 and can be used as a planning tool when identifying needs and potential future projects. However, while these focus areas are located in areas with key environmental and recreational attributes, environmental attributes exist on virtually all streams and lakes. New IPPs can be advantageous in the designated focus areas as well as in other stream reaches within the Basin. For instance attributes associated with major stream reaches are commonly dependent on conditions in upstream tributary reaches. The achievement or maintenance of attributes depends upon achieving or maintaining necessary values in upstream reaches in addition to the subject main reach. Table 2-14 provides the environmental and recreational attributes associated with each focus area. This table was developed through the nonconsumptive needs focus mapping and are presented in the Watershed Flow Evaluation Tool (WFET) study.

[13] CWCB, 2010. Nonconsumptive Needs Focus Mapping Report.

Figure 2-9 Focus Areas

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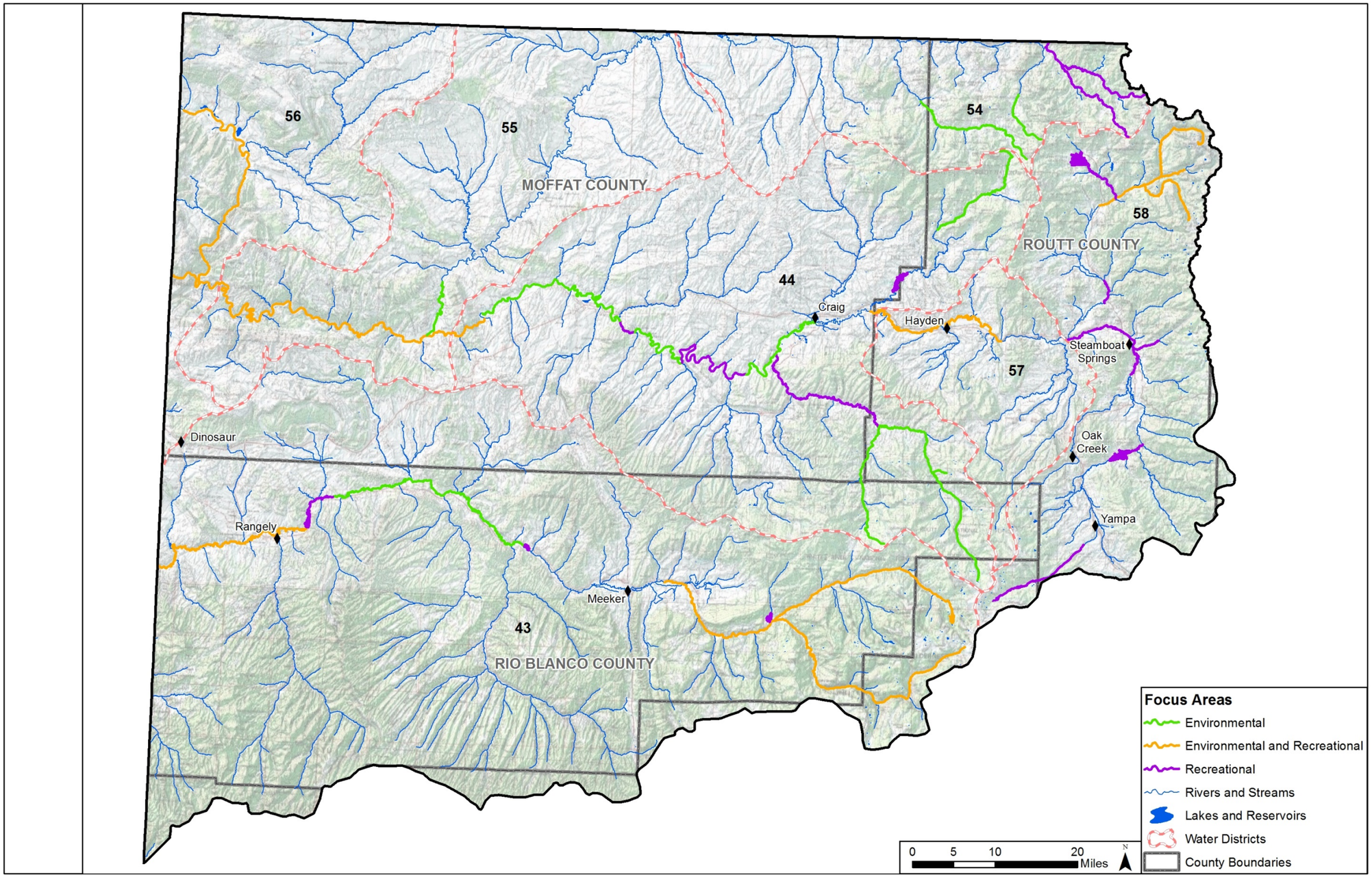

Source: CWCB, 2014. GIS shapefiles produced in support of BIP. SWSI 2010 and 2016.

Table 2-14 Attributes of Major Stream and Lake Segments

No.	Stream or Lake Segment (Based Upon Segment Maps)	ATTRIBUTE CATEGORY	1. Federal Threatened & Endangered Fish	2. State Threatened and Endangered Species	3. Important Riparian Habitat	4. Instream Flows and Natural Lake Levels	5. Fishing	6. Boating	7. Waterfowl Hunting	Rationale for Consideration as a Major Segment
				Major Environmental & Recreational Segments						
1	Yampa River - from entrance of Cross Mountain Canyon (East Cross Mountain) to confluence with Green River		a,b,c,d,e	a,b,c,f,e	a,b		c	a	a	Multiple environmental values including critical habitats for endangered fish plus Yampa's most sought after white water and overnight rafting destination including Dinosaur National Monument
2	Yampa River - from Pump Station to confluence of Elkhead Creek			a,c,e,f	a,c		c	a	a	Multiple environmental values plus high use boating and fishing includes TNC's the Carpenter Ranch
3	Green River - from Utah State line (Browns Park Wildlife Refuge) to the Utah State line		a,b,d	a,c,e,f	a,b,c		c	a	a	Multiple environmental and recreational values includes Browns park National Wildlife Refuge and rafting in Dinosaur National Monument
4	Elk River - from headwaters to the County Road 129 bridge at Clark; including the North, Middle and South Fork as well as the mainstem of the Elk			d,f,g	b	a	c	a		Multiple environmental and recreational values including high levels of recreation and significant fisheries use, multiple/critical environmental values
5	White River - from headwaters to Meeker; including the North and South Fork and mainstem of the White			c,d,f	a,b	a	c	a	a	Multiple environmental and recreational values including most extensive, valuable connectivity of Colorado Cutthroat Trout populations in the Yampa/White/Green basin; G1-G3 plant/wetland communities; valuable private and public water fisheries providing significant economic benefits for the upper White basin
6	White River - below Kenney Reservoir dam to Utah State line		b,d,e	a,b,c,f			c	a	a	Multiple environmental and recreational values including critical habitat for endangered fish
				Major Environmental Segments						
7	White River - from Rio Blanco Lake Dam to Kenney Reservoir		b,e	a,b,c				a		Multiple environmental and recreational values including critical habitat for Federal endangered species, multiple state aquatic species of concern
8	**Slater Creek - from headwaters to the Beaver Creek confluence**			**d**	**b**		c	a		**Valuable connectivity of Colorado Cutthroat Trout populations, with G1-G3 plant communities and multiple recreational opportunities**

No.	Stream or Lake Segment (Based Upon Segment Maps)	ATTRIBUTE CATEGORY	1. Federal Threatened & Endangered Fish	2. State Threatened and Endangered Species	3. Important Riparian Habitat	4. Instream Flows and Natural Lake Levels	5. Fishing	6. Boating	7. Waterfowl Hunting	Rationale for Consideration as a Major Segment
9	Elkhead Creek - from headwaters to confluence of North Fork of Elkhead Creek			a,d	b	a		a		Valuable connectivity of Colorado Cutthroat Trout populations, Boreal toad as well as G1-G3 plant communities and recreational opportunities
10	South Fork of the Little Snake - from headwaters to confluence of Johnson Creek			a,d		a				Valuable connectivity of Colorado Cutthroat Trout populations
11	South and East Fork of the Williams Fork - from headwaters to the confluence of the Forks			d,f	b	a	c			Valuable connectivity of Colorado Cutthroat Trout populations
12	Little Snake River - from Moffat County Road 10 to confluence of the Yampa River		c,d	b	a,b					Significant environmental values including occurrences of Colorado Pikeminnow and rare collections of Humpback Chub, populations of Roundtail Chub and valuable riparian plant communities
13	Yampa River - from Craig (Hwy 394 Bridge) to mouth of Cross Mountain Canyon		d,e	b,e,f	b		c	a	a	Critical habitat for Federal endangered species, multiple state aquatic species of concern
	Major Recreational Segments									
14	Yampa River - from Stagecoach Reservoir "Tailwaters" to northern boundary of Sarvis Creek State Wildlife area			a,c	a	a	c		a	High recreation and fisheries use
15	Fish Creek - from Fish Creek Falls to confluence of the Yampa River				a	a		a		Most significant, highest use kayaking "creek run" in basin
16	Yampa River - from Chuck Lewis Wildlife Area to Pump Station			a,c,e,f	b		c	a,b	a	Highest recreation use along entire Yampa River allowing for multiple recreational opportunities; only RICD in entire Yampa/White/Green Basin
17	Elk River - at Christina State Wildlife Area			c		a	c			Highest public fishery use on Lower Elk River
18	Willow Creek - below Steamboat Lake to confluence with the Elk				a		c	a		Valuable kayaking creek and fisheries use
19	Bear River - from headwaters to USFS boundary			d			c			Cutthroat Trout habitat and significant recreational fishing
20	Stagecoach Reservoir			a			c	a	a	High recreation and fisheries use

No.	Stream or Lake Segment (Based Upon Segment Maps)	ATTRIBUTE CATEGORY	1. Federal Threatened & Endangered Fish	2. State Threatened and Endangered Species	3. Important Riparian Habitat	4. Instream Flows and Natural Lake Levels	5. Fishing	6. Boating	7. Waterfowl Hunting	Rationale for Consideration as a Major Segment
21	Elkhead Reservoir						c	a	a	High recreation and fisheries use
22	Steamboat Lake			d	a		a,b	a	a	High recreation and fisheries use including only Gold Medal Water in basin
23	**Little Snake River - from headwaters of Middle Fork of the Little Snake River and King Solomon Creek to Wyoming border**			**a,c,d**	**b**	**a**	**c**	**a**		**Important fishery including public access and private waters; significant environmental values**
24	**Williams Fork - from South Fork to confluence of the Yampa River**				**a,b**	**a**	**c**			**Important Fishery**
25	**Avery Lake**						**c**		**a**	**Important recreational destination**
26	**Rio Blanco Reservoir**				**b**		**c**		**a**	**Important recreational destination**
27	**Kenny Reservoir**						**c**	**a**	**a**	**Important recreational destination**
28	**Yampa River - Duffy Canyon**		d,e	b,e,f	b		**c**	**a**	**a**	**Important recreational canyon**
29	**Yampa River - Little Yampa Canyon**		d,e	b,e,f	b		**c**	**a**	**a**	**Important recreational canyon**
30	**Yampa River - Juniper Canyon**		d,e	b,e,f	b		**c**	**a**	**a**	**Important recreational canyon**

[1] The CWCB's Statewide Water Supply Initiative Report (http://cwcb.state.co.us/WATER-MANAGEMENT/WATER-SUPPLY-PLANNING/ Pages/SWSI2010.aspx) provides further detail on the data sources used to generate this map.

KEY TO ATTRIBUTE CODES

Attribute 1 - Federal Threatened & Endangered Fish
- a. Bonytail Chub
- b. Razorback Sucker
- c. Humpback Chub
- d. Colorado Pikeminnow
- e. Federally Listed Critical Habitat

Attribute 2 - State Threatened and Endangered Species
- a. Bluehead Sucker
- b. Roundtail Chub
- c. Flannelmouth Sucker
- d. Colorado River Cutthroat Trout
- e. River Otter
- f. Northern Leopard Frog
- g. Boreal Toad

Attribute 3 - Important Riparian Habitat
- a. Riparian/Wetland - Dependent Rare Plants
- b. Significant Riparian/Wetland Plant Communities
- c. Audubon Important Bird Areas

Attribute 4 - Instream Flows and Natural Lake Levels
- a. CWCB Instream Flow Water Rights
- b. CWCB Natural Lake Level Water Rights

Attribute 5 - Fishing
- a. Gold Metal Trout Streams
- b. Gold Medal Trout Lakes
- c. Significant Fishing Waters (based on local knowledge)

Attribute 6 - Boating
- a. Rafting/kayaking/flatwater Reaches
- b. Recreational In-Channel Diversion Structures

Attribute 7 - Waterfowl Hunting
- a. Waterfowl Hunting

Notes (disclaimer verbiage):
1. Nonconsumptive environmental and/or recreational attributes exist on virtually all stream and lake segments, whether such attributes are identified herein or not. Exclusion of a segment from this chart does not indicate absence of non-consumptive attributes.
2. Attributes associated with the major segments are commonly dependent on conditions in upstream tributary segments. Therefore, the achievement or maintenance of non-consumptive attributes depends upon achieving or maintaining necessary values in upstream segments as well as within the major segment itself.

Important Riparian Habitats were considered based on the following CNHP rankings:

G/S1 Critically imperiled globally/state because of rarity (5 or fewer occurrences in the world/state; or 1,000 or fewer individuals), or because some factor of its biology makes it especially vulnerable to extinction.

G/S2 Imperiled globally/state because of rarity (6 to 20 occurrences, or 1,000 to 3,000 individuals), or because other factors demonstrably make it very vulnerable to extinction throughout its range.

G/S3 Vulnerable through its range or found locally in a restricted range (21 to 100 occurrences, or 3,000 to 10,000 individuals).

Source: WFET, 2012

2.4.2 Evaluation of Environmental Needs

The YWG Basin evaluated the recreational and environmental needs in the Basin through the P&M Study and WFET. The WFET provides series of criteria to quantitatively measure and compare environmental and recreational risks based on existing and modeled flow conditions in the Yampa and White basins. This methodology is incorporated into the P&M Study to assess risk to environmental and recreational uses indicated by the P&M Study model runs.

The P&M Study specifically addresses the target at the Maybell gage for augmenting existing base flows to assist in endangered fish recovery[14] and instream flow shortages and incorporates a series of risk-based ecology and flow relationship metrics to assess how current and potential future flows could impact the ecology and boating at specific locations within the Basin. This section focuses on the results of the modeled current condition in the P&M Study and also provides an overview of the Green River Biological Opinion. Future environmental and recreation needs will depend on a multitude of factors including future water development and climate conditions. These future needs are addressed in Chapter 3.

Instream Flows

CWCB instream flow reaches are decreed water rights used to protect flow levels in delineated stream reaches throughout the State. The instream flows protect diverse environments including cold water and warm water fisheries, as well as critical habitat for threatened or endangered native fish in the Yampa and White basins. These instream flows have decreed water rights and therefore provide flow protection in the designated reaches. Upstream and intervening junior water users are not able to divert water from the stream which could result in flows less than the decreed flow rates. It is noted that the targeted decreed flow rates for instream flows are often developed based on the minimum flows necessary to sustain natural conditions. The aquatic health of many streams can often be improved through flows that exceed the minimum decreed limits.

Figure 2-10 shows the decreed instream flows within the YWG Basin and the instream flows modeled for the P&M Study. Some instream flows were not included in the model because they are in headwaters areas or do not have direct relation, or impact, to demand nodes. Table 2-15 shows the average annual flow target and how much of that average annual target flow is met at a minimum along the modeled reach (i.e. the average annual flow target minus the instream flow shortage). Table 2-17 provides the monthly flow targets and percentage of modeled years that attained the target. A number of decreed instream flows in Figure 2-10 could not be modeled and are not included in Table 2-15 and Table 2-16.

[14] The P&M Study did not address the rest of the flow regime that may be necessary for endangered fish recovery on this reach of the Yampa, on the lower Little Snake River, on the Yampa River in Dinosaur National Monument, and on the Green River. These flow needs were addressed for the WFET report by replicating the full flow assessment of the existing and future depletions covered by the Yampa PBO.

Figure 2-10 Decreed and Modeled Instream Flows

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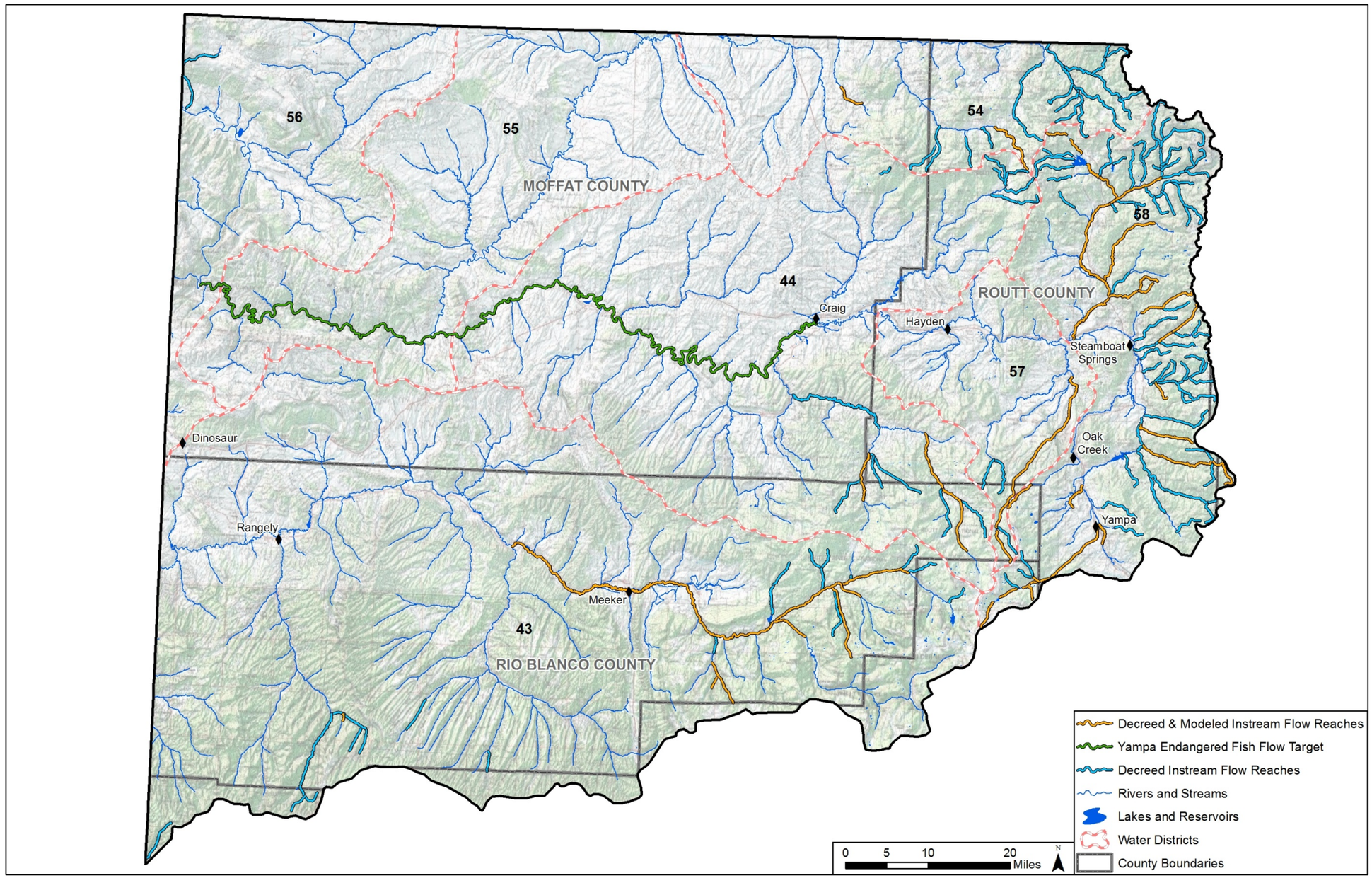

Source: P&M Study, 2014.

Table 2-15 Annual Instream Flow Target and Baseline Modeled Flows

Diversion Name	WDID	Average Annual Target Flow (cfs)	Modeled Average Annual Flow Along Reach (cfs)
Bear River (Middle)	582404	7.9	4.1
Bear River (Lower)	582202	12	5.8
Big Creek	582206	15	10.7
Coal Creek	582214	5	3.4
Dome Creek	582216	2	0.3
East Fork Williams Fork	441452	14.2	12.2
Elk River (Lower)	581355	65	26.9
Elk River (Upper)	582219	65	27.3
Green Creek	582245	5	2.1
Hunt Creek	582519	5	2.4
Marvine Creek	432334	40	39
Miller Creek	432337	10	8.4
North Fork Fish Creek	582287	5	4.3
North Fork White River	432339	70	69.7
North Fork White River	432338	120	117.5
Oak Creek	582290	2	1.9
Phillips Creek	582409	6	2.4
Service Creek	582306	6	3.9
Slater Creek	542076	3	2.9
Soda Creek	582311	5	4.1
South Fork White River	432344	80	74.8
South Fork Williams Fork	441456	5.9	5.4
Trout Creek (Lower)	571009	5	3.8
Ute Creek	432372	6	6
White River	431845	200	190.8
Williams Fork River	441448	20.7	20.3
Willow Creek	582332	7	4
Willow Creek	581461	5	3
Willow Spring & Pond	582162	13	6.7
Yampa River	582164	56.9	52.5

Table 2-16 Monthly Instream Flow Targets and Percentage of Modeled Years that Reached the Target

Node	Name	ISF StateMod Demand & % of Yrs Met Target	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
582404	Bear River (Middle)	ISF Demand	5.0	5.0	5.0	5.0	12.0	12.0	12.0	12.0	12.0	5.0	5.0	5.0
		% of years above	71%	59%	66%	86%	0%	0%	0%	0%	0%	89%	38%	55%
582202	Bear River (Lower)	ISF Demand	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
		% of years above	66%	52%	61%	75%	52%	59%	18%	4%	4%	9%	34%	50%
582206	Big Creek	ISF Demand	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
		% of years above	0%	2%	13%	86%	100%	100%	95%	41%	14%	13%	5%	0%
582214	Coal Creek	ISF Demand	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
		% of years above	0%	2%	7%	80%	100%	100%	95%	39%	13%	7%	2%	0%
582216	Dome Creek	ISF Demand	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
		% of years above	0%	0%	0%	0%	7%	0%	0%	0%	0%	0%	0%	0%
441452	East Fork Williams Fork	ISF Demand	10.0	10.0	10.0	10.0	20.0	20.0	20.0	20.0	20.0	10.0	10.0	10.0
		% of years above	23%	9%	57%	98%	100%	98%	70%	5%	5%	64%	71%	46%
581355	Elk River (Lower)	ISF Demand	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
		% of years above	0%	0%	2%	21%	100%	98%	48%	0%	13%	2%	0%	0%
582219	Elk River (Upper)	ISF Demand	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0	65.0
		% of years above	0%	0%	2%	21%	100%	100%	48%	0%	0%	0%	0%	0%
582245	Green Creek	ISF Demand	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
		% of years above	0%	0%	5%	100%	100%	84%	11%	0%	0%	2%	0%	0%
582519	Hunt Creek	ISF Demand	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
		% of years above	0%	2%	13%	82%	98%	93%	34%	2%	2%	5%	7%	0%
432334	Marvine Creek	ISF Demand	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
		% of years above	48%	34%	38%	100%	100%	100%	95%	84%	75%	71%	73%	57%
432337	Miller Creek	ISF Demand	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
		% of years above	50%	73%	82%	93%	95%	77%	89%	80%	86%	86%	64%	45%

Page 2-29

Node	Name	ISF StateMod Demand & % of Yrs Met Target	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
582287	North Fork Fish Creek	ISF Demand	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
		% of years above	0%	9%	7%	96%	100%	100%	100%	100%	100%	16%	18%	0%
432339	North Fork White River	ISF Demand	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0
		% of years above	84%	86%	86%	100%	100%	100%	96%	98%	96%	95%	96%	88%
432338	North Fork White River	ISF Demand	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0
		% of years above	50%	39%	43%	100%	100%	100%	96%	91%	88%	80%	75%	59%
582290	Oak Creek	ISF Demand	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
		% of years above	84%	79%	100%	100%	100%	100%	98%	75%	63%	89%	86%	91%
582409	Phillips Creek	ISF Demand	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
		% of years above	0%	0%	5%	57%	23%	7%	14%	13%	2%	2%	2%	0%
582306	Service Creek	ISF Demand	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
		% of years above	5%	7%	48%	100%	100%	91%	70%	14%	7%	14%	9%	5%
542076	Slater Creek	ISF Demand	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
		% of years above	100%	100%	100%	100%	100%	100%	89%	68%	73%	96%	100%	100%
582311	Soda Creek	ISF Demand	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
		% of years above	57%	70%	77%	100%	100%	100%	93%	41%	38%	43%	64%	57%
432344	South Fork White River	ISF Demand	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0
		% of years above	16%	14%	18%	79%	100%	100%	96%	88%	66%	61%	34%	16%
441456	South Fork Williams Fork	ISF Demand	5.0	5.0	6.5	8.0	8.0	8.0	8.0	3.5	3.5	5.0	5.0	5.0
		% of years above	66%	70%	71%	98%	100%	98%	50%	52%	38%	46%	46%	48%
571009	Trout Creek (Lower)	ISF Demand	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
		% of years above	61%	66%	82%	100%	100%	100%	45%	13%	13%	36%	79%	70%
432372	Ute Creek	ISF Demand	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
		% of years above	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
431845	White River	ISF Demand	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0
		% of years above	96%	100%	100%	100%	100%	96%	80%	59%	54%	91%	100%	82%

Page 2-30

Node	Name	ISF StateMod Demand & % of Yrs Met Target	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
441448	Williams Fork River	ISF Demand	14.0	14.0	14.0	14.0	30.0	30.0	30.0	30.0	30.0	14.0	14.0	14.0
		% of years above	100%	100%	100%	100%	100%	100%	89%	93%	63%	100%	100%	100%
582332	Willow Creek	ISF Demand	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
		% of years above	4%	13%	30%	88%	100%	100%	100%	98%	82%	5%	0%	2%
581461	Willow Creek	ISF Demand	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
		% of years above	5%	18%	36%	88%	100%	100%	100%	100%	100%	14%	2%	5%
582162	Willow Spring & Pond	ISF Demand	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
		% of years above	4%	5%	46%	100%	100%	93%	82%	14%	7%	14%	7%	5%
582164	Yampa River	ISF Demand	47.5	47.5	47.5	72.5	72.5	72.5	72.5	60.0	47.5	47.5	47.5	47.5
		% of years above	57%	46%	86%	100%	98%	91%	84%	84%	70%	73%	57%	55%

Page 2-31

Yampa Programmatic Biological Opinion - Endangered Species Fish Flow Target

In the late 1990's, a Management Plan for Endangered Fishes in the Yampa River Basin (Management Plan) was developed to assist with the recovery of four endangered fish species on the Yampa River. These species include the humpback chub, bonytail chub, Colorado pike minnow and razorback sucker. The Management Plan proposes to implement the following measures to minimize negative impacts to the listed fish and critical habitats:

- Provide and protect instream flows
- Reduce negative impacts of nonnative fishes
- Restore habitat (habitat development and maintenance)
- Manage genetic diversity/augment or restore populations
- Monitor populations and habitat
- Provides for future consumptive depletions

The Management Plan included an assessment of the flow impacts of existing storage and of increasing depletions by 30,104 acre feet per year on the Yampa River above the Little Snake in Colorado and by 23,428 acre-feet per year on the Little Snake River in Wyoming. An important component of the Management Plan was to augment the remaining base flows in the critical habitat reach of the Yampa River above the Little Snake River by making storage releases from an enlarged Elkhead reservoir that were decreed for instream use down to the confluence with the Green River. This reach is shown as the Endangered Fish Flow Reach in Figure 2-10. These augmentation releases were targeted to the flows at the Maybell gage that remained after existing irrigation in this reach and all upstream depletions and existing storage. Water can be released up to a rate of 50 cfs and added to the remaining base flows to meet the monthly targeted flows at Maybell[15]. While these flow targets are not decreed, the PBO relied on the availability of the remaining base flows in setting these targets with access to only 7,000 acre-feet of storage at Elkhead Reservoir. The PBO also relied on the adjudication of the releases for instream use that is protected from even the most senior diversions. A permanent water storage account of 5,000 acre-feet was funded up-front and is reserved in Elkhead Reservoir for maintaining flows throughout the Endangered Fish Flow Reach In addition, another 2,000 acre-feet may be released from Elkhead Reservoir for flow augmentation under a long-term (20 years), renewable lease with an annual fixed rate of $50 per acre-foot for the first 20 years. The water released from storage for instream augmentation can vary by year. In wet years, the program may not need its full storage allotment given that the natural flows at Maybell may often be high enough to meet the targeted monthly flows without necessitating releases.

Table 2-17 Selected Endangered Fish Flow Targets Baseline Condition[16]

Month	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Flow Target (cfs)	120	169	169	169	169	0	0	0	0	138	120	120
Average Minimum Simulated Flows Along the Reach (cfs)	117	168	153	164	158	0	0	0	0	120	57	88
Years Met of Exceeded Target	91%	89%	77%	75%	89%	N/A	N/A	N/A	100%	95%	70%	68%

Source: P&M Study, 2014.

Table 2-17 also shows the average minimum simulated flow along the reach and the percentage of modeled years in which the targeted flows were met for the baseline condition. Shortages occurred if the native flows and 50 cfs release

[16] Originally the PBO targeted 138 cfs at the Maybell gage from July-October and 169 cfs from November-March for the combined underlying flows and storage releases. The USFWS has since requested operations at a lower target of 120 cfs for August-October. The P&M Study mixed that lower target with those in the PBO as shown in this table. The FWS has also since requested operations at a higher target of 134 cfs for July-October.

from Elkhead Reservoir could not achieve the targeted flows. Additionally, releases from Elkhead Reservoir only occurred if the native flows at Maybell were below the target.[17]

Green River Biological Opinion

The Green River Biological Opinion (BO) provides a list of operational criteria for the Flaming Gorge Dam to assist in the recovery of the four endangered fish. These releases impact instream flows in the Green River reach that runs through Colorado and provides habitat for the fish. The action alternative in the Flaming Gorge Dam Final Environmental Impact Statement calls for a peak release magnitude of sufficient duration in April through July to achieve flow targets in the Green River upstream and immediately downstream of the confluence with the Yampa River. With exception for cases when the Flaming Gorge minimum release rate requirement is 800 cfs, the flow objectives for Green River from the Flaming Gorge Reservoir to the confluence with the Yampa River (specified as Reach 1 in the BO) and immediately downstream of the confluence (specified as Reach 2 in the BO) are the same. These flow objectives include the following:

- Achieve peak of 26,400 cfs for at least 1 day in 10% of all years
- Sustain peak of 22,700 cfs for at least 2 weeks in 10% of all years
- Sustain peak of 18,600 cfs for at least 4 weeks in 10% of all years
- Sustain peak of 20,300 cfs for at least 1 day in 30% of all years
- Sustain peak of 18,600 cfs for at least 2 weeks in 40% of all years
- Sustain peak of 18,600 cfs for at least 1 day in 50% of all years
- Sustain peak of 8,300 cfs for at least 1 week in 90% of all years
- Sustain peak of 8,300 cfs for at least 2 days in 98% of all years
- Sustain peak of 8,300 cfs for at least 1 day in 100% of all years

The Green River Biological Opinion followed closely on the heels of the Yampa Programmatic Biological Opinion and therefore relied on the flow regime for the Yampa River resulting from that programmatic opinion to help meet these targets for Reach 2 of the Green River.

Fisheries and Cottonwood Flow-Ecology Relationship Risks

The WFET developed a series of flow-ecology metrics to measure the ecological risk associated with decreased flows in the Yampa and White basins. These metrics were originally applied as a pilot study in the Roaring Fork and Fountain Creek watersheds and have been updated for the Yampa and White basins. The metrics are applied to the 19 P&M Study nodes shown in Figure 2-11. These metrics were developed using the Ecological Limits of Hydrologic Alternation framework which was publicized in 2006 by an international group of river scientists.[18] The Framework is used for evaluating and managing environmental flows in large regions where time and resources (i.e. intensive field studies) are not available. The framework applies information from rivers that have been studied intensively to rivers that have not yet been studied without needing site-specific detailed information.

[17] This accounting will mask shortages to the endangered fish flows in this reach under future conditions if the native flows at Maybell on which the PBO relied, are not maintained. That is, if these native base flows are reduced under future conditions, then the starting point for reporting such shortages is also reduced. On the other hand, if the native flows below Maybell were reduced by existing depletions and were not relied upon by the PBO, that should not constitute a shortage to the endangered fish flows.
[18] Source: Arthington et al. 2006

Figure 2-11 Modeled Nodes for the Flow-Ecology Risks

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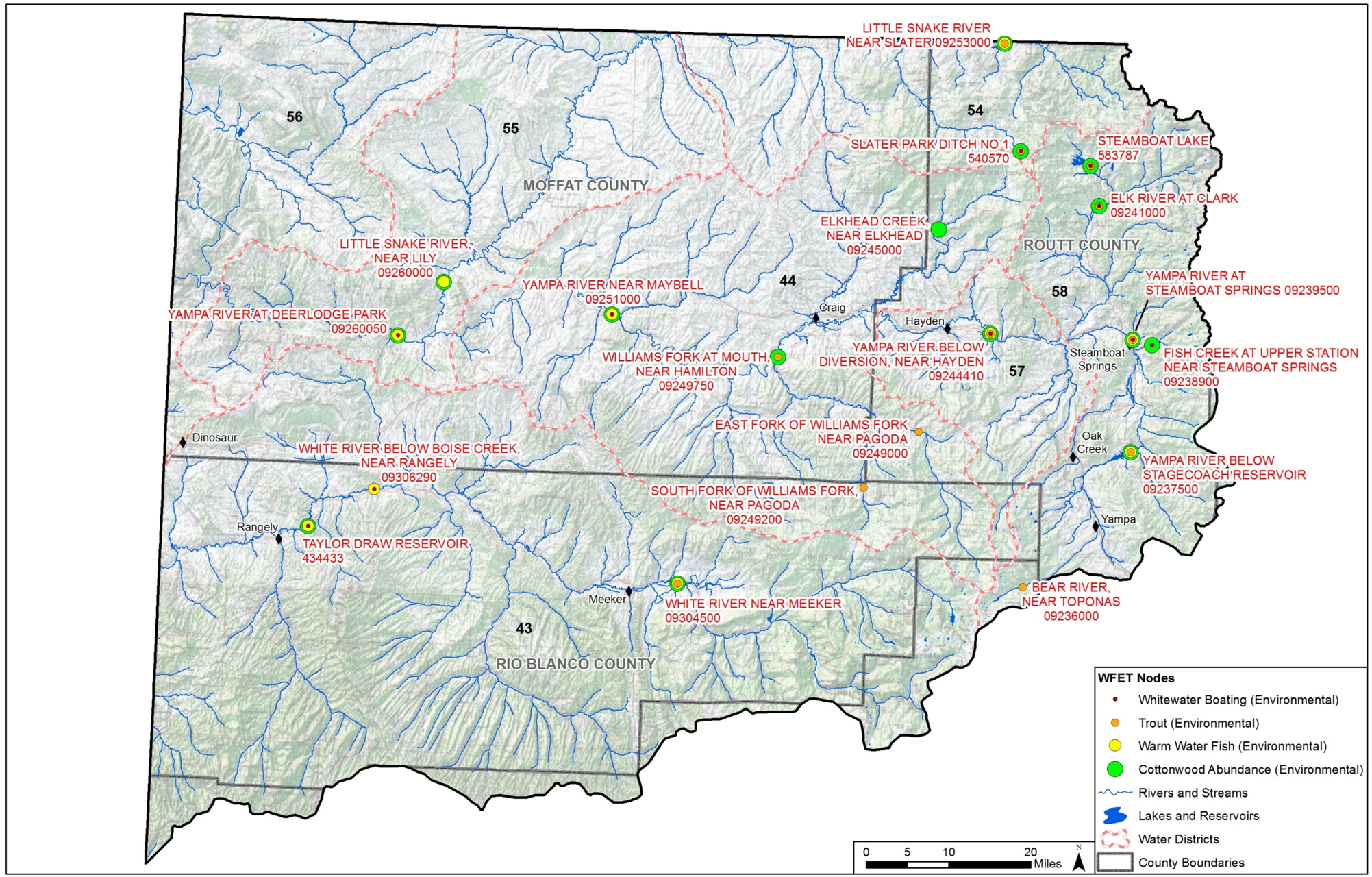

Source: P&M Study, 2014.

The metrics provide a means to assess the stream's ability to support trout, warm water fish and cottonwood populations by relating modeled streamflows to the natural flows of the stream prior to human development. A summary of each metric is provided below. Additional details on each metric, including the equations used for each metric is provided in Appendix A.

- Trout flow-ecology relationship –Compares modeled monthly flows in August and September (spawning season) relative to the annual natural flows.
- Warm water fish flow-ecology relationship – Represents the reduction in potential biomass of warm water fish based on 30-day minimum flows in a stream under modeled flow conditions for July through November.
- Cottonwood flow-ecology relationship[19] – Relationship between high peak flows under natural conditions relative to modeled flow conditions in April through June.

Each of the metrics above was used to assess the current ecological risk to trout, warm water fish and cottonwood riparian habitat relative to natural conditions. The results for the P&M modeled baseline conditions are presented in Table 2-18. Additional information on how each of the risk levels were developed for each flow-ecology metric is provided in Appendix A.

These results indicate that the modeled cottonwood areas are least impacted by current human river depletions whereas trout followed by warm water fish are more impacted. Areas of high risk for trout include the South Fork of the Little Snake from the headwaters to the confluence of Johnson Creek (9245000) and from the South Fork of the Williams Form from the headwaters to the confluence of the Forks (9249200). Warm water fish are assessed to be at high risk in the Little Snake River from Moffat County Road 10 to the confluence of the Yampa River (9260000) and cottonwoods are assessed to be at high risk on the Yampa River from Stagecoach Reservoir tailwaters to the northern boundary of Sarvis Creek State Wildlife Area (9237500).

Table 2-18 Risks Levels Based on the Ecology-Flow Metrics for Baseline Conditions

	Reach Name	Evaluation Node	Trout Flow-Ecology Relationship	Warm Water Fish Flow-Ecology Relationship	Cottonwood Abundance
1	Yampa River from entrance of Cross Mountain Canyon East Cross Mountain to confluence with Green River	9260050	n/a	Moderate Risk	Low Risk
2	Yampa River from Pump Station to confluence of Elkhead Creek	9244410	Moderate Risk	Low Risk	Low Risk
4	Elk River from headwaters to the County Road 129 bridge at Clark including the North Middle and South Fork as well as the mainstem of the Elk	9241000	Minimal Risk	n/a	Low Risk
5	White River from headwaters to Meeker including the North and South Fork and mainstem of the White	9304500	Minimal Risk	Low Risk	Low Risk
6	White River below Kenney Reservoir dam to Utah State line	434433	n/a	Low Risk	Moderate Risk
7	White River from Rio Blanco Lake Dam to Kenney Reservoir	9306290	n/a	Low Risk	n/a
8	Slater Creek from headwaters to the Beaver Creek confluence	540570	Moderate Risk	n/a	Low Risk

[19] The WFET and P&M Study refer to the "cottonwood flow-ecology" metric as the "riparian flow-ecology" metric. This metric has been renamed to reflect that the metric exclusively assesses cottonwood as opposed to other riparian species.

	Reach Name	Evaluation Node	Trout Flow-Ecology Relationship	Warm Water Fish Flow-Ecology Relationship	Cottonwood Abundance
9	Elkhead Creek from headwaters to confluence of North Fork of Elkhead Creek	9245000	n/a	n/a	Low Risk
10	South Fork of the Little Snake from headwaters to confluence of Johnson Creek	9253000	High Risk	Low Risk	Low Risk
11a	East Fork of the Williams Fork from headwaters to the confluence of the Forks	9249000	Minimal Risk	n/a	n/a
11b	South Fork of the Williams Fork from headwaters to the confluence of the Forks	9249200	High Risk	n/a	n/a
11c	Williams Fork from the South Fork to the confluence with the Yampa River	9249750	Moderate Risk	n/a	Low Risk
12	Little Snake River from Moffat County Road 10 to confluence of the Yampa River	9260000	n/a	High Risk	Low Risk
13	Yampa River from Craig Hwy 394 Bridge to mouth of Cross Mountain Canyon	9251000	n/a	Moderate Risk	Low Risk
14	Yampa River from Stagecoach Reservoir Tailwaters to northern boundary of Sarvis Creek State Wildlife area	9237500	Minimal Risk	Low Risk	High Risk
15	Fish Creek from Fish Creek Falls to confluence of the Yampa River	9238900	n/a	n/a	Low Risk
16	Yampa River from Chuck Lewis Wildlife Area to Pump Station	9239500	Moderate Risk	Low Risk	Low Risk
18	Willow Creek below Steamboat Lake to confluence with the Elk	583787	Low Risk	n/a	Low Risk
19	Bear River from headwaters to USFS boundary	9236000	Low Risk	n/a	n/a

Source: P&M Study, 2014.

2.4.3 Evaluation of Recreational Needs

Steamboat Recreational In-Channel Diversion (RICD)

The City of Steamboat Springs has an absolute recreational instream channel diversion water right for the Steamboat Springs boating park. When in priority, this junior water right may be used to protect flows through the Steamboat Springs boating park at the specified rates shown in Table 2-19. These claimed flows are limited to the hours of 8:00 am to 8:00 pm with exception of 10 days between April 15 and July 15 for nighttime competitive events. The RICD was modeled in the P&M Study. In order to conduct the modeling, the decrees flow rates were modified to fit within a monthly timestep. The surrogate modeled flows are shown in Table 2-19.

Table 2-19 Decreed Flow Rates for the Steamboat RICD

Time Period	April 15-20	May 1-15	May 16-31	June 1-15	June 16-30	July 1-15	July 16-31	Aug 1-15
Decreed Flow Rates (cfs)	400	650	1000	1400	650	250	100	95
StateMod Surrogate Flow Rates (cfs)	200	825		1025		175		47.5

Source: P&M Study, 2014.

The modeled baseline results, shown in Table 2-20, indicate that the RICD is currently met in April yet experiences shortages 21% and 37% of the modeling period for June and July, respectively. The majority of these shortages occur in drier years.

Table 2-20 Percentage of Modeled Year in Which the Target RICD Monthly Target is Met

Time Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
StateMod Surrogate Flow Rates (cfs)	0	0	0	200	825	1,025	175	47	0	0	0	0
Years Met or Exceeded Target	100%	100%	100%	100%	98%	79%	63%	95%	100%	100%	100%	100%

Source: P&M Study, 2014.

Boating Flow-Usability Relationship

The WFET also developed a means to characterize the usability of flows along key recreational reaches for whitewater recreation. A survey was conducted by American Whitewater to determine recommended flow ranges for the eleven locations shown in Table 2-21. The P&M Study integrated the survey information in Table 2-20 with modeled flows to determine the percentage of months with usable flows. Figure 2-12 presents the percentage of months under which the flows are characterized as minimal, optimal and highest for boating purposes for 10 segments within the modeled timeframe[20]. These data are based on the P&M Study which incorporated the information from Table 2-20 into monthly flows for the purposes of modeling. Flow conditions are considered usable for boating under the optimal and highest flow conditions. These results indicate that the Yampa River from the entrance of Cross Mountain Canyon to the confluence with the Green River and the Little Yampa Canyon have the greatest percentage of usable months during the baseline modeling period. Four of the reaches in Figure 2-12 do not have usable boating flows.

Table 2-21 WFET Whitewater Boating Flows

	Segment	Measurement Gage	Minimum (cfs)	Optimal (cfs)	Highest (cfs)	Season
15	Fish Creek	9238900	400	800-1,000	1,400	April through July
16	Steamboat Town	9239500	700	1,500-2,700	5,000+	April through July
4a	Elk River Box	9242500[1]	700	1,000-2,100	5,000+	April through July
4b	Elk River – Clark	9241000	700	1,300-4,000	5,000+	April through July
18	Willow Creek	583787	300	700-800	1,250	April through July
	Mad Creek	Visual	400	400-1,000	2,000+	April through July

[20] Figure 2-12 presents baseline results only for modeled boating segments and not for all the segments listed in Table 2-21.

	Segment	Measurement Gage	Minimum (cfs)	Optimal (cfs)	Highest (cfs)	Season
	MF Little Snake	Visual	500	800-1,100	2,000+	April through July
8	Slater Creek	540570[2]	600	1,100-2,100	3,000+	April through July
2	Yampa - Lower Town	9244410	900	1,500-1,500	4,000	April through July
13/29	Little Yampa Canyon	9247600	1,100	1,700-2,500	10,000+	April through July
1	Cross Mountain Gorge	9251000	700	1,500-3,500	5,000	April through July
1	Yampa Canyon	9260050	1,300	2,700-20,000	20,000+	April through July
3	Gates of Lodore	9234500[3]	1,100	1,900-15,000	20,000+	April through July
5	SF White River	No Defined Gage[4]	700	2,500-3,500	10,000	April through July
6	White River below Kenney Reservoir	434433	700	1,500-2,500	10,000+	March through October
7	White River Rangely to Bonanza	9306290	700	1,500-5,000	10,000+	April through July

1 Gage not in the StateMod Model
2 Not evaluated in the WFET, due to insufficient data
3 Gage not in the StateMod Model
4 No defined location in the WFET study to evaluate whitewater boating flows
Source: P&M Study, 2014.

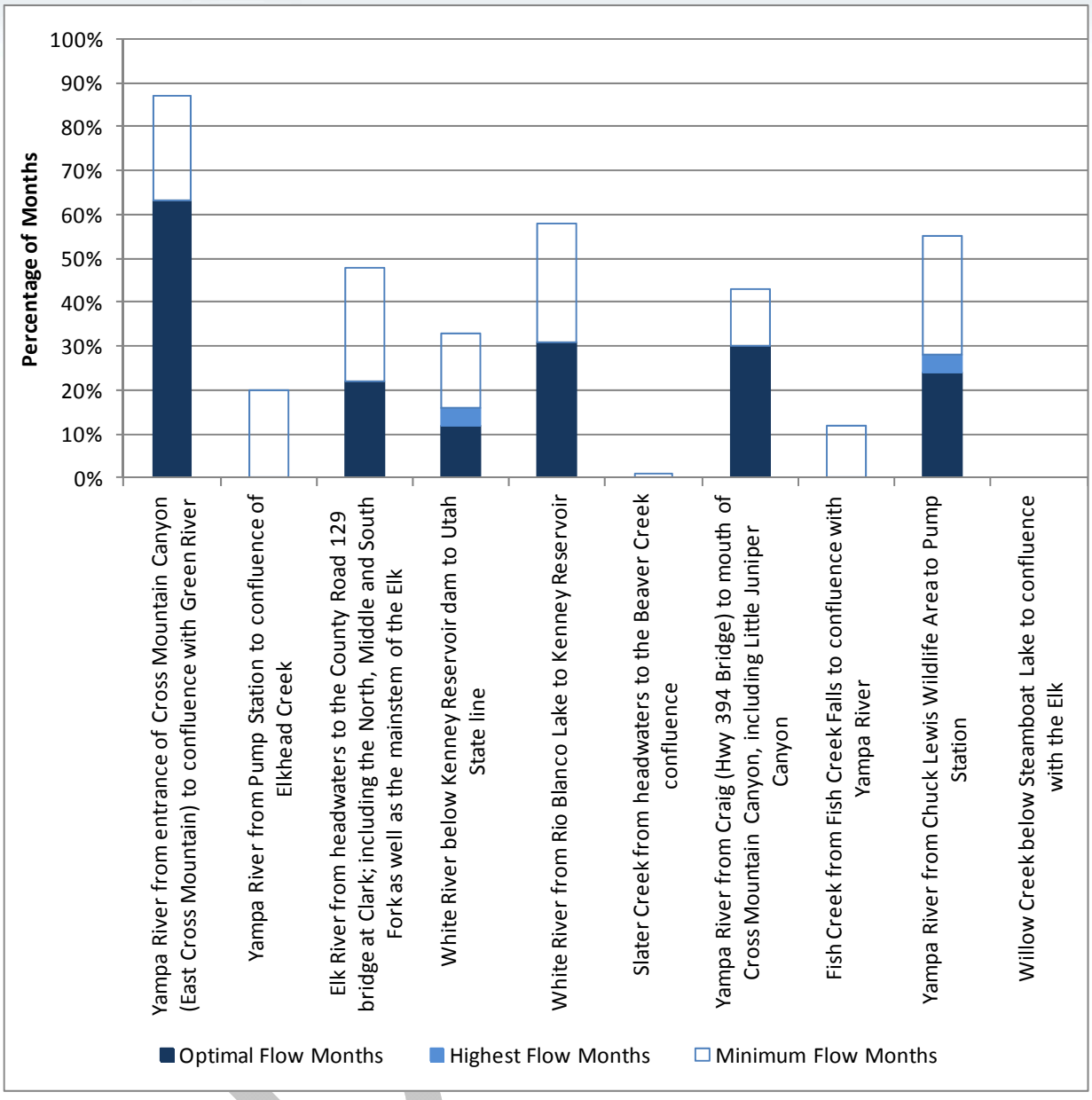

Figure 2-12 Baseline Recreational Whitewater Boating Results

Source: P&M Study, 2014.
Note: The frequency of months with high and low flows days are averaged in the P&M Study because the model is based on a monthly timestep. This reduces variability.

Table of Contents

SECTION 3.0 EVALUATE CONSUMPTIVE AND ENVIRONMENTAL AND RECREATIONAL CONSIDERATIONS

This chapter provides an overview of considerations that the BIP will use to assess the Yampa/White/Green (YWG) Basin's water needs, shortages and potential future supplies. The majority of information presented in this chapter was developed through a series of Statewide Water Supply Initiative (SWSI) and Basin-wide studies. This includes the 2014 Project & Methods (P&M) Study, which is the most recently completed study conducted by the YWG Basin Roundtable. This section includes an overview of considerations, a summary of water management and administration, a discussion of the recently completed hydrologic modeling in the P&M Study, and a description of water shortages specific to the Municipal and Industrial (M&I), Self-Supplied Industrial (SSI), agricultural and environmental and recreational sectors.

It is important to note that although M&I, SSI, agricultural and environmental and recreational results presented in this section are based on the P&M Study, additional modeling will occur after submission of the draft BIP in July 2014 to include additional IPPs which will provide refinement of shortage information. As the BIP process continues, discussions will persist on how to best meet the shortages throughout the Basin.

3.1 OVERVIEW OF CONSIDERATIONS

The YWG Basin Roundtable recognizes that almost any water supply whether it is categorized as an Identified Project and Process (IPP) or not, will involve complex and nuanced tradeoffs. Each project will present its own specific set of opportunities and constraints and what is a constraint for one project might be an opportunity for another. Consequently, at this time, the YWG Basin Roundtable believes it is not possible to develop a comprehensive list of opportunities and constraints. Instead, the BIP sets out planning "considerations" that will serve to guide the future development and evaluation of water supply and resource projects. An overview of the current considerations are summarized in Table 3-1 and discussed below.

Table 3-1 Considerations for Water Supply Planning in the Yampa-White-Green Basin

Summary of Considerations for the Yampa/White/Green Basin
Less developed relative to other basins in the State
Relatively junior water rights relative to other basins in the State
Limited storage
Less developed diversion infrastructure
No history of mainstem administration
Numerous large conditional water rights
Flow requirements for endangered species protection ▪ Yampa PBO o Increase in irrigated lands o Increase in agricultural consumptive use ▪ Green River Record of Decision (ROD) ▪ Prospective White River PBO

Balancing the uses and needs for water in the YWG Basin first requires coordination within the Basin and amongst its stakeholders to ensure long-term viability of its current water supplies and some future development of its native water supplies. Other parties within the State of Colorado have expressed interest in diversions from the Yampa, and downstream States have delivery needs that are partially met from the Yampa and White Rivers. This BIP serves as a forum to address certainty of existing uses, enable future growth, and retain the recreational and environmental values important to our Roundtable and the State as a whole. These are the outcomes that the Basin holds at the core of its needs. Through this BIP, the YWG Basin strives to balance the current and future needs of the region while integrating these important considerations into the statewide planning process.

Development. The YWG Basin drainages are relatively less developed compared to other basins in the State of Colorado. Economic and population growth came later to the YWG Basin, with the result that the Basin has relatively lower levels of water use compared to average annual flows. This is an opportunity for further in-basin development and for preservation of environmental and recreational values, but it also makes the basin an attractive target for proposals for new trans-mountain diversions, which could impose significant constraints on opportunities for IPPs.

Junior water rights. Another consideration for the YWG Basin is that, due to the later development and growth in the Basin, particularly for M&I uses, appropriation dates for water rights in the Basin are more junior relative to other Colorado River tributaries. This causes concern when considering Colorado River Compact administration, because this situation could lead to a more severe curtailment of existing uses in the Yampa and White River Basin.

Limited storage. The YWG Basin drainages have less storage relative to average flow than do other basins. Although there is some existing storage for agricultural supplies, particularly in the upper Yampa Basin, most of the storage is reserved for dry-year supplies for industrial and municipal uses. The small amount of storage coupled with relatively junior water rights in the YWG Basin presents a concern about reduced physical and legal reliability of its water resources, particularly during drought periods. Flows on the mainstem and on tributary streams without storage are often inadequate in the late season. On the other hand, riverine systems in the YWG Basin are unique because they are some of the few in the State that exhibit a more natural hydrograph due to the lack of large on-channel storage capacity. This provides valuable benefits to endangered species riparian habitat and to the recreational sector, and this BIP recognizes that relationship.

Diversion infrastructure. Diversion structures are not well developed. Gravel pushup dams are oftentimes used to make agricultural diversions in various locations, but these dams cannot sweep the river. Numerous diversions do not have measuring devices.

Administration. Administration has only occurred on the mainstem Yampa and White Rivers in special circumstances, such as protecting reservoir releases in dry conditions. This historical lack of administration is not due solely to the relatively lesser development on these basins (water shortages are common during dry seasons), but is a result of a culture of a willingness to share shortages voluntarily and the existence of an undeveloped diversion infrastructure. The Division engineer will not allow calls to be placed at diversions that do not have measuring devices or that cannot sweep the river.

Conditional water rights. As shown in Table 3-2 there are a number of conditional storage water rights, particularly in the White River Basin (District 43) and Yampa River Basin (District 44). This presents both an opportunity and a constraint for the long-term water resource development of the basins. For example, conditional senior water rights held by energy companies in the White River Basin can discourage the development of new projects relying on junior water rights. The yield of these junior water supply projects could be reduced to infeasible levels if senior conditional

water rights are developed and made absolute at a later date. Conversely, these senior conditional water rights provide the potential for development of relatively firm IPPs with senior priority. This situation illustrates the need for careful collaboration and cooperation in order to reach the best outcome for the YWG Basin.

Table 3-2 Volume of Conditional Storage Rights by Priority in the Yampa-White-Green Basin[1]

Water District	Stream Name	1900-1920 (AF)	1920-1940 (AF)	1940-1960 (AF)	1960-1980 (AF)	1980-2002 (AF)	Total (AF)
43	White River	204	0	12,548	1,018,918	266,128	1,297,798
44	Williams Fork/Yampa River	0	0	844,294	638,662	1,179,449	2,662,405
54	Slater Creek/Little Snake River	0	0	0	323,580	166,898	490,478
55	Little Snake River	0	0	0	0	46,426	46,426
56	Green River	0	0	0	1,200	500	1,700
57	Yampa River	0	0	0	111,010	52,616	163,626
58	Elk/Yampa River	0	0	34	201,579	97,449	299,062
Total		**204**	**0**	**856,876**	**2,294,949**	**1,809,466**	**4,961,495**

Source: Water Supply and Needs Report for the Yampa/White/Green Basin, July 2006.
[1] Note that this table is current as of 2006; additional water rights have likely been filed and abandoned since that time, e.g., the abandonment of the Juniper-Cross water right in Water District 44 exceeded 1 million AF.

Endangered species. Constraints on water development and water management to protect habitat for endangered species are in place in the Green and Yampa basins, and similar constraints are being contemplated for the White River Basin. Accordingly, the BIP addresses how the Basin's water needs must be developed in ways that provide collaborative solutions to water supply challenges while maintaining a balanced and diverse economic base long into the future. Existing flow protections for endangered species must be also considered in this process.

In particular, the Yampa PBO is based on existing storage and a current depletion of 125,271 acre-feet above the Little Snake River with a projected increase in depletion of 30,104 acre feet by 2045[1]. The estimates of current and future depletions above the Little Snake River in the P&M Study are significantly higher than this. One of the major reasons for this is that the StateCU and StateMod models were refined to include the Denver Water High Altitude crop coefficients for pasture grass/hay fields above 6,500 feet. In order to be consistent with CRWAS and common State Engineer Office practices, an elevation adjustment of 10% per 1,000 meters above sea level was made for all crops. When compared to previous SWSI IWR estimates, the IWR requirement increased by 54 percent basin-wide when the high–altitude coefficient for the grass/hay was included and by 65% when the elevation adjustment and high altitude crops were incorporated (Agricultural Water Needs Assessment Report, 2011). The Yampa PBO was based on un-adjusted consumptive use, which leads to an "apples-to-oranges" comparison. Additional modeling efforts and coordination will be necessary to incorporate updated depletions and determine the amount of flow that could be sustainably maintained in the Yampa River for protection of endangered species.

[1] The cooperative agreement implementing the management plan for the PBO also provides: "When the first increment of depletions in Colorado [of 30,104 acre feet] approaches full development, the impacts of developing a second increment [of 20,000 acre-feet] and the status of the endangered fish species at that time will be re-evaluated pursuant to the PBO for this Agreement to implement the Management Plan.".

3.2 WATER MANAGEMENT AND WATER ADMINISTRATION

The YWG Basin is one of the few areas in Colorado where a large part of the Basin is not over appropriated and regularly under administration. Nonetheless, certain tributaries are frequently administered at certain times of the year (e.g., the Elk River and the Yampa River main stem upstream of the Town of Yampa). Still, significant portions of the Basin have not experienced a call due in part to water users within the Basin coordinating diversions and avoiding a formal call.

The majority of historical calls in the Basin, other than in the Elk River, are attributed to irrigation uses. Occasional calls have been made by CWCB to maintain instream flows in the Elk River. In addition to calls, certain stream reaches have been administered to ensure that reservoir releases are conveyed to the designated downstream use. Streams that are commonly administered include:

- Green River Basin - Talamantes Creek, Vermillion Creek, Beaver Creek and Pot Creek
- Yampa River Basin – Bear Creek, Phillips Creek, Hunt Creek tributaries, Fish Creek,[2] Soda Creek, Elk River, Trout Creek, Elkhead Creek, Fortification Creek, Deer Creek and Morapos Creek
- White River Basin – Piceance Creek.

Pot Creek, a tributary to the Green River that flows between Colorado and Utah, is administered based on the Pot Creek Memorandum of Understanding. This MOU includes a schedule of priorities for use in both states and defines a period before which direct flow diversion cannot be exercised.

3.3 HYDROLOGIC MODELING

The P&M Study was the primary study used to inform the BIP regarding future water supplies, demands, and shortages including projections of demands and alternative hydrologic conditions.[3] The P&M Study is the most up-to-date study conducted on the YWG Basin. It was conducted by the YWG Basin Roundtable (BRT) to:

- Develop a common understanding of consumptive, recreational and environmental water needs in the Yampa-White Basin.
- Analyze river operations of the Yampa and White Basins, including alternative model scenarios.
- Evaluate water right priorities of Statewide SWSI Alternatives relative to those of the YWG Basin.

The P&M Study used the StateMod modeling platform which is Colorado's water allocation model maintained by Colorado Decision Support Systems (CDSS). StateMod is the water allocation model in CDSS that is used for the primary purpose of modeling water rights and allocating water to those rights. StateMod uses strict prior appropriations (i.e., first in time, first in right) to model diversions. The model was initially developed in 1994 and has been continually updated as new studies and data becomes available. The 2009 release for both the Yampa and White basins was used for this study. The model uses a monthly time-step. A variety of previous studies discussed in Appendix A were used to inform the modeling effort.

The P&M Study evaluated Baseline Conditions and six modeling scenarios. As shown in Figure 3-1 these scenarios consist of a combination of demands, hydrology and supply projects (IPPs). The demand inputs include the current and future year (2050) water needs for the M&I, energy, agriculture, environment and recreation sectors at specific modeling nodes in the StateMod model. Information on how the demands were developed for each of these sectors

[2] Administration of this reach is becoming less frequent. CWCB has historically placed an instream flow right call on Fish Creek, however, the Mt. Werner Water District is leaving more flows in the Creek which lessens the need for an instream flow call.
[3] The Yampa/White/Green BIP Committee decided on March 5th, 2014 that the P&M Study would serve as the major study informing the BIP.

is provided in Chapter 2. The P&M Study results present the percentage of average annual water shortages at each of the respective StateMod nodes and for each of the sectors both in tables and spatial figures.

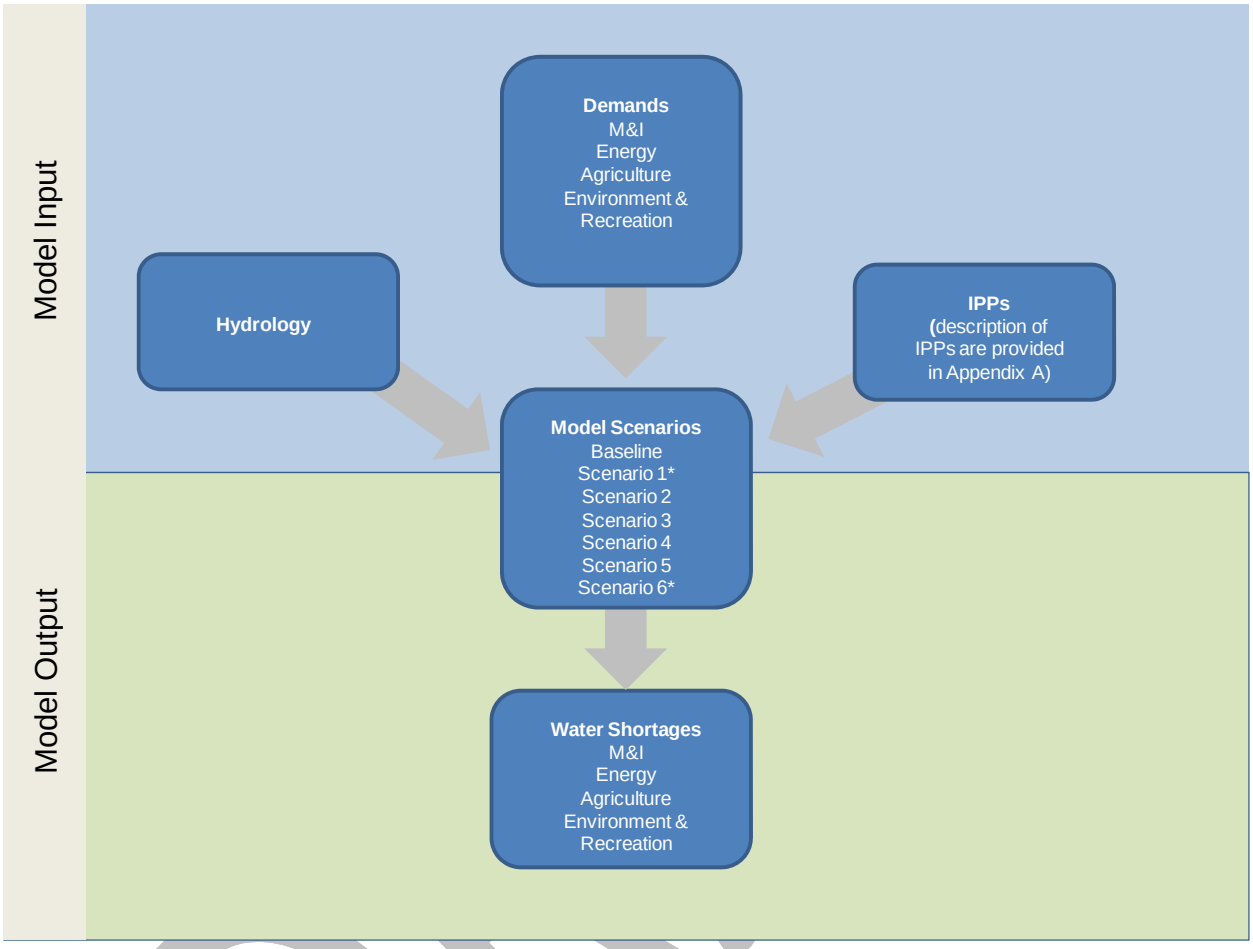

Figure 3-1 Elements of the Model Scenarios

Table 3-3 shows the elements for each of the respective scenarios incorporated into the BIP. The modeled baseline represents current conditions and operations. This includes all existing reservoirs, water rights, imports, diversions, and return flows while incorporating the historical hydrology and climate over the period 1950 through 2005. It provides a means to compare the other scenarios (e.g., supply projects, climate change, new demands, etc.) The Dry Future IPP Scenario and Dry Future Scenario entail high demands and dry hydrology which provides a conservative planning framework to best guarantee that the Basin's future water needs can be met. These scenarios are referred to as Scenario 1 and Scenario 6, respectively, in the P&M Study.

Table 3-3 Model Scenarios

BIP Scenario	Nomenclature in the P&M Study	Hydrology	Demands	IPPs
Baseline	Baseline	Historical	Existing demands	No IPPs Selected
Dry Future IPP Scenario	Scenario 1	Dry	High	All IPPs Selected
Dry Future Scenario	Scenario 6	Dry	High	No IPPs Selected

The modeling data presented in this document consists of information presented in the 2014 P&M Study. As mentioned above, additional modeling will occur after July 2014 to refine the results of the P&M Study. This information will be incorporated into future versions of the BIP.

3.4 CURRENT AND FUTURE SHORTAGES ANALYSIS

The water shortage information presented in this section is based on the modeling conducted for the 2014 P&M Study. As discussed in Section 3.3, the BIP focuses on the modeled Baseline Conditions and future scenario assuming high demands and dry hydrology. Both the Dry Future IPP Scenario and the Dry Future Scenario are based on dry hydrology. The Dry Future IPP Scenario includes a series of supply and storage IPPs while the Dry Future Scenario does not include these IPPs. These scenarios are evaluated below. The specific IPPs included in the Dry Future IPP Scenario are discussed in Chapter 4.

3.4.1 M&I, SSI, and Agricultural Shortages

Figure 3-2 through Figure 3-4 show the annual average percentage shortages for the M&I, SSI and agricultural sectors at the diversion point on the river (model node).[4] The M&I and SSI demands and percentage shortages are represented at a specific diversion point on the river (model node), whereas the agricultural shortages are presented as the irrigation shortages across multiple model nodes aggregated by Hydrologic Unit Code (HUC). A summary of the results for each modeling scenario are highlighted below, followed by a more detailed discussion on the shortages for each sector.

The modeled Baseline Condition, shown in Figure 3-2, indicates that there are shortages under current conditions. While the M&I and SSI shortages are far less than 10%, there are locations in Districts 44 and 43 where the agricultural shortages are within the range of 26% to 50%. In light of drought and climate change, further discussions around an appropriate Baseline Condition will continue.

The consumptive use shortages increase with the modeled Dry Future IPP Scenario and Dry Future Scenario (without IPPs), as shown in Figure 3-3 and Figure 3-4, respectively. The Dry Future IPP Scenario represents a high future demand condition, dry hydrologic conditions and assumes new IPPs are developed. The Dry Future Scenario also represents the high future demand condition and dry hydrologic conditions, yet does not include the new IPPs. Appendix A provides further information on the scenarios and IPPs.

[4] For purposes of this study, the shortages are reported at the diversion point on the stream as opposed to the P&M Study which presented the shortages at the place-of-use. These latter shortages include losses and inefficiencies incurred from the point of diversion to the end use. The approach taken in the BIP provides a more direct means in evaluating the need for new IPPs by showing the demand/shortage directly incurred on the stream.

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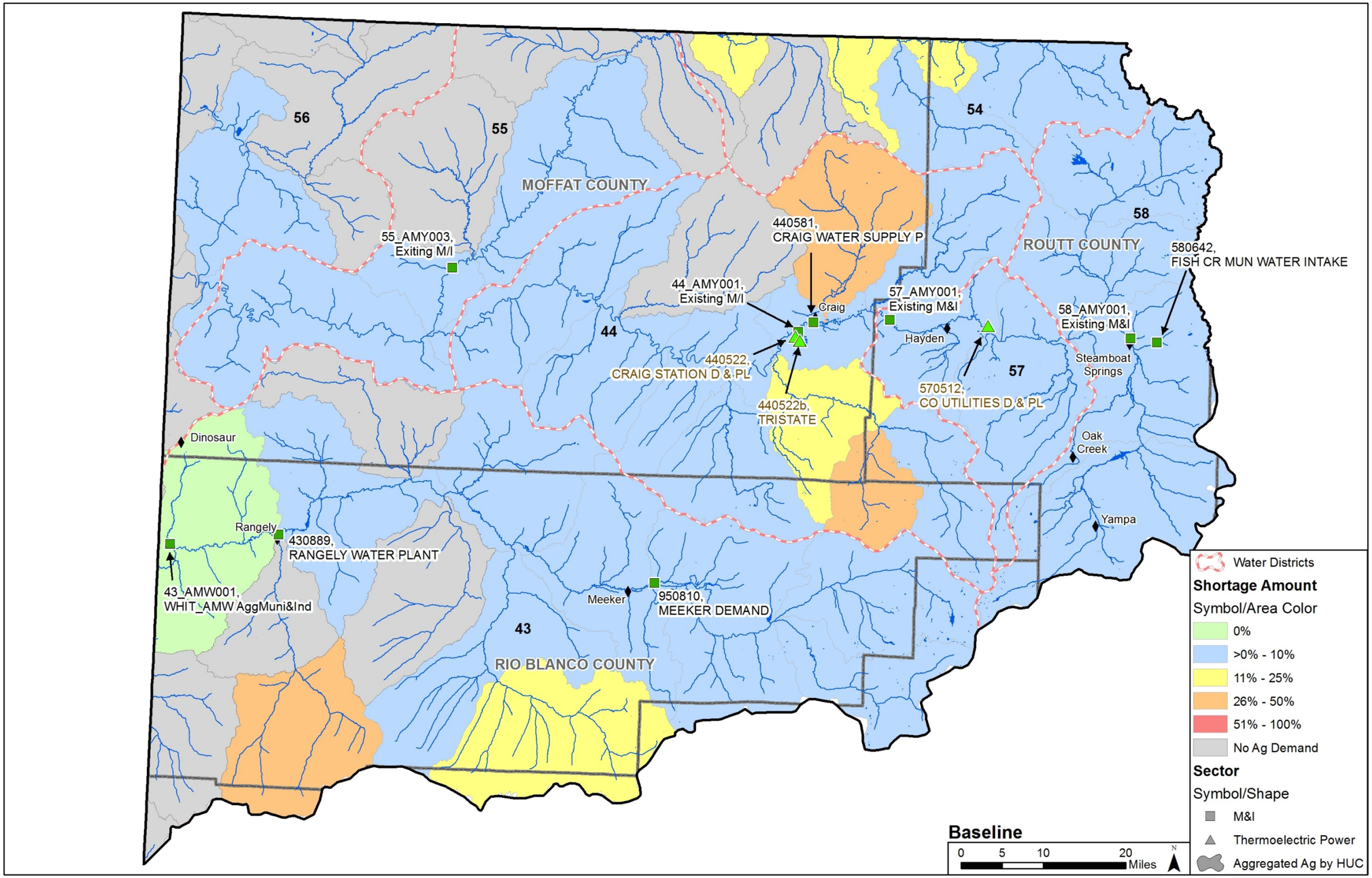

Figure 3-2 Shortages for the Modeled Baseline Condition

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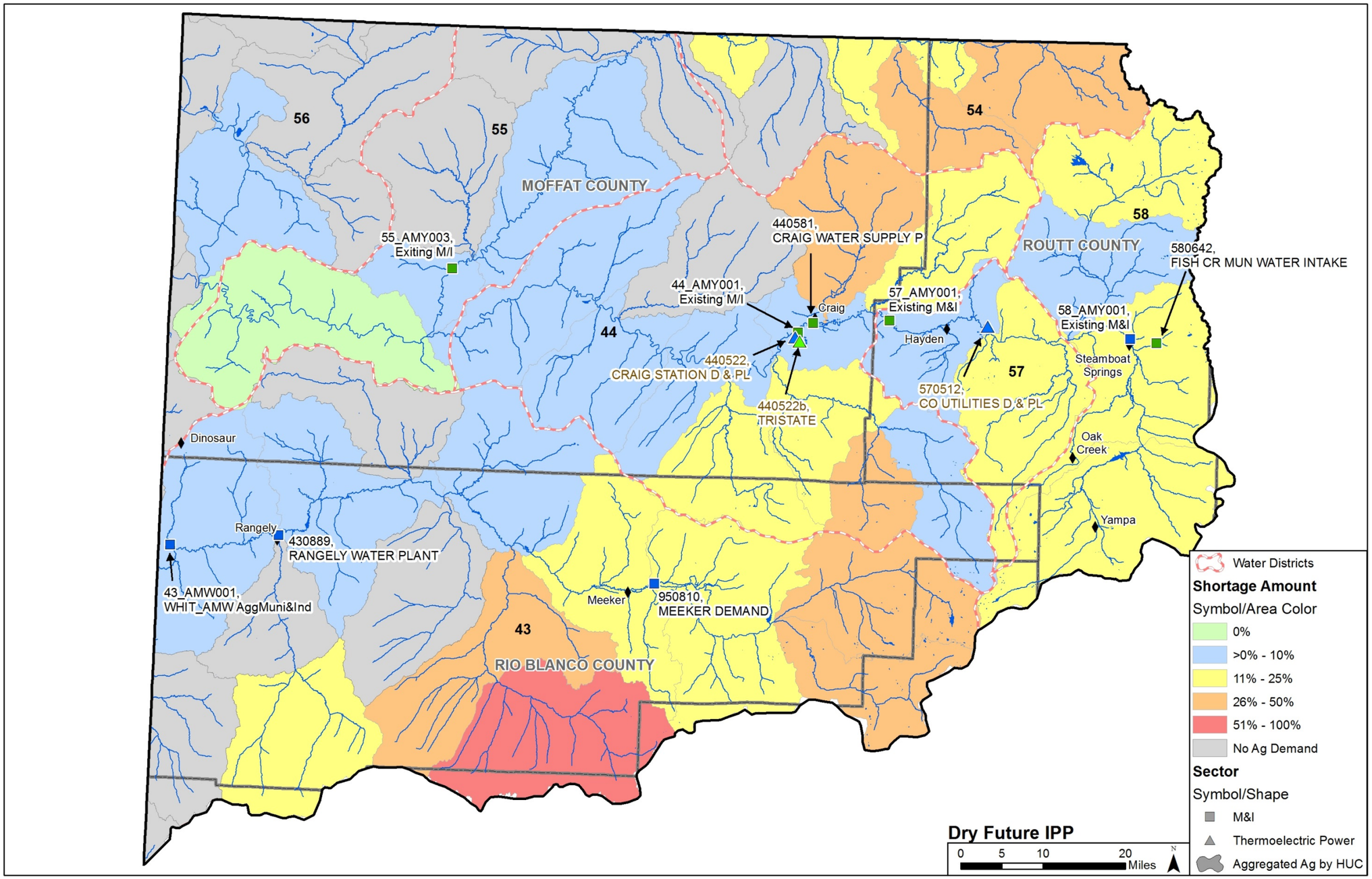

Figure 3-3 Shortages for the Modeled Dry Future IPP Scenario

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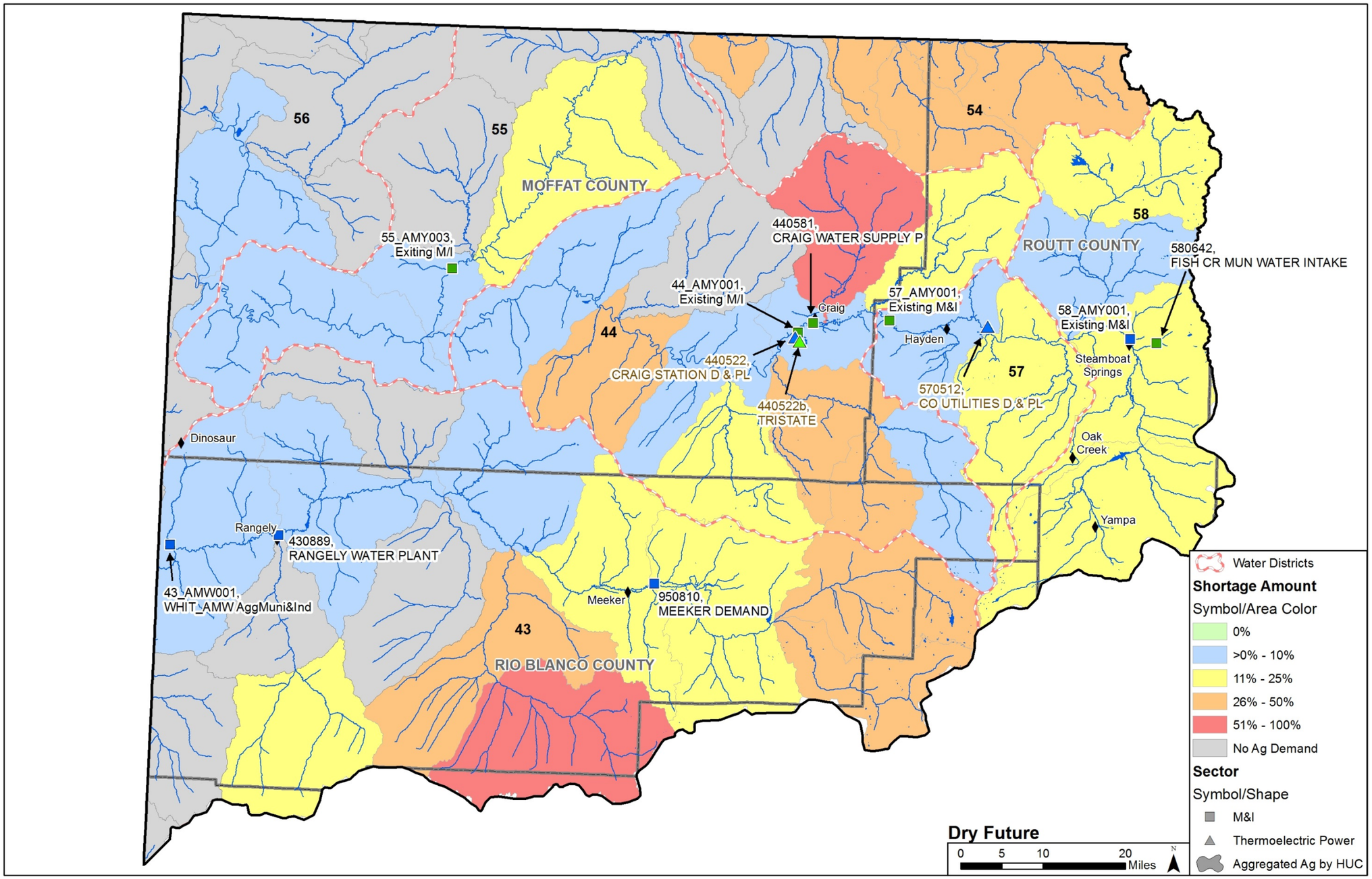

Figure 3-4 Shortages for the Modeled Dry Future Scenario

M&I Shortages

As discussed in Chapter 2, M&I demands are small compared to agricultural demands in the YWG Basin. As shown in Figure 3-2 under Baseline Conditions, no shortages exist to M&I demand nodes due to generally adequate water supply and augmentation from reservoirs.

While M&I shortages exist under the high demand, low water supply scenarios of the Dry Future IPP Scenario and the Dry Future Scenario, the shortages remain below 10%. Under both scenarios, District 43 Existing M&I in Rio Blanco County (Rangely Water, Meeker Demand) and District 58 Existing M&I in Routt County (the City of Steamboat Springs) begin to exhibit shortages, whereas Moffat County municipal nodes do not show M&I shortages under either scenario. If IPPs are developed that include M&I use, shortages would likely decrease in locations with supply augmentation.

SSI Shortages

Under Baseline Conditions, no shortages exist for Self-Supplied Industrial (SSI), which consist of thermoelectric power generation needs. Slight shortages exist for the Hayden Station and units 1 and 2 of Craig Station under the Dry Future IPP Scenario and the Dry Future Scenario. Therefore, these nodes are represented with blue triangles in Figure 3-3 and Figure 3-4. These scenarios meet thermoelectric demands with redundant water supplies from Steamboat Lake for Hayden Station and Elkhead and Stagecoach Reservoirs for Craig Station. The shortages occurred for both locations in a dry month in March 1961 but become nearly negligible (0.14% for Hayden Station and 0.12% for units 1 and 2 at Craig Station for both scenarios) when averaged over the 56-year period of record used in the P&M Study.

However, SSI water users consider their water supply short when they must rely upon redundant water supplies. For example, the years 2002, 2003, 2012 and 2013 were considered water supply short or borderline short by some SSI water users due to reliance on redundant supplies. Further discussions will take place on the most appropriate Baseline Conditions and the assessment of shortages in light of drought, climate change and evolving power generation technologies.

Agricultural Shortages

Figure 3-2 shows that under Baseline Conditions, the majority of the Basin experiences agricultural shortages of up to 10% on an average basis. This is designated as the blue areas in Figure 3-2. The P&M Study and Agricultural Water Needs Study highlight the following areas of shortage under modeled Baseline Conditions:

- The Piceance Creek watershed has the highest agricultural shortages in the White Basin. This watershed is important for future energy development.
- Fortification and Morapos Creeks have some of the highest agricultural shortages in the Yampa Basin.
- Many of the diversions in the upper tributaries have low irrigation efficiencies and small drainage areas which result in unreliable irrigation supplies.

The percentages of agricultural shortages significantly increase in the eastern and southern portions of the Basin under the simulated high demand dry hydrology conditions for the Dry Future IPP and Dry Future scenarios. Figure 3-5, shows the modeled agricultural water shortage in acre-feet for each water district. Shortages significantly increase for the Dry Future IPP Scenario and the Dry Future Scenario in Districts 43, 44, 54, 57 and 58; minimal changes are observed in Water Districts 55 and 56 in the northwest portion of the Basin. The agricultural shortages by model node for each scenario are provided in Appendix B.

The simulated increase in shortages for the Dry Future IPP and Dry Future scenarios are largely attributed to the drier hydrology and a shift to earlier season runoff as a result of warmer temperatures with climate change. The simulated late season shortages tend to increase unless there is storage available. Modeled shortages are common in the upper tributaries without existing storage or an IPP.

Comparison of the Dry Future IPP Scenario and the Dry Future Scenario indicate that the development of IPPs would significantly reduce agricultural shortages in District 44 where the total shortages are modeled to be about 56,000 acre-feet without IPPs (Dry Future Scenario) and are reduced to about 22,000 acre-feet with IPPs (Dry Future IPP Scenario). This is largely attributed to the modeled IPP reservoirs in the headwaters of this District. Additional information on these IPPs is provided in Chapter 4. Shortages are also reduced in Water Districts 54 and 57 as a result of the IPPs.

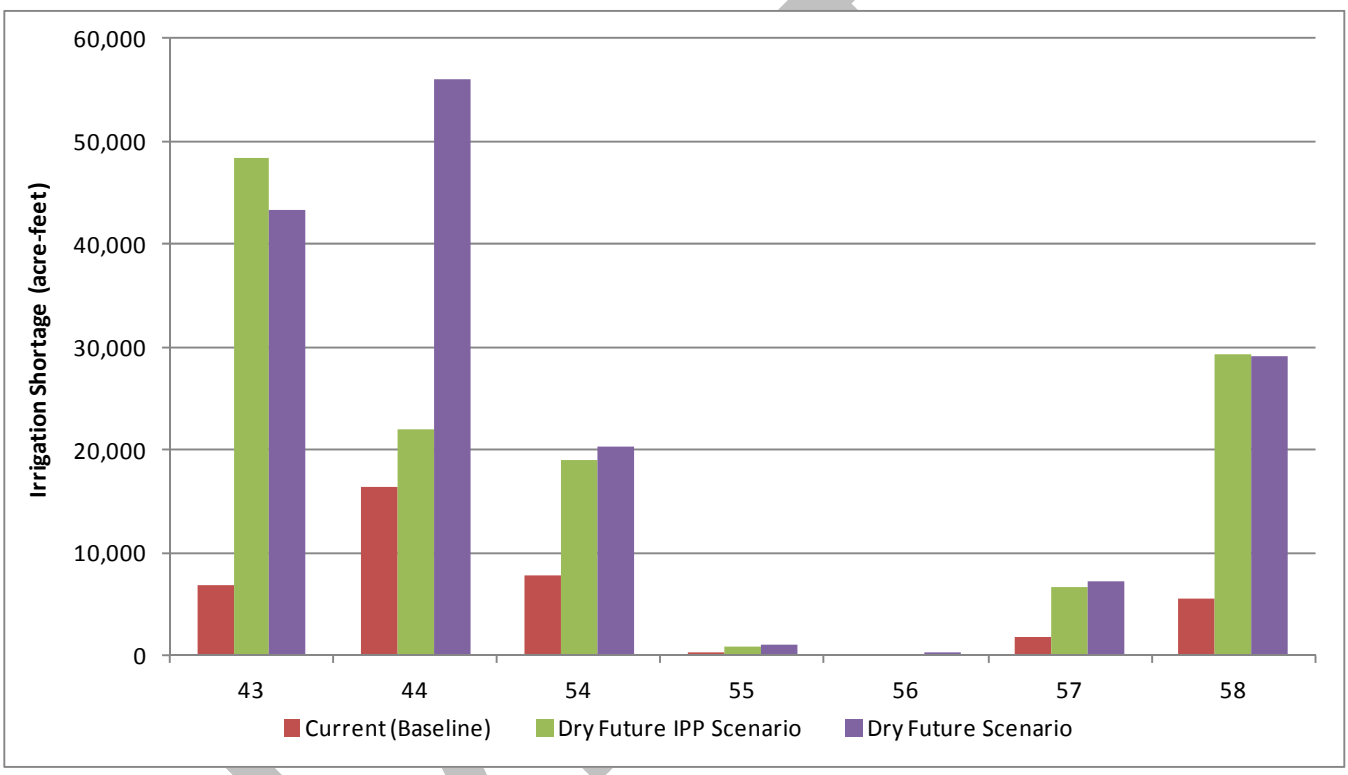

Figure 3-5 Modeled Irrigation Shortages

3.4.2 Environmental and Recreational Shortages

Instream Flows

The instream flows modeled for the P&M Study for Baseline Conditions, the Dry Future IPP Scenario and the Dry Future Scenario are displayed in Figure 3-6 through Figure 3-8, respectively, and the tabular results are provided in Table 3-4. These results show the extent to which modeled stream flows do not meet the targeted decreed instream flows on an average annual basis. Appendix B provides the percentage of modeled years that met the instream flow targets by modeled node and scenario.

Figure 3-6 and Table 3-4 indicates that several of the modeled streams in the headwaters of the Yampa River have shortages of 25% or greater for the Baseline Conditions. The Elk River (nodes 581355 and 581355),[5] Green Creek (node 582245), Hunt Creek (582519) and Bear River (lower) (node 582202) show the greatest impact with shortages exceeding 50%. This suggests that, on an annual average basis, these streams are not meeting the minimum flows needed to sustain ecological health. In addition many upper tributaries protected by instream flow rights are often not met during runoff or in low conditions during the late summer and winter.[6]

Comparison of the Baseline Conditions with the Dry Future Scenario indicate that the instream flow shortages along the majority of the modeled stream reaches will increase if future demand reaches the high level, and if that the Basin is, on average, drier than historical conditions. Stream reaches most impacted[7] include the East Fork of the Williams Fork River (node 441452), Marvine Creek (node 432334), North Fork of the White River (node 432339), South Fork of the White River (node 432344) and the mainstem of the White River (node 431845).

The comparison of the Dry Future IPP Scenario and the Dry Future Scenario suggests that the implementation of the modeled IPPs under high demand/dry conditions will have little impact on instream flows for the majority of the modeled reaches with a few exceptions. The modeling indicates that the implementation of the IPPs would increase instream flow shortages by 27% on Trout Creek. The development of IPPs could reduce instream flow shortages on the following reaches: Oak Creek (by 1.4%, node 582290), Slater Creek (by 3.5%, node 542076)) and Willow Spring & Pond (by 1.8%, node 582162).

[5] Releases from Steamboat Lake are made to Willow Creek and Elk River to meet instream flow requirements, however, the storage in Steamboat Lake is not sufficient to meet all instream flow needs.
[6] Source: 2014 P&M Study
[7] Resulted in an increase in shortage of greater than 25% between the modeled Baseline condition and Scenario 6.

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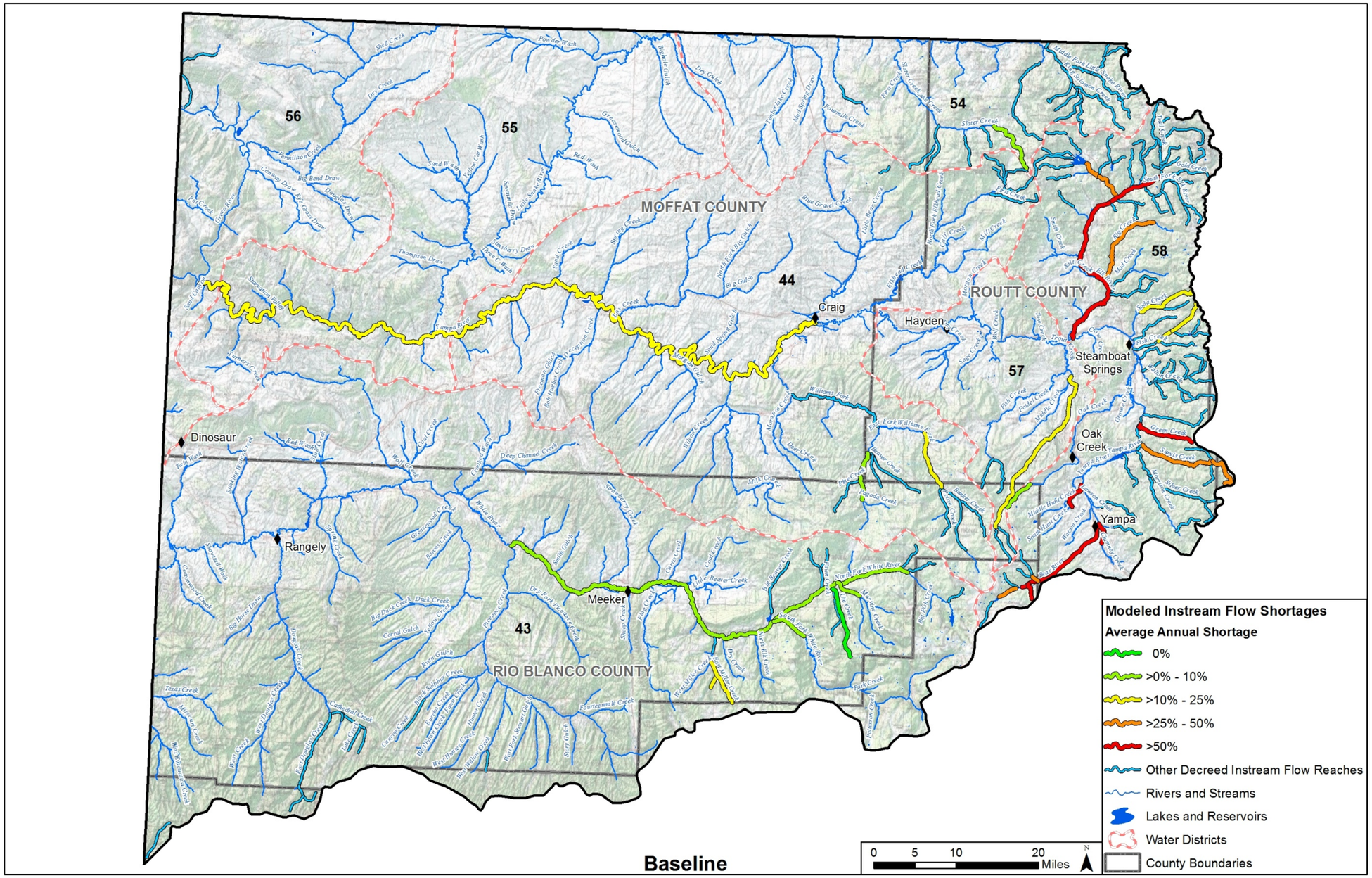

Figure 3-6 Average Annual Modeled Instream Flow Shortages for Baseline Conditions

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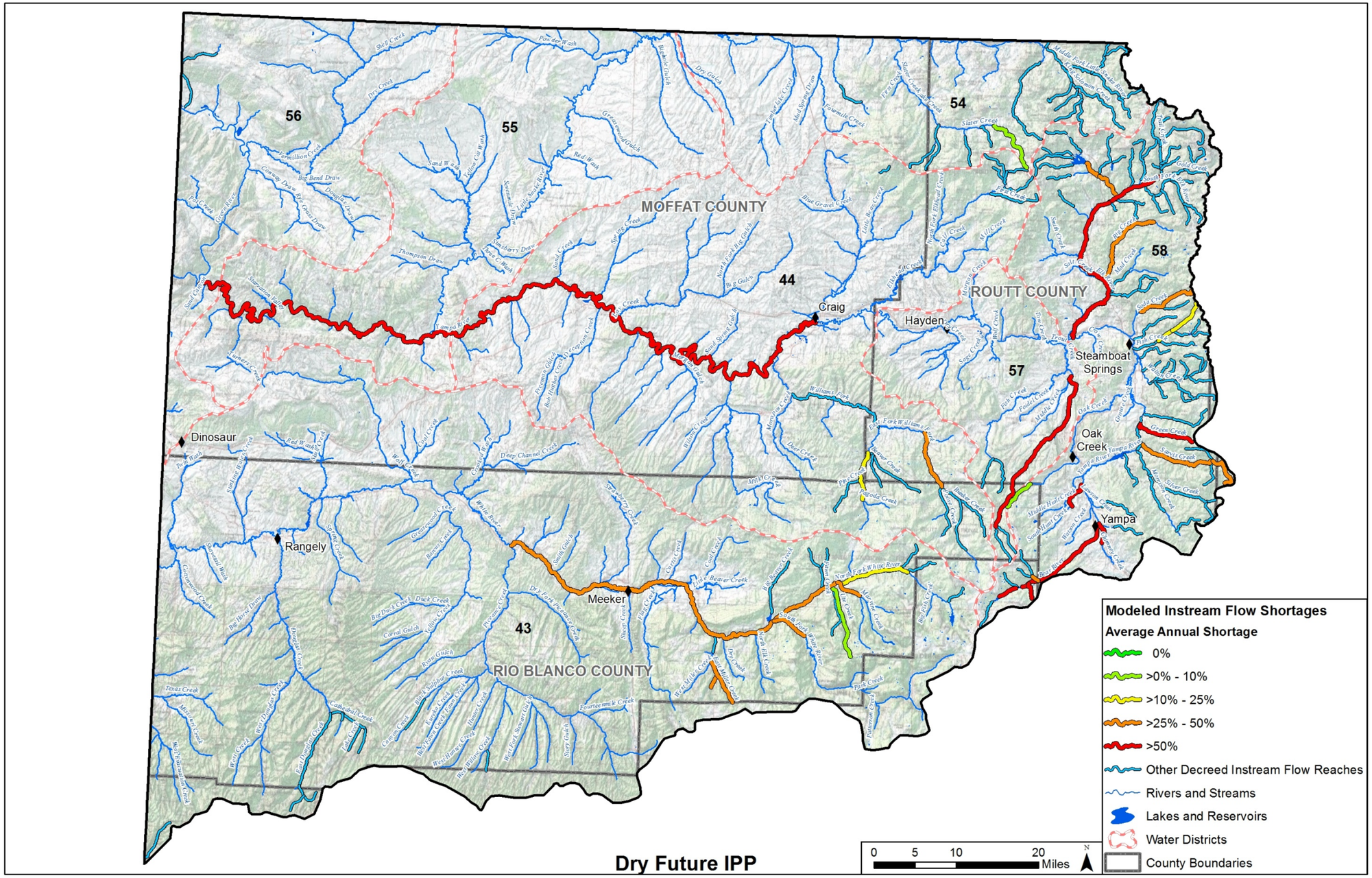

Figure 3-7 Average Annual Modeled Instream Flow Shortages for the Dry Future IPP Scenario

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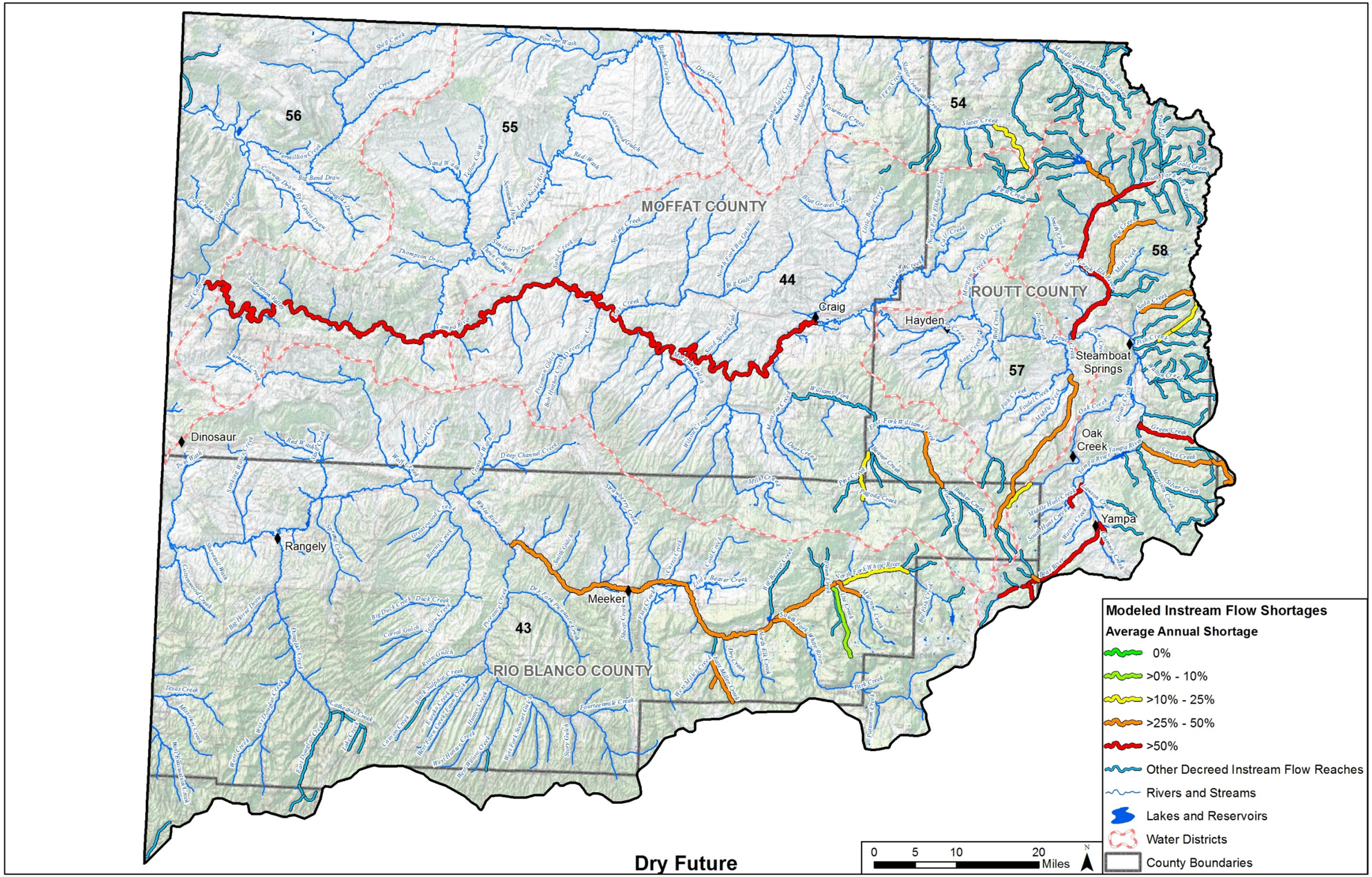

Figure 3-8 Average Annual Modeled Instream Flow Shortages for Dry Future Scenario

Table 3-4 Modeled Annual Average Instream Flow Reaches

Node	Name of Model Node	Instream Modeled Flow Target (cfs)	Annual Average Flow (cfs)			Annual Average Short (cfs)			Percentage Shortage (%)		
			Baseline	Dry Future IPP Scenario	Dry Future Scenario	Baseline	Dry Future IPP Scenario	Dry Future Scenario	Baseline	Dry Future IPP Scenario	Dry Future Scenario
582404	Bear River (Middle)	7.9	4.1	2.9	2.9	3.8	5.0	5.1	47.8%	63.5%	63.7%
582202	Bear River (Lower)	12.0	5.8	3.3	3.3	6.2	8.7	8.7	51.6%	72.5%	72.9%
582206	Big Creek	15.0	10.7	8.8	8.8	4.3	6.2	6.2	28.4%	41.6%	41.6%
582214	Coal Creek	5.0	3.4	2.8	2.8	1.6	2.2	2.2	32.1%	44.2%	44.2%
582216	Dome Creek	2.0	0.3	0.4	0.4	1.7	1.6	1.6	85.9%	81.0%	81.0%
441452	East Fork Williams Fork	14.2	12.3	8.7	8.7	1.9	5.5	5.5	13.5%	38.7%	38.9%
581355	Elk River (Lower)	65.0	26.9	24.5	24.4	38.1	40.5	40.6	58.6%	62.4%	62.5%
582219	Elk River (Upper)	65.0	27.3	26.0	25.8	37.7	39.1	39.2	58.1%	60.1%	60.4%
582245	Green Creek	5.0	2.1	2.1	2.1	2.9	2.9	2.9	58.3%	58.9%	59.0%
582519	Hunt Creek	5.0	2.4	1.8	1.8	2.6	3.2	3.2	52.2%	63.2%	63.6%
432334	Marvine Creek	40.0	39.0	27.4	27.3	1.0	12.6	12.7	2.5%	31.4%	31.7%
432337	Miller Creek	10.0	8.4	7.1	7.1	1.6	2.9	2.9	16.1%	28.9%	28.9%
582287	North Fork Fish Creek	5.0	4.3	4.2	4.2	0.7	0.8	0.8	15.0%	15.8%	15.8%
432339	North Fork White River	70.0	69.7	52.9	52.9	0.3	17.1	17.1	0.4%	24.4%	24.4%
432338	North Fork White River	120.0	117.5	84.0	84.0	2.5	36.0	36.0	2.1%	30.0%	30.0%
582290	Oak Creek	2.0	1.9	1.8	1.8	0.1	0.2	0.2	7.0%	8.9%	10.3%
582409	Phillips Creek	6.0	2.4	1.4	1.3	3.6	4.6	4.7	59.9%	77.5%	77.5%
582306	Service Creek	6.0	3.9	3.6	3.6	2.1	2.4	2.4	34.2%	40.6%	40.6%
542076	Slater Creek	3.0	2.9	2.8	2.6	0.1	0.2	0.4	3.4%	8.2%	11.8%
582311	Soda Creek	5.0	4.1	3.2	3.2	0.9	1.8	1.8	17.4%	36.7%	36.7%
432344	South Fork White River	80.0	74.8	47.1	47.0	5.2	32.9	33.0	6.5%	41.1%	41.2%
441456	South Fork Williams Fork	5.9	5.4	4.8	4.7	0.5	1.1	1.1	8.6%	19.1%	19.5%

Node	Name of Model Node	Instream Modeled Flow Target (cfs)	Annual Average Flow (cfs)			Annual Average Short (cfs)			Percentage Shortage (%)		
			Baseline	Dry Future IPP Scenario	Dry Future Scenario	Baseline	Dry Future IPP Scenario	Dry Future Scenario	Baseline	Dry Future IPP Scenario	Dry Future Scenario
571009	Trout Creek (Lower)	5.0	3.8	1.6	2.9	1.2	3.4	2.1	24.7%	68.7%	41.7%
432372	Ute Creek	6.0	6.0	5.7	5.7	0.0	0.3	0.3	0.0%	4.9%	5.0%
431845	White River	200.0	190.8	111.9	113.6	9.2	88.1	86.4	4.6%	44.1%	43.2%
441448	Williams Fork River	20.7	20.3	15.8	16.2	0.4	4.9	4.5	1.7%	23.8%	21.9%
582332	Willow Creek	7.0	4.0	3.8	3.8	3.0	3.2	3.2	42.2%	46.1%	45.7%
581461	Willow Creek	5.0	3.0	2.8	2.9	2.0	2.2	2.1	40.7%	43.3%	42.8%
582162	Willow Spring & Pond	13.0	8.7	7.5	7.2	4.3	5.6	5.8	33.0%	42.7%	44.5%
582164	Yampa River	56.9	53.1	44.7	44.8	3.8	12.2	12.2	6.6%	21.4%	21.4%

Note: The percentage shortage shown in the table above is equal to the annual shortage divided by the annual average flow target.

Yampa PBO – Endangered Species Fish Flow Target

Figure 3-9 shows the monthly target at the Maybell gage for augmenting existing base flows to assist in endangered fish recovery[8] in relation to the modeled average flows for Baseline Conditions and under the high demand and dry hydrology of the Dry Future IPP and Dry Future Scenarios. The location and extents of this stream reach is shown in Figure 2-10. These results indicate that the modeled instream flows under Baseline Conditions do not meet the instream flow targets, as shown in Table 3-5.

The ability to meet the Yampa PBO base flow augmentation targets significantly decreases when both Future Dry Scenarios are compared to Baseline Conditions. Between 45% and 82% of the time, shortages occur in early fall and winter while summer shortages occur 93% to 100% of the time. Comparison of the Dry Future IPP Scenario with the Dry Future Scenario indicates that the development of IPPs will decrease the Basin's ability to meet instream flows during the fall and winter. IPP reservoir releases to meet downstream needs would increase instream flows in the summer though not significantly enough to impact the number of days in which targeted flows are met.

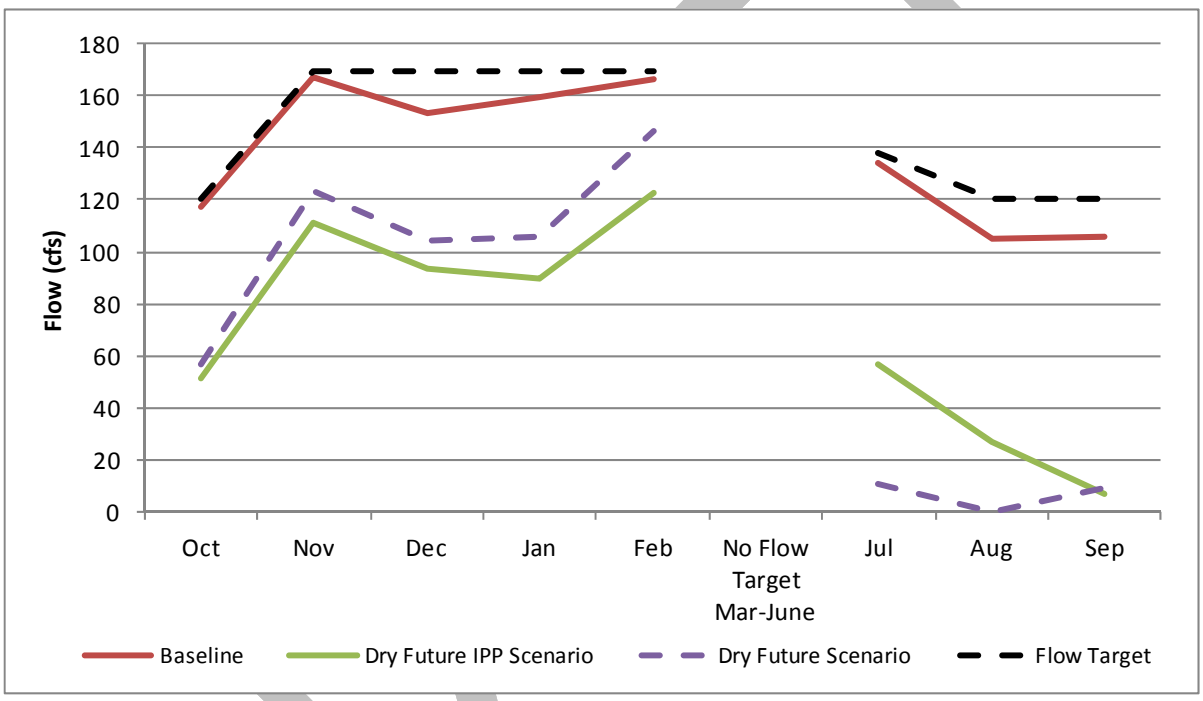

Figure 3-9 Average Monthly Flow through the Yampa River Endangered Species Flow Reach (1950 – 2005)

[8] The P&M Study did not address the rest of the flow regime that may be necessary for endangered fish recovery on this reach of the Yampa, on the lower Little Snake River, on the Yampa River in Dinosaur National Monument, and on the Green River. These flow needs were addressed for the WFET report by replicating the full flow assessment of the existing and future depletions covered by the Yampa PBO.

Table 3-5 Yampa River PBO Flow Targets and Modeled Percentage of Years there is a Shortage

Model Scenario	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Flow Target (cfs)	120	169	169	169	169	n/a	n/a	n/a	n/a	138	120	120
Baseline	9%	11%	23%	25%	11%	n/a	n/a	n/a	n/a	5%	30%	32%
Dry Future IPP Scenario	93%	79%	89%	93%	73%	n/a	n/a	n/a	n/a	93%	100%	98%
Dry Future Scenario	77%	68%	82%	79%	45%	n/a	n/a	n/a	n/a	93%	100%	93%

Fisheries and Cottonwood Flow-Ecology Relationship Risks

The results for the P&M model Baseline Conditions, the Dry Future IPP Scenario and the Dry Future Scenario are presented in Table 3-6 through Table 3-8 and Figure 3-10 through Figure 3-12 for the trout, warm water fish and cottonwood flow-ecology relationships. See Chapter 2 and Appendix A for more information on the flow-ecology relationships.

Generally the most vulnerable reaches for trout are streams with low flows in the upper tributaries. Some of the upper tributaries in the YWG Basin have low or zero flow in late summer/early fall, which can make these tributaries "high risk" even when there is no significant development. Table 3-6 indicates that an increase in demands and dry conditions for the Dry Future IPP Scenario and Dry Future Scenario do not increase the level of risk observed for trout under Baseline Conditions for the following reaches: Slater Creek (node 540570), Willow Creek below Steamboat Lake (node 583787) and the Yampa River from Stagecoach Reservoir to the northern boundary of Sarvis Creek State Wildlife area (node 9237500). The remaining reaches reflect an increased magnitude of risk under both the Dry Future IPP Scenario and the Dry Future Scenario conditions. Comparison of the Dry Future IPP Scenario with the Dry Future Scenario indicate that the development of IPPs do not significantly affect the level of ecological risk to trout within the modeled reaches.

Table 3-6 Modeled Results of the Flow-Ecology Relationship Risks for Trout

			Trout Flow Risk (Aug and Sept)		
			Baseline	Dry Future IPP Scenario	Dry Future Scenario
	Reach Name	Model Node	Existing Demand Historical	High Demand Dry (with IPPs)	High Demand Dry (no IPPs)
2	Yampa River from Pump Station to confluence of Elkhead Creek	9244410	Moderate Risk	Very High Risk	Very High Risk
4	Elk River from headwaters to the County Road 129 bridge at Clark; including the North, Middle and South Fork as well as the mainstem of the Elk	9241000	Minimal Risk	Moderate Risk	Moderate Risk
5	White River from headwaters to Meeker; including the North and South Fork and mainstem of the White	9304500	Minimal Risk	Very High Risk	Very High Risk
8	Slater Creek from headwaters to the Beaver Creek confluence	540570	Moderate Risk	Moderate Risk	Moderate Risk

	Reach Name	Model Node	Trout Flow Risk (Aug and Sept)		
			Baseline	Dry Future IPP Scenario	Dry Future Scenario
			Existing Demand Historical	High Demand Dry (with IPPs)	High Demand Dry (no IPPs)
10	South Fork of the Little Snake from headwaters to confluence of Johnson Creek	9253000	High Risk	Very High Risk	Very High Risk
11a	East Fork of the Williams Fork from headwaters to the confluence of the Forks	9249000	Minimal Risk	High Risk	Moderate Risk
11b	South Fork of the Williams Fork from headwaters to the confluence of the Forks	9249200	High Risk	Very High Risk	Very High Risk
11c	Williams Fork - from South Fork to confluence of the Yampa River	9249750	Moderate Risk	High Risk	High Risk
14	Yampa River from Stagecoach Reservoir "Tailwaters" to northern boundary of Sarvis Creek State Wildlife area	9237500	Minimal Risk	Minimal Risk	Minimal Risk
16	Yampa River from Chuck Lewis Wildlife Area to Pump Station	9239500	Moderate Risk	High Risk	High Risk
18	Willow Creek below Steamboat Lake to confluence with the Elk	583787	Low Risk	Low Risk	Low Risk
19	Bear River from headwaters to USFS boundary	9236000	Low Risk	Minimal Risk	Minimal Risk

The overall level of ecological risk associated with the warm water fish, shown in Table 3-7, is less than with the trout. Areas of high risk are generally associated with water development. The majority of warm water fish reaches show an increase in risk under both the Dry Future IPP Scenario and Dry Future Scenario (high demand dry hydrology) with the exception to the Little Snake River extending from Moffat County Road 10 to the confluence with the Yampa River (node 9260000) which is consistently at high risk.

Comparison of the Dry Future IPP and Dry Future Scenarios indicates that the development of IPPs do not significantly affect the level of ecological risk to warm water within the modeled reaches with exception to the South Fork of the Little Snake from headwaters to confluence of Johnson Creek (node 9253000) and for the Yampa River from Craig (Hwy 394 Bridge) to mouth of Cross Mountain Canyon (node 9251000).

Table 3-7 Modeled Results of the Flow-Ecology Relationship Risks for Warm Water

	Reach Name	Model Node	Warm Water Flow Risk (July - Nov)		
			Baseline	Dry Future IPP Scenario	Dry Future Scenario
			Existing Demand Historical	High Demand Dry (with IPPs)	High Demand Dry (no IPPs)
1	Yampa River from entrance of Cross Mountain Canyon (East Cross Mountain) to confluence with Green River	9260050	Moderate Risk	High Risk	High Risk
2	Yampa River from Pump Station to confluence of Elkhead Creek	9244410	Low Risk	Moderate Risk	Moderate Risk
5	White River from headwaters to Meeker; including the North and South Fork and mainstem of the White	9304500	Low Risk	High Risk	High Risk
6	White River below Kenney Reservoir dam to Utah State line	434433	Low Risk	High Risk	High Risk
7	White River from Rio Blanco dam to Kenney Reservoir	9306290	Low Risk	High Risk	High Risk
10	South Fork of the Little Snake from headwaters to confluence of Johnson Creek	9253000	Low Risk	Moderate Risk	High Risk
12	Little Snake River from Moffat County Road 10 to confluence of the Yampa River	9260000	High Risk	High Risk	High Risk
13	Yampa River from Craig (Hwy 394 Bridge) to mouth of Cross Mountain Canyon	9251000	Moderate Risk	Moderate Risk	Very High Risk
14	Yampa River from Stagecoach Reservoir "Tailwaters" to northern boundary of Sarvis Creek State Wildlife area	9237500	Low Risk	Moderate Risk	Moderate Risk
16	Yampa River from Chuck Lewis Wildlife Area to Pump Station	9239500	Low Risk	Moderate Risk	Moderate Risk

Table 3-8 shows that the overall level of ecological risk for cottonwood is relatively low for the majority of modeled scenarios with exception to the White River from the headwaters to Meeker (node 9304500), the White River below Kenney Reservoir (node 434433) and the Yampa River from Stagecoach Reservoir to the northern boundary of Sarvis Creek State Wildlife Area (node 9237500). The Yampa River below Stagecoach Reservoir is at high risk under Baseline Conditions and would currently benefit the most out of all model nodes from an IPP that increases high flows from April to June in this reach.

Comparison of the Dry Future IPP Scenario and the Dry Future Scenario indicates that the development of the modeled IPPs would not significantly impact the high flow conditions occurring in April to June. As shown in Table 3-8, the cottonwood abundance metric is generally low risk regardless of the presence of IPPs with exception to the White River below Kenney Reservoir (node 43433). IPPs could significantly reduce the risk to cottonwood within this reach.

Table 3-8 Modeled Results of the Flow-Ecology Relationship Risks for Cottonwood

	Reach Name	Model Node	Cottonwood Abundance Risk (April - June)		
			Baseline	Dry Future IPP Scenario	Dry Future Scenario
			Existing Demand Historical	High Demand Dry (with IPPs)	High Demand Dry (no IPPs)
1	Yampa River from entrance of Cross Mountain Canyon (East Cross Mountain) to confluence with Green River	9260050	Low Risk	Low Risk	Low Risk
2	Yampa River from Pump Station to confluence of Elkhead Creek	9244410	Low Risk	Low Risk	Low Risk
4	Elk River from headwaters to the County Road 129 bridge at Clark; including the North, Middle and South Fork as well as the mainstem of the Elk	9241000	Low Risk	Low Risk	Low Risk
5	White River from headwaters to Meeker; including the North and South Fork and mainstem of the White	9304500	Low Risk	Moderate Risk	Moderate Risk
6	White River below Kenney Reservoir dam to Utah State line	434433	Moderate Risk	Very High Risk	Low Risk
8	Slater Creek from headwaters to the Beaver Creek confluence	540570	Low Risk	Low Risk	Low Risk
9	Elkhead Creek from headwaters to confluence of North Fork of Elkhead Creek	9245000	Low Risk	Low Risk	Low Risk
10	South Fork of the Little Snake from headwaters to confluence of Johnson Creek	9253000	Low Risk	Low Risk	Low Risk
11c	Williams Fork - from South Fork to confluence of the Yampa River	9249750	Low Risk	Low Risk	Low Risk
12	Little Snake River from Moffat County Road 10 to confluence of the Yampa River	9260000	Low Risk	Low Risk	Low Risk
13	Yampa River from Craig (Hwy 394 Bridge) to mouth of Cross Mountain Canyon	9251000	Low Risk	Low Risk	Low Risk
14	Yampa River from Stagecoach Reservoir "Tailwaters" to northern boundary of Sarvis Creek State Wildlife Area	9237500	High Risk	High Risk	High Risk
15	Fish Creek from Fish Creek Falls to confluence of the Yampa River	9238900	Low Risk	Low Risk	Low Risk
16	Yampa River from Chuck Lewis Wildlife Area to Pump Station	9239500	Low Risk	Low Risk	Low Risk
18	Willow Creek below Steamboat Lake to confluence with the Elk	583787	Low Risk	Low Risk	Low Risk

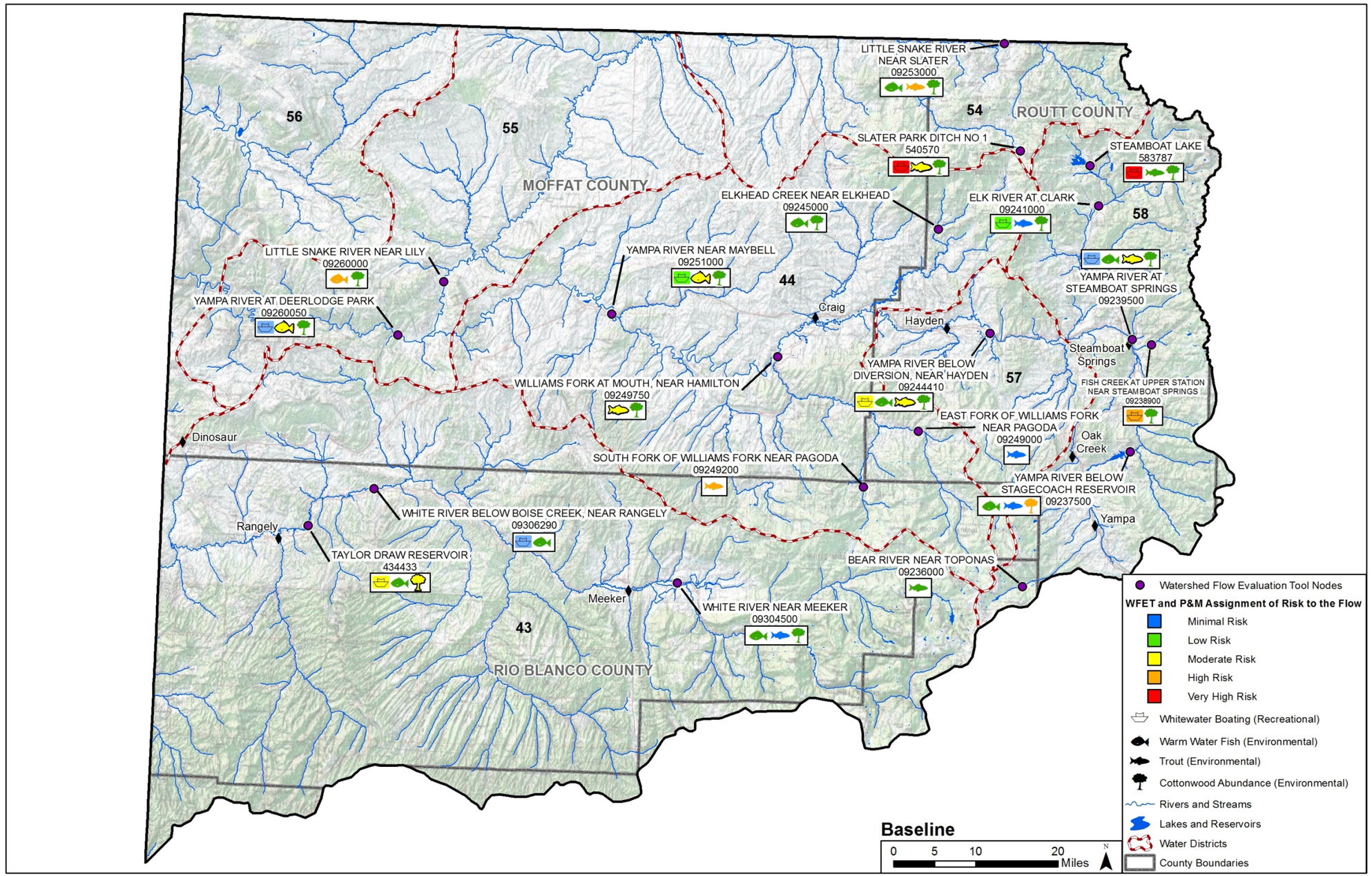

Figure 3-10 Flow-Ecology Relationship Risks for Modeled Baseline Conditions

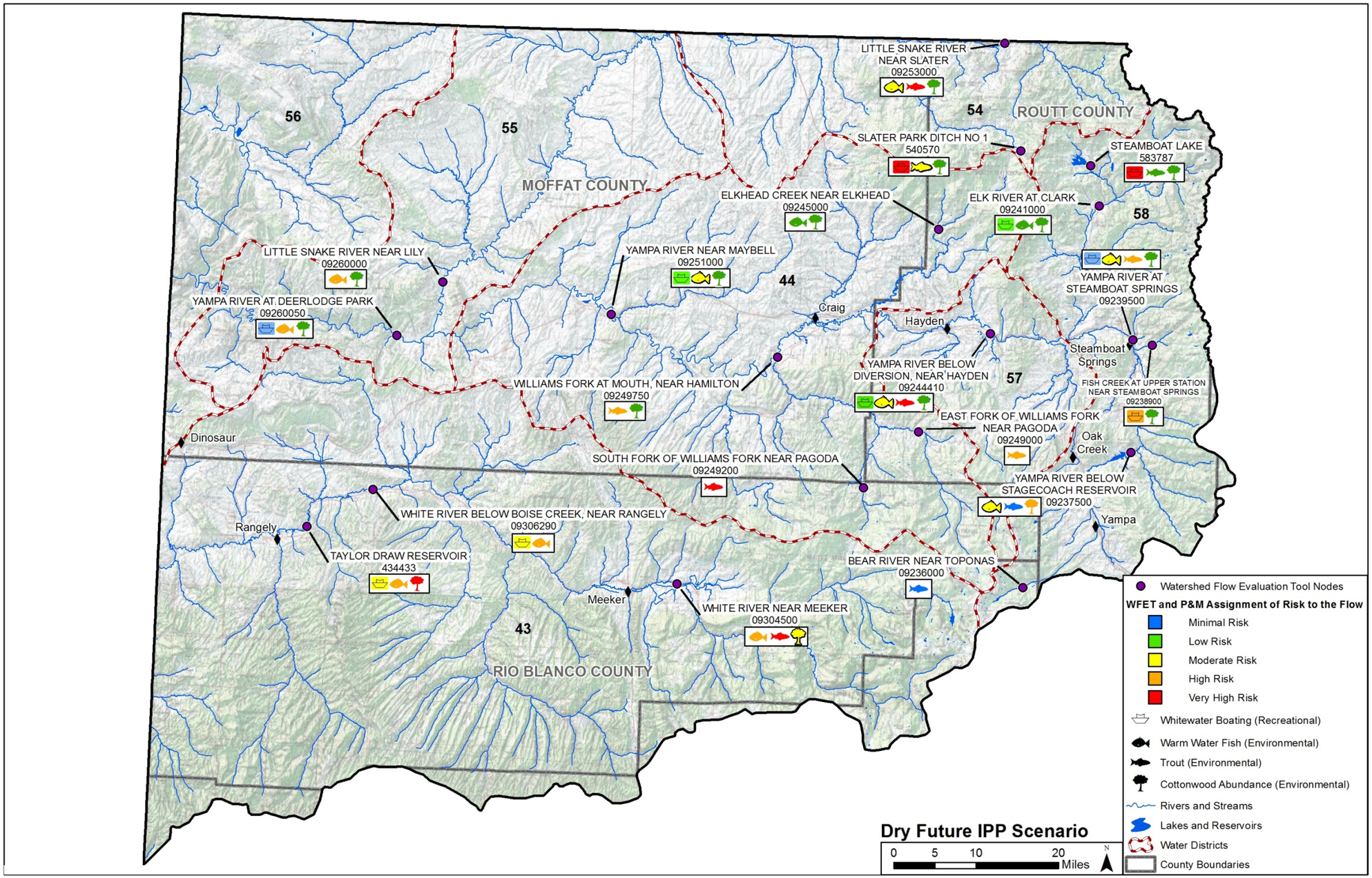

Figure 3-11 Flow-Ecology Relationship Risks for Modeled Dry Future IPP Scenario

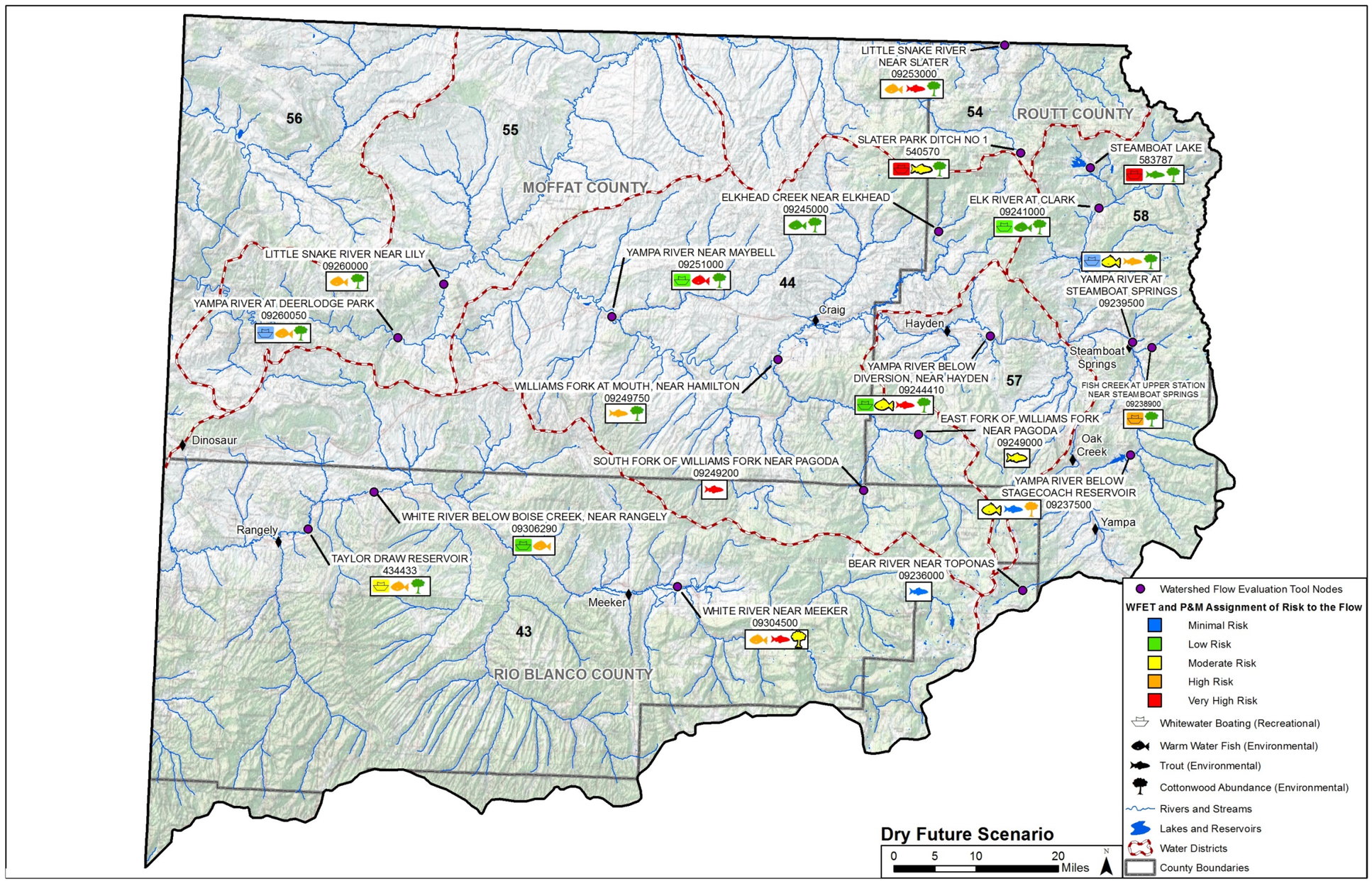

Figure 3-12 Flow-Ecology Relationship Risks for Modeled Dry Future Scenario

Steamboat RICD

Figure 3-13 shows the monthly Steamboat Recreation In-Channel Diversion (RICD) streamflow targets in relation to the modeled average flows for the Baseline Condition and the Dry Future IPP and Dry Future Scenarios. Table 3-9 shows that for Baseline Conditions, on average, the flow targets are met 100% of the time in April and September and for at least 95% of the time in May and August. Targeted flows are not met in June and July 21% and 38% of the time, respectively.

Comparison of the Dry Future Scenario with Baseline Conditions indicates that flows decrease in the RICD reach with the frequency in which the targeted flows are met. The most significant impacts occur in June, July and August where shortages increase in frequency to 29%, 60% and 22%, respectively. Comparison of the Dry Future IPP Scenario and Dry Future Scenario indicate that the IPPs do not significantly affect the flows within the RICD reach.

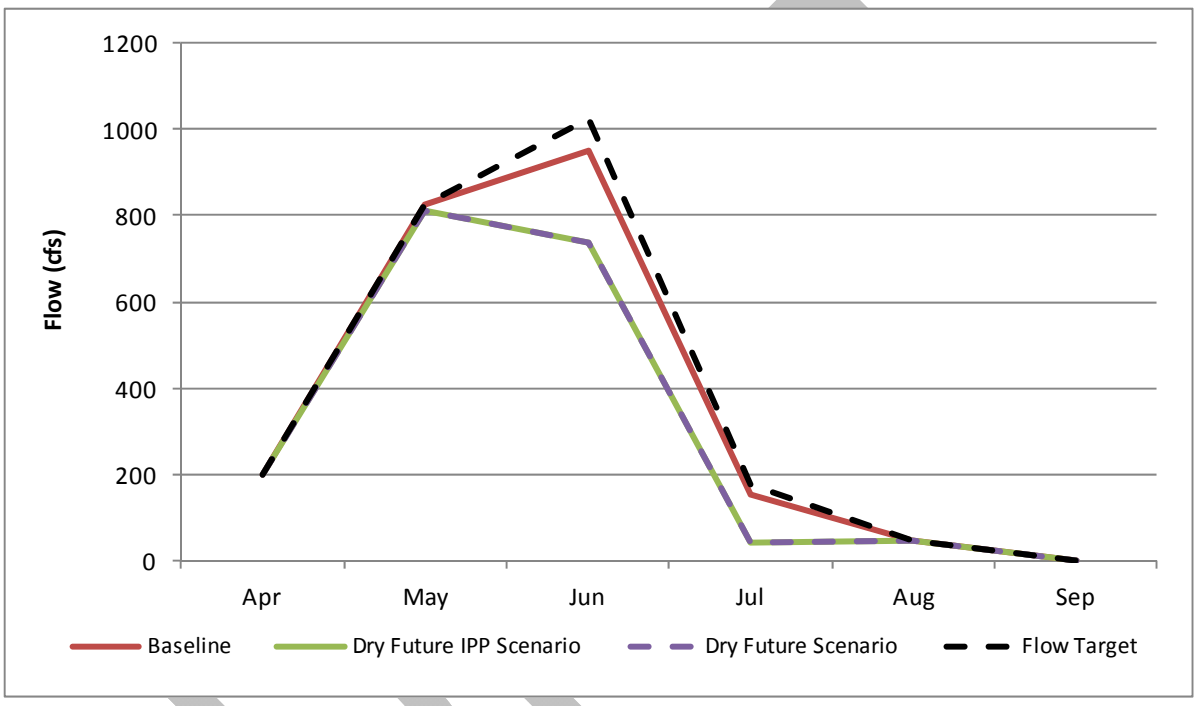

Figure 3-13 Average Monthly Flow at the Steamboat RICD

Table 3-9 Steamboat RICD and Modeled Percentage of Years there is a Shortage

Model Scenario	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Flow Target (cfs)	n/a	n/a	n/a	n/a	n/a	n/a	200	825	1025	175	47	0
Baseline	n/a	n/a	n/a	n/a	n/a	n/a	0%	2%	21%	38%	5%	0%
Dry Future IPP Scenario	n/a	n/a	n/a	n/a	n/a	n/a	0%	7%	50%	98%	27%	0%
Dry Future Scenario	n/a	n/a	n/a	n/a	n/a	n/a	0%	7%	50%	98%	25%	0%

Recreational Whitewater Boating Flow Risk Metric

Table 3-10 presents the percentage of the boating season with usable flows at designed modeled nodes for the modeled Baseline Conditions, Dry Future IPP Scenario and Dry Future Scenario.[9] These results indicate that there is a significant variability in usable days throughout the Basin. Slater Creek (node 540570) and Willow Creek (node 583787) have very few usable days for all three modeled scenarios, whereas the percentage of usable days on the Yampa River from Cross Mountain Canyon to the Green River (node 9260050) is 87% under Baseline Conditions and 70% for the Dry Future IPP and Dry Future Scenarios. The number of usable days increases slightly for the following nodes from Baseline Conditions to the Dry Future Scenario: Fish Creek (node 9238900), Yampa River from Chuck Lewis Wildlife Area to Pump Station (node 9239500) and Willow Creek (node 583787). This is due to the timing and duration of the flows resulting in a slightly larger percent of usable days, but not necessarily higher flows.

Table 3-10 Modeled Results for the Recreational Whitewater Boating Flow Risk Metric

	Reach Name	Model Node	Percentage of Boating Season with Usable Flows (Seasons of Use Varies by Node)		
			Baseline	Dry Future IPP Scenario	Dry Future Scenario
			Existing Demand Historical	High Demand Dry (with IPPs)	High Demand Dry (no IPPs)
1	Yampa River from entrance of Cross Mountain Canyon (East Cross Mountain) to confluence with Green River	9260050	87%	69%	70%
2	Yampa River from Pump Station to confluence of Elkhead Creek	9244410	20%	7%	7%
4	Elk River from headwaters to the County Road 129 bridge at Clark; including the North, Middle and South Fork as well as the mainstem of the Elk	9241000	48%	48%	48%
6	White River below Kenney Reservoir dam to Utah State Line	434433	33%	25%	26%
7	White River from Rio Blanco Lake dam to Kenney Reservoir	9306290	58%	25%	47%
8	Slater Creek from headwaters to the Beaver Creek confluence	540570	1%	1%	1%
13	Yampa River from Craig (Hwy 394 Bridge to mouth of Cross Mountain Canyon, including Little Juniper Canyon	9251000	43%	29%	28%
15	Fish Creek from Fish Creek Falls to confluence with Yampa River	9238900	12%	18%	18%
16	Yampa River from Chuck Lewis Wildlife Area to Pump Station	9239500	55%	57%	57%
18	Willow Creek below Steamboat Lake to confluence with the Elk	583787	0%	3%	3%

[9] Note: The timing and duration of the whitewater boating season is customized to each individual model node. Additional information on the boating seasons may be found in the Watershed Flow Evaluation Tool.

Table of Contents

SECTION 4.0 PROJECTS AND METHODS

This chapter provides an overview of the YWG Basin's watershed health; forest health and wildfires; Identified Projects and Processes (IPPs); and the education and public outreach component necessary to ensure that the BIP planning process represents the values and community needs of the Basin. The IPPs presented in this chapter are dynamic lists reflective of the current planning process. These lists will continue to be updated with new IPPs as the Basin continues to refine its water needs and its overall understanding of IPPs. The majority of information presented in this chapter was developed through stakeholder input and the 2014 Projects and Methods Study (P&M Study). The following bullets summarize consumptive and environmental and recreational IPPs and public outreach.

- Education and outreach strategies for the Yampa-White-Green Basin Implementation Plan (YWG BIP) included advertisements, meetings, surveys, and stakeholder collaboration. The YWG BIP was advertised through various channels to inform as many residents of Northwest Colorado of the YWG BIP and to encourage them to attend outreach meetings, learn about the BIP process and respond to the Basin Roundtable. The purpose of the meetings was to inform water stakeholders about the Colorado Water Plan, the YWG BIP and their right/responsibility to provide input to the Basin Roundtable for the YWG BIP. Additional input was sought using two surveys distributed throughout the Basin to gather details on existing or proposed consumptive and environmental/recreational IPPs. The draft report was posted for review using similar methods.
- Consumptive IPPs consist of projects that will address agricultural, M&I, and SSI water needs. Examples include reservoir enlargements, new storage projects, municipal water conservation, and expansion of municipal supply well fields. In addition to IPPs previously identified through the State Water Supply Index (SWSI) and the P&M Study, new projects were identified through surveys distributed throughout the Basin, and through additional discussions with the BIP Committee. The consumptive IPPs provide means to meet consumptive needs agricultural, M&I, and SSI needs, oftentimes in a collaborative manner. The Basin Roundtable will continue to explore additional multi-purpose opportunities where they may exist through future planning efforts.
- Seventeen environmental and recreational IPPs were identified to help meet environmental and recreational water supply needs. The environmental and recreational IPPs were also identified through surveys. These IPPs include studies, agreements, constructed projects, ecological improvements and other legal mechanisms that can be used to meet the environmental and recreational needs of the Basin.

4.1 EDUCATION, PARTICIPATION AND OUTREACH

Education, participation, and outreach efforts were essential for informing stakeholders and decision-makers of the existence and goals of the YWG BIP and Colorado Water Plan. These efforts also informed YWG Basin residents of the Colorado Water Plan and provided a mechanism to comment on the YWG BIP's content. Existing and new IPPs were identified during the outreach process through the use of surveys. The surveys and the results are discussed in further detail in Section 4.1.3 and Section 4.2. Appendix B contains the public outreach reports, public comments, and a summary table of those comments.

4.1.1 Advertisement

Advertising for the YWG BIP was approached in a variety of venues with the intent to inform as many residents of Northwest Colorado of the pending plan and to encourage them to attend an outreach meeting, learn about the YWG BIP process and respond to the Basin Roundtable. All advertising was done during February prior to the meetings.

- 2000 flyers were inserted into a weekly edition of *The Rio Blanco Herald Times*. The flyer was two sided: the front side explained the Colorado Water Plan, and the back side informed people of meetings in northwest Colorado and of response opportunities.
- 747 postcards were mailed to residents in Rio Blanco County and 353 to residents in Moffat County informing them of meeting dates and response opportunities.

- 150 postcards were hand-distributed at various meetings in Steamboat Springs.
- Email postcards (for further outreach distribution) were sent to almost 60 organizations, agencies and groups informing them of the meeting dates and encouraging them to spread the word, have board members attend a meeting and submit recommendations to the Basin Roundtable. A summary of the groups contacted is provided below.
  - Basin Roundtable members
  - Commissioners Offices for Routt, Rio Blanco, Moffat Counties
  - Administrative Offices for the towns of Yampa, Oak Creek, Steamboat, Hayden, Craig, Dinosaur, Meeker, and Rangely
  - Chambers of Commerce in Steamboat Springs, Craig, and Meeker
  - Economic Development Councils in South Routt, Steamboat Springs, Craig
  - Colorado State University Extension Offices in Routt, Rio Blanco and Moffat Counties
  - Conservation District Offices in Routt, Rio Blanco and Moffat Counties
  - Regional offices of federal government agencies: NRCS, USFS, FSA
  - Local organizations in Routt, Rio Blanco and Moffat: Agriculture Groups, Habitat Programs, Environmental Groups,
  - Health Care Groups, and Tourism/Recreation Groups
- Five print advertisements were placed in *The Steamboat Pilot* and two in the *Craig Daily Press* informing people of the meeting dates.
- Flyers were posted in "gathering spots" in Steamboat Springs, Craig and Meeker. The flyer was two sided: the front side explained the Colorado Water Plan, and the back side informed people of meetings in northwest Colorado and response opportunities. In addition the flyer was sent to all of the above-listed organizations, agencies and groups asking them to post the notice.
- Personal invitations were extended by Community Agriculture Alliance staff and board, Basin Roundtable Members, Colorado State University Extension staff and Conservation District staff.

4.1.2 Meetings

Five outreach meetings were held in the YWG Basin in February and early March 2014, reaching a total attendance of 267 people. The purpose of the meetings was to inform water stakeholders about the Colorado Water Plan, the BIPs and their right/responsibility to provide input to the Basin Roundtable for the YWG BIP. The meetings (Table 4-1) were structured using the same format and were facilitated by Basin Roundtable members from each respective area. A PowerPoint presentation, which originated from the Colorado Water Conservation Board, was revised to contain pertinent information about the three river basins in northwest Colorado. Demographic questions asked at each meeting allowed the Basin Roundtable to ascertain which river basin people called home, which county they lived in, their primary use of water and what they considered the most important use of water. A comment/question/answer period concluded each meeting. Meeting highlights are summarized in Table 4-2.

Table 4-1 Summary of YWG Public Outreach Meetings

Date Completed	Location	Participation	RT Members Involved
Feb 6, 2014 Thursday	Rangely CNCC	41 Attended 37 Registered 24 Used Public Poll	Jeff Devere Jon Hill Dan Eddy Alden Vanden Brink Ren Martyn
Feb 13, 2014 Wednesday	Steamboat Springs Community Center	98 Attended 88 Registered	Kevin McBride Jay Gallagher Doug Monger Tom Sharp Geoff Blakeslee Dan Craig Steve Colby Jackie Brown Ren Martyn Tom Gray Don Jones
Feb 19, 2014 Wednesday	Craig American Legion	50 People Attended 46 Registered 43 Used Public Poll	Tom Gray Don Jones Burt Clements Doug Monger
Feb 24, 2014 Monday	Meeker Rio Blanco Fairgrounds	58 People Attended 56 People Registered 48 Used Public Poll	Jeff Devere Jon Hill Al Vanden Brink Ren Martyn
March 11, 2014 Tuesday	Browns Park Browns Park School	20 People Attended 18 People Registered 16 Used Public Poll	T Wright Dickinson Ren Martyn

Table 4-2 Demographic Results of BIP Public Outreach Meetings

Outreach Meeting	"Home Basin"	County Live In	Primary Use of Water	Most Important Use of Water
Rangely (24 respondents)	2 Yampa 22 White	3 Moffat 21 Rio Blanco	17 Agriculture 4 Municipal/Industrial 3 Recreation	#1 Agriculture #2/3 Tie: Energy & Municipal/Industrial #4 Environment #5 Recreation
Steamboat Springs (52 respondents) **	51 Yampa 1 Out of Region	49 Routt 1 Moffat 2 Out of State	19 Agriculture 11 Municipal/Industrial 11 Environment 10 Recreation 1 Energy	Not identified
Craig (43 respondents)	42 Yampa 1 White	40 Moffat 1 Rio Blanco 1 Routt 1 Out of State	25 Agriculture 6 Municipal/Industrial 5 Recreation 5 Environment 2 Energy	#1 Agriculture #2 Environment #3 Municipal/Industrial #4 Energy #5 Recreation
Meeker (48 respondents)	11 Yampa 37 White	3 Moffat 43 Rio Blanco 2 Routt 1 Out of State	40 Agriculture 7 Municipal/Industrial 1 Environment	#1 Agriculture #2 Municipal/Industrial #3 Energy #4 Environment #5 Recreation

Outreach Meeting	"Home Basin"	County Live In	Primary Use of Water	Most Important Use of Water
Browns Park (16 respondents)	16 Green	12 Moffat 4 Out of State	9 Agriculture 5 Municipal/Industrial 2 Environment	#1/2 Tie: Agriculture and Energy #3 Municipal #4Environment #5 Recreation
Total 267 attended 183 responses**	106 Yampa = 58% 60 White = 33% 16 Green % = 9 1 Out of Region	58 Moffat = 32% 65 Rio Blanco = 36% 52 Routt = 28% 8 Out of State = 4%	110 Agriculture = 60% 33 Municipal/Industrial =18% 19 Environment = 10% 18 Recreation = 10% 3 Energy = 2%	

** Technical Problems at Steamboat Springs: only 59% (52 actual count) of the 88 respondents' data was stored

4.1.3 Surveys

The public outreach included a survey regarding consumptive IPPs and one regarding environmental and recreational IPPs. The purpose of the surveys was to gather details on existing or proposed IPPs not previously identified in the SWSI or P&M Study. The surveys were developed with input from the YWG BIP Committee to refine the questions and make them more targeted. The surveys were distributed on April 14, 2014 to Committee members and Basin Roundtable members, who were given an opportunity to fill them out and distribute it to other stakeholders as they saw fit. The surveys resulted in 3 new IPPs for consumptive use projects and 17 additional IPPs for environmental and recreational projects. These IPPs, and others, are discussed in further detail in Section 4.2.

4.1.4 Stakeholder Collaboration

The YWG Public Education, Participation and Outreach (PEPO) Workgroup and Community Agriculture Alliance engaged the Colorado State University Extension Offices in Routt and Rio Blanco Counties and the conservation districts in Routt, Moffat and Rio Blanco Counties as advertising liaisons. Each of these groups has working relationships with various water users in their counties and was willing to encourage people to attend a meetings, learn about the YWG BIP and respond with written comments to the Basin Roundtable. The Community Agricultural Alliance worked with the conservation districts to contact their constituencies and provide input to the process.

4.2 WATERSHED HEALTH

Overview of Watershed Health in the Yampa, White and Green Basins

Watershed health is influenced by both natural processes and human activities and is important for drinking water, agriculture, recreation, and ecological integrity.[1] As water moves through a watershed the surface and sub-surface conditions affect the quality of the water. Water quality refers to the chemical, physical and biological characteristics of water. It is a measure of the condition of water relative to the requirements of aquatic and human need or purpose. The YWG Basin is largely comprised of headwater tributary streams that support relatively high water quality, but are not without impairments to watershed health. Water quality is vitally important to local and regional economies in the YWG Basin. The dominant employment industries in the Basin are: construction (15% of total jobs); education, health and social services (15%); arts, entertainment, recreation, lodging and food services (13%); retail trade (12%); and agriculture, forestry, hunting and mining (10%).[2] The last three industries in that list account for 35% of total jobs in the YWG Basin, meaning that over one-third of the jobs in the YWG Basin are dependent on water quality that supports tourism, recreation, and agriculture.

[1] Brown, Jackie. Rouut County Conservation District, Upper Yampa River Watershed Group. *State of the Upper Yampa River Watershed Report.* August 2014.
[2] U.S. Census American FactFinder. http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml

In most subbasins within the YWG Basin, many government (US Forest Service, US Fish and Wildlife Service (USFWS), Bureau of Reclamation, National Park Service, Colorado Parks & Wildlife, municipalities, and Water Conservancy Districts), and non-government organizations (The Nature Conservancy, Trout Unlimited, Colorado Water Trust, local grassroots organizations) work both individually and collaboratively to actively support efforts that protect and improve water quality and watershed health. The Upper Yampa River Watershed Group (UYRWG) represents a collaboration to protect and enhance the health of the Upper Yampa River Watershed from the headwaters of the Yampa River to the confluence of and including Elkhead Creek. The 2014 State of the Watershed Report is the first step in the local watershed planning process and serves to document existing conditions. There are other examples of watershed protection efforts on agricultural lands (riparian fencing and riparian habitat protection), within municipalities (water body setbacks and floodplain regulations), stormwater management programs, and more. Many efforts and partnerships are built upon the simple concept that water quality and water quantity must be considered holistically in order to maintain a balance between properly functioning river systems and successful water supply projects. All future proponents of IPPs will be encouraged to work with the respective organizations to develop comprehensive components that consider all of these important aspects of watershed health.

The Colorado Department of Public Health and Environment's narrative standards describe goals and numeric standards set maximum acceptable concentrations of specific pollutants. Many constituents that are issues of concern for aquatic life, human health or suitability of water for various uses include those on the CDPHE Regulation 93 2012 303(d) list of impaired waters or the Monitoring & Evaluation list. Impaired waters remain listed until sufficient monitoring shows the stream is no longer impaired. Eighteen stream segments are on the 303(d) list for sediment, metals (iron, copper, and selenium), aquatic life, pH, and E. coli. There are twenty-five segments on the Monitoring and Evaluation List (M&E) for metals (lead, mercury, iron, copper, selenium, zinc, and manganese), dissolved oxygen, sediment, E. coli, aquatic life, pH, and temperature (CDPHE Regulation 93. March 2012). The US Geological Survey (USGS) has produced reports that analyze water quality data in many of the river subbasins located within the YWG Basin:

- USGS, Water-Quality Assessment and Macroinvertebrate Data for the Upper Yampa River Watershed, Colorado, 1975 through 2009 USGS Scientific Investigations Report 2012-5214
- Characterization and Data-Gap Analysis of Surface-Water Quality in the Piceance Study Area, Western Colorado, 1959–2009 USGS Investigations Report 2013–5015
- USGS, Baseline characterization of water quality and mass loading in Piceance Creek, Rio Blanco County, Colorado, December 2000 USGS Water-Resources Investigations Report: 2002-4134
- Comparison of 2011–12 water years and historical water-quality data, White River Basin, Colorado
- Specific Conductance and Dissolved-Solids Characteristics for the Green River and Muddy Creek, Wyoming, Water Years 1999–2008 USGS Scientific Investigations Report 2009–5168

There are six locations as part of the Yampa River Basin Monitoring Program that the USGS monitors each year as of 2010 that will be used to define baseline conditions. Partners sponsoring the Program and the Upper Yampa River Watershed Group will help determine if and where additional monitoring sites are needed. The USGS is conducting water quality baseline monitoring in the White River Basin. Lower Yampa sediment monitoring through USGS Grand Canyon Monitoring and Research Center is also ongoing in and above Dinosaur National Monument as well as on the Green River above Gates of Lodore. USGS also performs water quality monitoring for the lower Yampa Basin below Craig, Colorado, to the border with Utah. Further water quality sampling and monitoring occurs in the YWG Basin through various other agencies.

Soil disturbance activities are among the primary sources of sedimentation in the Yampa Basin. These activities include channel modifications, impoundments, and bank degradation which can stem from many different land use activities and natural occurrences. (Wildfires also impact sedimentation. This is discussed in further detail in the next subsection.) Several USGS products have been released regarding sedimentation on the lower Yampa and Green River basins; Characterization of Hydrodynamic and Sediment Conditions in the Lower Yampa River at Deerlodge Park, East Entrance to Dinosaur National Monument, Northwest Colorado, 2011 Scientific Investigations Map: 3273

and Summary of Sediment Data from the Yampa River and Upper Green River Basins, Colorado and Utah, 1993–2002 Scientific Investigations Report 2004–5242.

Updated and informed reservoir and flow management is critical to sustaining aquatic life and ecosystem function while balancing consumptive demands. A Programmatic Biological Opinion is performed by the USFWS and is a consultation process with other federal agencies to avoid jeopardizing listed species. These consultations are under Section 7 of the Endangered Species Act of 1973. Agencies also consult to avoid harming critical habitat. Whenever possible, programmatic consultations address multiple (typically small) projects and require that applicants take specific steps to protect endangered species.

A Biological Opinion is also performed by the USFWS and occurs when another federal agency asks USFWS to concur that their project will not jeopardize the species. After formal consultation, a Biological Opinion is written which determines whether a listed species will be jeopardized or critical habitat adversely modified. It is the basis for actions that need to be taken to minimize impact to the species. As part of the Upper Colorado River Endangered Fish Recovery Program effort, the USFWS have submitted both types of opinions regarding river operations:

- Green River: Bureau of Reclamation, Record of Decision Operation of Flaming Gorge Dam Final Environmental Impact Statement, February 2006
- Green River: US Fish & Wildlife Service, Operation of Flaming Gorge Dam Final Environmental Impact Statement, Final Biological Opinion, September 2005
- Yampa River: US Fish & Wildlife Service, Final Programmatic Biological Opinion on the Management Plan for Endangered Fishes in the Yampa River Basin, January 2005
- White River: US Fish & Wildlife Service, COLORADO RIVER RECOVERY PROGRAM Project #:168 FY 13-15 SCOPE OF WORK for White River Management Plan, August 2013
- White River: Information on the forthcoming USFWS Programmatic Biological Opinion for the White River accessed July 9, 2014

Though the above planning documents focus primarily on federally endangered fish, there are numerous aquatic and terrestrial species that depend on the YWG Basin for habitat and require attention when planning for projects. Information on State threatened and endangered species can be found on the Colorado Parks and Wildlife website, and information on the status of federally threatened and endangered species is available on the USFWS website.

Several other studies on water quality in the YWG Basin are available online. Table 4-3 lists these studies and their web addresses.

Table 4-3 Water Quality Studies of the YWG Basin

Study Name	Web Address
Colorado Department of Public Health and Environment Water Quality Control Commission, Regulation 93, March 2012	https://www.colorado.gov/pacific/sites/default/files/Regulation-93.pdf
US Geological Survey WaterSMART—The Colorado River Basin Focus-Area Study Fact Sheet 2012-3114, September 2012	http://pubs.usgs.gov/fs/2012/3114/
Routt & Moffat Counties, Yampa River Watershed 208 Plan, 2002	http://routtcountycd.com/wp-content/uploads/2012/04/208-Plan-Final.pdf
USGS, Water-Quality Assessment and Macroinvertebrate Data for the Upper Yampa River Watershed, Colorado, 1975 through 2009; USGS Scientific Investigations Report 2012-5214	http://pubs.usgs.gov/sir/2012/5214/
Characterization and Data-Gap Analysis of Surface-Water Quality in the Piceance Study Area, Western Colorado, 1959–2009; USGS Scientific Investigations Report 2013–5015	http://pubs.usgs.gov/sir/2013/5015/

Study Name	Web Address
Brown, Jackie. Routt County Conservation District, Upper Yampa River Watershed Group. State of the Upper Yampa River Watershed Report, August 2014	www.routtcountycd.com/Watershed (link to be live by August 1, 2014)
USGS, Baseline characterization of water quality and mass loading in Piceance Creek, Rio Blanco County, Colorado, December 2000; USGS Water-Resources Investigations Report: 2002-4134	http://pubs.er.usgs.gov/publication/wri024134
Comparison of 2011–12 water years and historical water-quality data, White River Basin, Colorado	http://co.water.usgs.gov/infodata/white_summaries/index.html
Specific Conductance and Dissolved-Solids Characteristics for the Green River and Muddy Creek, Wyoming, Water Years 1999–2008; U.S. Geological Survey Scientific Investigations Report 2009–5168	http://pubs.usgs.gov/sir/2009/5168/
USGS, Characterization of Hydrodynamic and Sediment Conditions in the Lower Yampa River at Deerlodge Park, East Entrance to Dinosaur National Monument, Northwest Colorado, 2011; Scientific Investigations Map: 3273	http://pubs.usgs.gov/sim/3273/
USGS, Summary of Sediment Data from the Yampa River and Upper Green River Basins, Colorado and Utah, 1993–2002. Scientific Investigations Report 2004–5242	http://pubs.usgs.gov/sir/2004/5242/pdf/SIR2004-5242.pdf
Bureau of Reclamation, Record of Decision Operation of Flaming Gorge Dam Final Environmental Impact Statement, February 2006	https://www.usbr.gov/uc/envdocs/rod/fgFEIS/final-ROD-15feb06.pdf
US Fish & Wildlife Service, Operation of Flaming Gorge Dam Final Environmental Impact Statement, Final Biological Opinion, September 2005	http://www.riversimulator.org/Resources/USFWS/BOflamingGorge2005.pdf
US Fish & Wildlife Service, Final Programmatic Biological Opinion on the Management Plan for Endangered Fishes in the Yampa River Basin, January 2005	http://www.riversimulator.org/Resources/USFWS/BOyampa.pdf
US Fish & Wildlife Service, COLORADO RIVER RECOVERY PROGRAM Project #:168 FY 13-15 SCOPE OF WORK for White River Management Plan, August 2013	http://www.coloradoriverrecovery.org/documents-publications/work-plan-documents/sow/14-15/isf/168.pdf
Information on the forthcoming USFWS Programmatic Biological Opinion for the White River accessed July 9, 2014	http://www.onthecolorado.org/articles.cfm?mode=detail&id=1383319405772
USGS Colorado Water Science Center, Comparison of 2011-12 water years and historical water-quality data, Yampa River Basin, Colorado	http://co.water.usgs.gov/infodata/yampa_summaries/
USGS Colorado Water Science Center, Comparison of 2011-12 water years and historical water-quality data, White River Basin, Colorado	http://co.water.usgs.gov/infodata/white_summaries/index.html
USGS Grand Canyon Monitoring Research Center, Green River above Gates of Lodore, Colorado	http://co.water.usgs.gov/infodata/white_summaries/index.html
USGS Colorado Water Science Center, Comparison of 2011-12 water years and historical water-quality data, White River Basin, Colorado, Sampling locations by Station number and Station name in lower Yampa Basin	http://co.water.usgs.gov/infodata/yampa_summaries/html/Sites.html

4.3 FOREST HEALTH AND WILDFIRES

Forest health is integral to water quality, and many population centers in the YWG Basin are vulnerable to water quality issues caused by severe wildfires. High intensity wildfires increase the potential for soil erosion and sedimentation by removing vegetation that anchors the soil and slows runoff and rainwater, and by causing soil to become hydrophobic. The loss of vegetation and creation of hydrophobic soils creates prime conditions for erosion, landslides, and mudflows in post-wildfire areas. Sediment, soil, and mud infiltrate water supplies in post-burn areas, decreasing water quality and water storage.

Although Colorado's most severe wildfires have primarily occurred along the Front Range, the YWG Basin is susceptible to large wildfire incidents. In fact, Northwest Colorado, and Moffat County is particular, is the second most likely place in the nation for fires caused by lightning strikes (http://www.craigdailypress.com/news/2003/aug/18/moffat_county_continues/). BLM monitoring systems show that thousands of lightning strikes can happen during a single thunderstorm in the County. Most of these strikes do not evolve into wildland fire starts, but the potential for a large wildland fire to occur is still a major concern. The Moffat County Wildfire and Fuels Management Plan was developed between 2001 and 2003 to address this risk, identify wildfire suppression priority zones in the County, and recommend wildfire mitigation activities. The Routt County Community Wildfire Protection Plan identified three large wildfires including the Mt. Zirkel Complex in 2002 (approximately 30,000 acres burned), Green Creek Fire (4,400 acres), and the Lost Lakes Fire Use (5,536 acres).[3] Other major fires in the Basin include the Big Fish Fire of 2002, which burned 17,000 acres in the Flat Tops Wilderness Area roughly 34 miles southwest of Steamboat Springs. The 2012 Rio Blanco County Community Wildfire Protection Plan listed 17 fires over 1,000 acres in size between 1993 and 2011. The occurrence of another severe wildfire in the YWG Basin is generally considered to be a matter of "when," not "if."

Several communities in the YWG Basin are dependent on forest water supply, as noted in each county's Community Wildfire Protection Plan. Landowners in the YWG Basin have noted that major wildfires in the area have caused erosion issues, sedimentation, landslides, and water quality chemistry issues during spring runoff and following rainstorms. The City of Steamboat Springs is particularly at risk for wildfire impacts to drinking water. The Steamboat Springs surface water supply comes from Fish Creek and Fish Creek Reservoir, both of which are supplied by runoff from forested lands. Fish Creek is one of the higher risk areas for wildfire-water quality issues, as illustrated in Figure 4-1 and Figure 4-2 from the Colorado Wildfire Risk Assessment Portal. These figures show that the Fish Creek watershed is ranked highest in the Yampa Basin for both drinking water importance areas and drinking water risk. To mitigate this risk, Steamboat Springs is trying to secure additional water sources, such as alluvial wells on the Yampa River. The Town of Yampa has an underground infiltration gallery, and thus wouldn't be as affected by erosion and sedimentation issues caused by wildfires. The Town also has the option to pump out of the Yampa River if needed. The City of Craig also has less wildfire-water quality risk compared to Steamboat Springs given that there is less wildfire fuel in the vicinity. However, because of the sedimentary soils in the area, Craig could still potentially experience wildfires that decrease water quality.

[3] Routt County CWPP, 2010, pg. 16

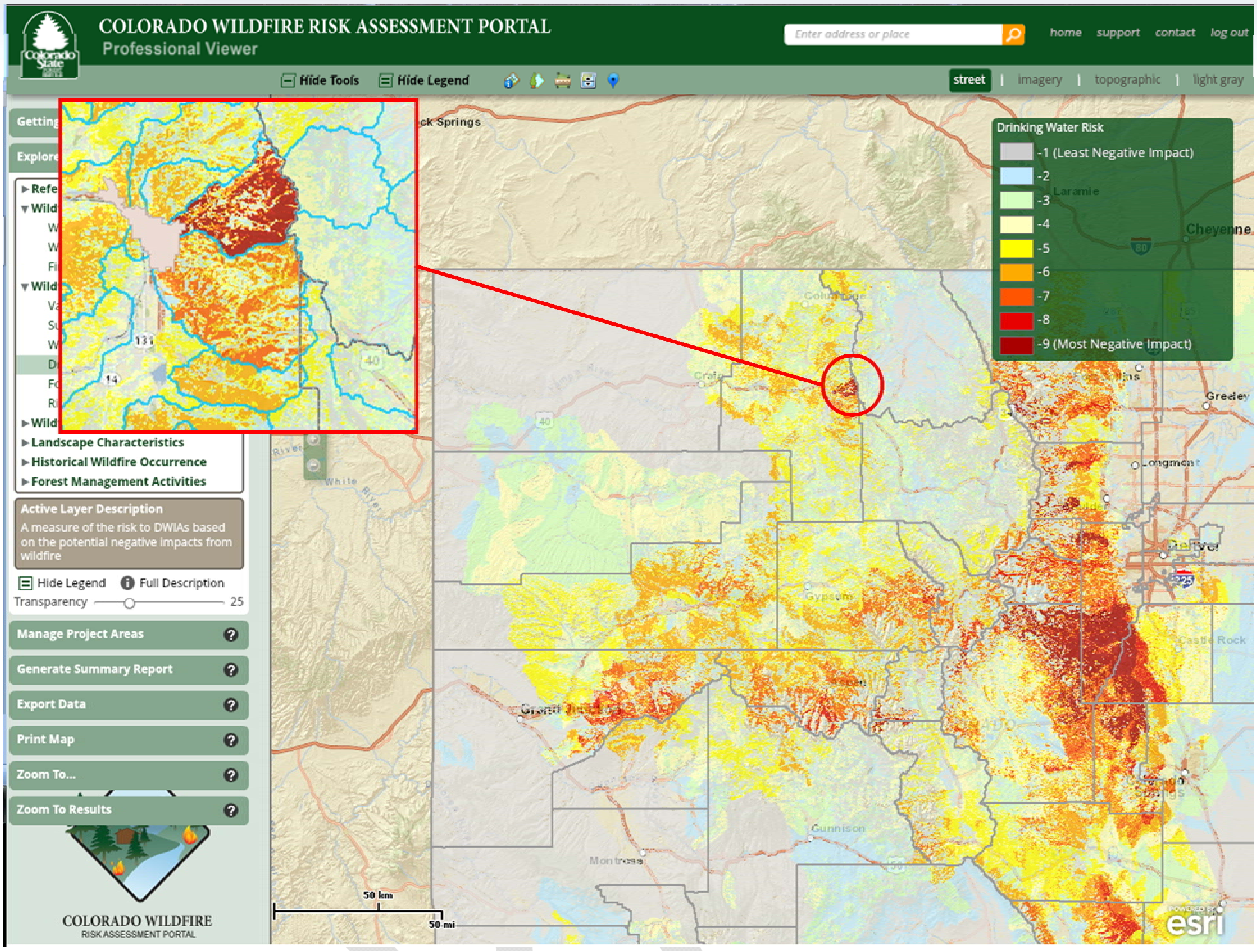

Figure 4-1 Drinking Water Risk

Source: Colorado Wildfire Risk Assessment Portal

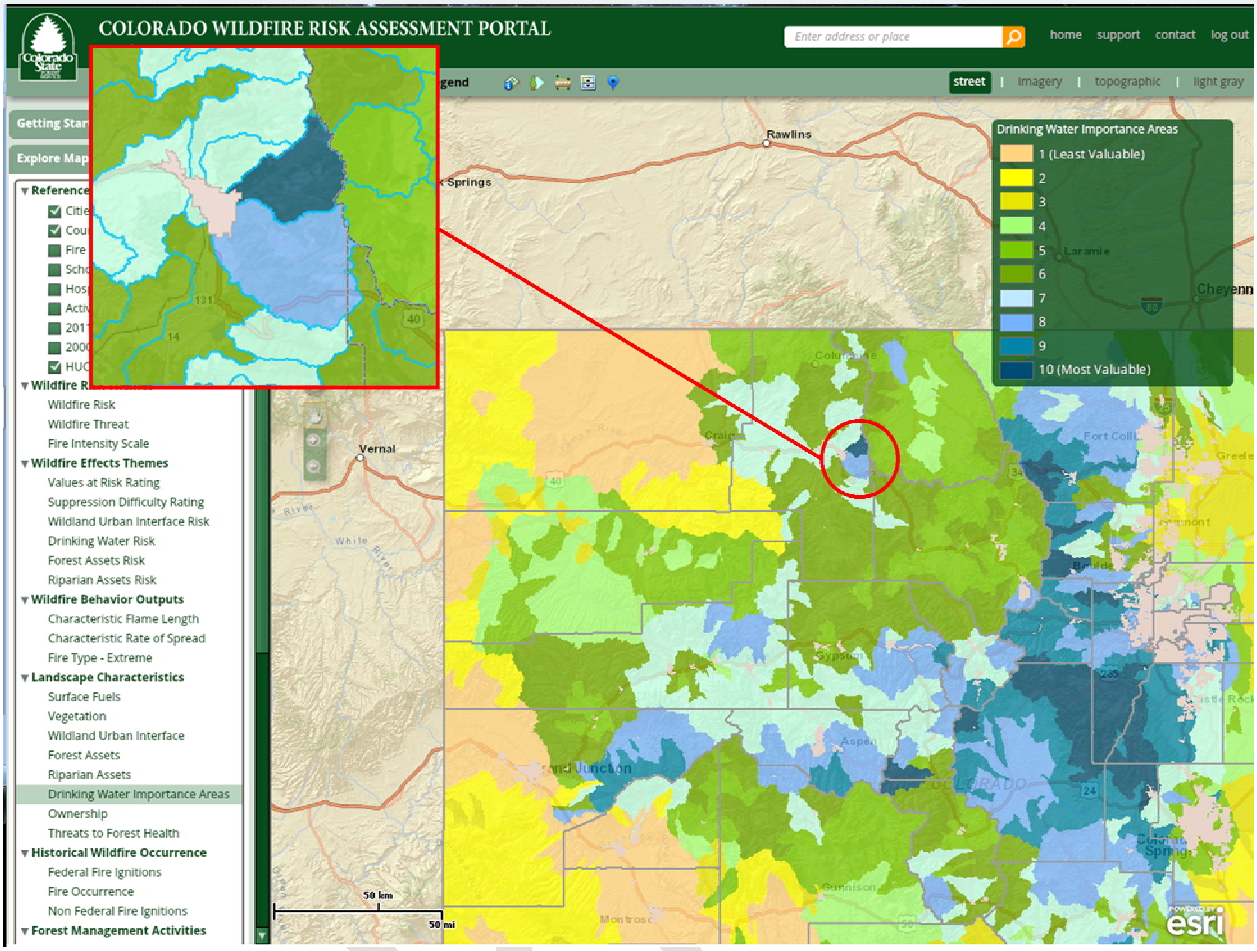

Figure 4-2 Drinking Water Importance Areas

Source: Colorado Wildfire Risk Assessment Portal

Source Water Protection Plans

Since roughly 2009, Colorado communities have been encouraged to develop Critical Community Watershed Wildfire Protection Plans as part of Source Water Protection Plans. The Critical Community Watershed Wildfire Protection Plans resemble Community Wildfire Protection Plans but focus on watershed protection rather than on the wildland urban interface. Projects from Community Wildfire Protection Plans may be located in watersheds though, and those projects should be incorporated into the Critical Community Watershed Wildfire Protection Plans. Representatives from local fire protection districts, US Forest Service, Colorado State Forest Service, Bureau of Land Management, and other wildfire mitigation stakeholders should be included in source water and watershed protection planning efforts. More information on the Critical Community Watershed Wildfire Protection Plan initiative can be found on www.colorado.gov by searching for "Critical Community Watershed Wildfire Protection Plans."

JW Associates, Inc. completed a report in 2010 titled "Upper Yampa Phase 1 Watershed Assessment: Prioritization of watershed-based hazards to water supplies." This report follows the Critical Community Watershed Wildfire Protection Plan model, examining post-wildfire hazards in watersheds including flooding, debris flow, and increased sediment yields. The report generated a composite hazard ranking of the Upper Yampa watersheds based on three components: wildfire hazard, flooding/debris flow hazard, and soil erodability. The results of the composite hazard ranking indicated that the highest ranked sixth-level watersheds include outlet of Mad Creek, Middle Fork Elk River,

Upper Trout Creek, Bunker Creek, headwaters of Oak Creek, and Harrison Creek. The Phase 1 report does not make specific recommendations for protecting watershed health in relation to the impacts from wildfires.

Moffat, Rio Blanco, and Routt counties all have county-level Community Wildfire Protection Plans. All three plans identify watersheds as critical assets in their planning areas and note the importance of protecting watershed quality as part of wildfire mitigation. Watershed protection is taken into account for each Community Wildfire Protection Plan's mitigation projects.

The Routt County Community Wildfire Protection Plan (2010) identifies "maintaining healthy watersheds" as one of its primary goals. The Routt County Community Wildfire Protection Plan specifically identifies several municipal watersheds within the Community Wildfire Protection Plan planning area. Surface water and wells provide the water supply for the majority of these communities. The need to protect watersheds is stated several times throughout this Community Wildfire Protection Plan. The Moffat County Community Wildfire Protection Plan evaluates potential watershed issues in Appendix F Fuel Reduction Project Plans. None of the proposed wildfire mitigation projects in the plan were found to threaten a water source.

Although wildfire mitigation is necessary to help reduce the likelihood of a severe wildfire occurring, the mitigation activities themselves can be a source of water contamination. Mechanical treatments that involve disturbing the soil can increase sediment loads in surface waters. Herbicide treatments can cause water contamination.[4] Methods for mitigating water contamination from wildfire mitigation activities include installing erosion control devices around source water intakes during wildfire mitigation projects. Communities should work with the Bureau of Land Management, US Forest Service, Colorado State Forest Service, Natural Resources Conservation Service, and conservation districts to protect water sources while undertaking wildfire mitigation projects.

4.4 M&I, SSI, AGRICULTURE AND MULTI-PURPOSE IPPS

The Basin Roundtable is developing a collection of IPPs through the YWG BIP planning effort. These IPPs consist of projects previously identified through SWSI and the P&M Study in addition to new projects identified through the surveys distributed to the Basin Roundtable in April of 2014. These surveys were distributed as a component of the BIP planning effort, asking the Basin Roundtable members and other stakeholders within the Basin to provide information on M&I, SSI, and/or agricultural projects that have previously not been identified as IPPs.

Table 4-4 provides a summary of these IPPs while Figure 4-3 shows the locations. The IPPs are categorized by whether or not they were modeled in the P&M Study. The ten IPPs that were modeled in the P&M Study are denoted with black crosses and contained the following elements:

- Project Proponent
- Location
- Physical Characteristics
- Operations
- Water Rights – Either conditional water rights, or an undecreed water right, is assumed as a proxy

IPPs that did not contain these elements were not modeled in the P&M Study and are identified in Figure 4-3 with red crosses. It is important to note that while these projects are the currently foreseeable IPPs, Table 4-4 is not an inclusive list. The table may be modified to include additional new IPPs as regional and local planning efforts continue throughout the Basin. To accommodate this potential change, placeholders have been added at the end of the list, e.g., water conservation efforts by additional municipal water providers and other generic IPPs to meet future needs. Current planning processes also have not identified all of the IPPs necessary to address all of the consumptive

[4] Garfield County CWPP, 2012, pg. 63

shortages presented in Chapters 2 and 3. As recommended in Chapter 5, additional analysis and follow-up studies will provide the Basin a better picture of how various IPPs can be used to meet shortages to both consumptive and environmental/recreational needs. As planning efforts continue, the Basin Roundtable will explore how projects and processes can provide multi-purpose benefits, an approach that is advantageous for all interests and is a goal of SWSI and the IBCC. These opportunities will be further refined as projects are carried through the permitting phase. To highlight this approach, Table 4-4 denotes IPPs that may include benefits to other sectors that are not currently identified.

Table 4-4 Summary of Current M&I, SSI, Agriculture and Multi-Purpose IPPs

Map ID	Name of Project	Project Location	M&I	SSI	Ag	Enval/ Rec	Modeled/ Not Modeled	Primary Purpose of Project	Project Status	Projected Completion	Proponents	Storage Right	Project Yield	Project Capacity	Project Cost	Funding Sources	Challenges
1	Elkhead Reservoir Enlargement Project						Not Modeled				Colorado River Water Conservation District		4,300 AF				
2	Fish Creek direct flow and storage	Fish Creek Drainage in Buffalo Pass area	X				Not Modeled	Releases from Long Lake (396 AF) and Fish Creek Reservoirs (4167 AF) are used to augment native flows when they fall below 7 cfs; MWW & City hold the most senior pre-compact rights 8.3 cfs. Future M&I needs	Existing infrastructure	DNA	Mt. Werner Water / City of Steamboat Springs						
3	Lake Avery Enlargement[6]	Expansion to Big Beaver Reservoir (Avery Lake)		X			Modeled	The only operation for the Lake Avery Enlargement is making direct releases to meet oil shale production demands.				The purpose of the Scenario 2 and 3 models of the Energy Development Water Needs Assessment were to reliably meet oil shale production demands with rights junior to all other diversions in the basin. That methodology was also used in the Projects and Methods Study. Therefore it is modeled with an undecreed water right. --The Lake Avery Enlargement is filled both by a pipeline diverting water from the White River upstream of Big Beaver Creek and a direct storage right on Big Beaver Creek.		48,274 AF + 7,658 AF (original capacity of Big Beaver Res)			
4	Little Bear 1 Reservoir[1]	Fortification Creek Basin			X	Possible secondary benefit	Modeled	Releases are made to three aggregate diversions (WDID 440511, 440612, and 440688), which were identified as the three diversions to which Little Bear I				No conditional storage rights, junior right assumed		800 AF			

Map ID	Name of Project	Project Location	M&I	SSI	Ag	Enval/ Rec	Modeled/ Not Modeled	Primary Purpose of Project	Project Status	Projected Completion	Proponents	Storage Right	Project Yield	Project Capacity	Project Cost	Funding Sources	Challenges
								Reservoir could release water as described in the Agricultural Water Needs Study.									
5	Milk Creek Reservoir[3]	Milk Creek Reservoir upstream of the confluence with the Yampa River		X	X	Possible secondary benefit	Modeled	Similar to Rampart Reservoir, Milk Creek Reservoir cannot release to any water short diversions on upper Milk Creek; however, releases are made to the Yampa River oxbows diversion. Milk Creek Reservoir also exchanges to all diversions upstream on Milk Creek if exchange capacity exists on the creek. No operations were defined for the industrial storage account				An existing conditional water right with a 1976 date of decree of 70,000 AF; however, this is only for industrial beneficial uses. At the request of the BRT subcommittee, Milk Creek Reservoir was modeled for agricultural and industrial uses. For the Projects and Methods Study, this conditional right maintained its 1976 water right date, but the industrial storage was reduced to 35,000 AF. --The remaining 35,000 AF of storage is filled using an undecreed water right for agricultural uses.		70,000 AF			
6a 6b 6c	Lower White River Storage Project	Possible off-channel storage sites near the White River: -Wolf Creek -Spring Creek -Gilliam	X	X	X	X	Modeled with junior water rights	Water Storage, M&I, Recreation, Supplemental Flows, Energy, Augmentation	Ongoing Feasibility Study	To be defined in Feasibility Study	Town of Rangely, Rio Blanco County, Colorado River Water Conservation District (potentially), CWCB (potentially), U.S. Fish and Wildlife Service (potentially), Energy Companies (potentially)		To be defined in the Feasibility Report		To be defined in the Feasibility Report	Rio Blanco Water Conservancy District revenues and mill levy, Colorado Water Conservation Board, Town of Rangely, Rio Blanco County, U.S. Fish and Wildlife Service, Colorado Parks and Wildlife, Colorado Water Resources and Power Development Authority, Various Energy Companies (Sources to be determined in Phase II of the	Developing a viable financing plan and completing Federal NEPA documentation will be challenging, but are not considered to be insurmountable

Map ID	Name of Project	Project Location	M&I	SSI	Ag	Enval/ Rec	Modeled/ Not Modeled	Primary Purpose of Project	Project Status	Projected Completion	Proponents	Storage Right	Project Yield	Project Capacity	Project Cost	Funding Sources	Challenges
																Feasibility Study)	
7	Monument Butte Reservoir[1]	Morapos Creek Basin			X	Possible secondary benefit	Modeled	Releases are made to four aggregate diversions (WDID 440590, 440651, 440814, and aggregate diversion 44_ADY016A), which were identified as the diversions to which Monument Butte Reservoir could release water to as described in the Agricultural Water Needs Study.				No conditional storage rights, junior right assumed		4,390 AF			
8	Morrison Creek Reservoir Project[4]	Morrison Creek	X	X	X	X	Modeled	Firming Stagecoach Reservoir			Upper Yampa Water Conservancy District	There are two storage rights for Morrison Creek Reservoir, a first fill and a second fill. The first fill right has a 4,965 AF conditional water right (administration number = 41272.39991) and the second fill has a 5,655 AF conditional water right (administration number = 57676.00000).	5,000 AF				
9	Oil Shale Production Pipelines/Diversions (new diversions)[6]	White		X			Modeled										
10	Peabody-Trout Creek Reservoir[2]	Trout Creek upstream of the confluence with the Yampa River		X	Possible secondary benefit	Possible secondary benefit	Modeled	The sole purpose of the Peabody-Trout Creek Reservoir is to meet the 6,000 AFY energy development demands (which do not have a direct diversion water right) that are also part of the Peabody-Trout Creek Project				A first fill water right with administration number 43575.00000 and conditional storage of 15,000 AF		11,720 AF			
11	Rampart Reservoir[1]	Lower Fortification Creek upstream of Wisconsin Ditch			X	Possible secondary benefit	Modeled	Since Rampart Reservoir is only located upstream of two potentially short water diversions (the oxbows aggregate diversion and WDID 440511), releases				- A first fill water right with administration number 41126.00000 and conditional storage of 12,133 AF -A second fill water right with		12,133 AF			

Map ID	Name of Project	Project Location	M&I	SSI	Ag	Enval/ Rec	Modeled/ Not Modeled	Primary Purpose of Project	Project Status	Projected Completion	Proponents	Storage Right	Project Yield	Project Capacity	Project Cost	Funding Sources	Challenges
								are made to the oxbows aggregate diversion and WDID 440511. The second set of operations for Rampart Reservoir is to exchange water upstream to South Fork II and Little Bear I. The last set of operations for Rampart Reservoir is to exchange water upstream to each individual diversion on Fortification Creek				administration number 47905.00000 and conditional storage of 11,692 AF					
12	South Fork II Reservoir[1]	Fortification Creek Basin			X	Possible secondary benefit	Modeled	Releases are made to seven aggregate diversions (WDID 440511, 440612, 440647, 440650, 440681, 440688 and 440998), which were identified as the seven diversions to which South Fork II Reservoir could release water as described in the Agricultural Water Needs Study.				No conditional storage rights, junior right assumed		1,700 AF			
13	Upper Morrison Diversion	Section 14, Township 3N, Range 84W	X	X	Possible secondary benefit	Possible secondary benefit	Modeled (turned off)	Firming of Stagecoach Reservoir (part of Morrison Creek Reservoir (IPP #8) as an alternate point of diversion)			Upper Yampa Water Conservancy District			50 cfs (Case 01CW0041 App. Date 12-30-1994)			
14	Steamboat Springs Conservation	Steamboat area water provider districts	X				Not Modeled	Program to realize a 15% passive conservation savings over time equal to 800 AF by 2035 by implementing measures such as leak detection programs, fixture rebate programs, and reducing landscape irrigation needs.	On-going		Steamboat Springs		720 AF			CWCB, Area Water Providers	
15	Wolf Creek Reservoir[6]	White River downstream of the confluence with Piceance Creek		X			Modeled	Water from Wolf Creek Reservoir is transported upstream via carrier to directly meet oil shale production				The purpose of the Scenario 2 and 3 models of the Energy Development Water Needs		162,400 AF			

Map ID	Name of Project	Project Location	M&I	SSI	Ag	Enval/ Rec	Modeled/ Not Modeled	Primary Purpose of Project	Project Status	Projected Completion	Proponents	Storage Right	Project Yield	Project Capacity	Project Cost	Funding Sources	Challenges
								demands.				Assessment were to reliably meet oil shale production demands with rights junior to all other diversions in the basin. That methodology was also used in the Projects and Methods Study; therefore, it is modeled with a 2013 water right. --The only water right Wolf Creek Reservoir uses to store water is an undecreed water right on the White River					
16	Rangely Raw/Irrigation	White River			X	X	Not Modeled	Agriculture and Recreation	Planning/feasibility	Study to begin May 2014	Colorado Northwest Community College, Rio Blanco Water Conservancy District, Town of Rangely, Western Rio Blanco Metropolitan Recreation District.		250 AF				
17	Morrison Creek District Yampa River Water Treatment Plant	Yampa River just upstream of Stagecoach Reservoir	X				Not Modeled	Municipal water supply for Stagecoach development	Planned	Unknown			9 cfs		unknown		Need for project dependent on growth in Stagecoach which is a designated growth area in Routt County
18	Elk River Project	On the east bank of the Elk River on the SE1/4 of the SW1/4 of Section 22, Township 7North, Range 85 West of the 6th P.M., Routt County, Colorado.	X				Not Modeled	Future M&I needs and redundant supply in the event of supply interruption or wildfire.	Conceptual		Steamboat Springs		3,000 AF	Reservoir capacity TBD		TBD	
19	Expansion of Yampa River Wells	On both sides of Yampa River south of Steamboat Springs in vicinity of Dougherty Rd and US 40	X				Not Modeled	Expand Yampa River Wells from 1.8 MGD to 3.5 MGD to: -provide for future M&I needs -provide redundancy in case of wildfire above WTP on Fish Creek, i.e., production can be moved to Fish	Developing hydrologic model		City of Steamboat Springs Mt. Werner Water and Sanitation District		Current operating yield = 500 AF during 90-day seasonal operation	Year round operation at current sustainable 1.8 MGD capacity = up to 2016 AFY Year round operation at expanded 3.5 MGD capacity = up to 3930 AFY all depending on fall and winter yields		City of Steamboat Springs Mt. Werner Water and Sanitation District	

Map ID	Name of Project	Project Location	M&I	SSI	Ag	Enval/ Rec	Modeled/ Not Modeled	Primary Purpose of Project	Project Status	Projected Completion	Proponents	Storage Right	Project Yield	Project Capacity	Project Cost	Funding Sources	Challenges
								Creek wells									
20a 20b 20c 20d 20e 20f 20g 20h	Yellow Jacket Water Conservancy District Reservoir Feasibility Study	White River and drainages; possible sites include: -Lost Park -Mahogany -Ripple Creek -Sawmill Mountain -Strawberry Creek -Thornburgh -Tom Little Gulch -Wray Gulch	X	X	X	X	Modeled with junior water rights	M&I, agriculture, recreation, environmental, other beneficial uses	Study completed								
	Colorado River Compact Water Bank	Colorado River Basin				X	Not Modeled	1. Prevent curtailment 2. Protect certain critical post-compact (i.e. junior) uses in the event of curtailment.	Feasibility study in progress	2007	Southwestern Water Conservation District, The Nature Conservancy, Front Range Water Council, State of Colorado		N/A			Proponent funding and CWCB ATM grant funding	A large number of technical, legal, economic, and administrative challenges will need to be addressed ultimately
	Other Municipal Water Conservation																
	Other IPPs to Meet Future Needs																

[1]Originally identified in the Yampa River Basin Small Reservoir Study - Phase 2 (Montgomery Watson, 2000)
[2]Described in Modeling for the Peabody-Trout Creek Reservoir Supply Project (ERC, year unknown)
[3]Identified by Tri-State Generation & Transmission Association (Chartrand, 2013)
[4]Evaluated in Upper Yampa WCD (UYWCD) Supply Plan Model
[5]Originally identified in the Steamboat Supply Master Plan (Stantec, 2008); re-evaluated in UYWCD Supply Plan Model
[6]Identified in the Energy Development Water Needs Assessment Phase II report (AMEC, 2011)
-Note that Oil Shale Production Pipelines/Diversions is a conceptual supply system rather than an actual system with physical components. The three elements include:
-White River direct diversion to meet oil shale production demands on Piceance Creek
-White River pipeline used to fill the Lake Avery enlargement
-As part of Wolf Creek Reservoir operations, oil shale production demands are augmented by water delivered via a carrier from Wolf Creek Reservoir

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Id	Project Name
1	Elkhead Reservoir Enlargement
2	Fish Creek direct flow and storage
3	Lake Avery Enlargement
4	Little Bear 1 Reservoir
5	Milk Creek Reservoir
6a	Wolf Creek Reservoir (Lwr White R.Stg.)
6b	Spring Creek Reservoir (Lwr White R.Stg.)
6c	Gillam Draw Reservoir (Lwr White R.Stg.)
7	Monument Butte Reservoir
8	Morrison Creek Reservoir Project
9	Oil Shale Production Pipelines/Diversions
10	Peabody-Trout Creek Reservoir
11	Rampart Reservoir
12	South Fork II Reservoir
13	Upper Morrison Diversion
14	Steamboat Springs Conservation
15	Wolf Creek Reservoir
16	Rangely Raw/Irrigation
17	Morrison Creek Dist. Yampa River WTP
18	Elk River Project
19	Yampa River Wells
20a	Lost Park Reservoir (Yellow Jkt WCD)
20b	Mahogany Reservoir (Yellow Jkt WCD)
20c	Ripple Creek Reservoir (Yellow Jkt WCD)
20d	Sawmill Mountain Reservoir (Yellow Jkt WCD)
20e	Strawberry Creek Reservoir (Yellow Jkt WCD)
20f	Thornburgh Reservoir (Yellow Jkt WCD)
20g	Tom Little Gulch Reservoir (Yellow Jkt WCD)
20h	Wray Gulch Dam & Reservoir (Yellow Jkt WCD)

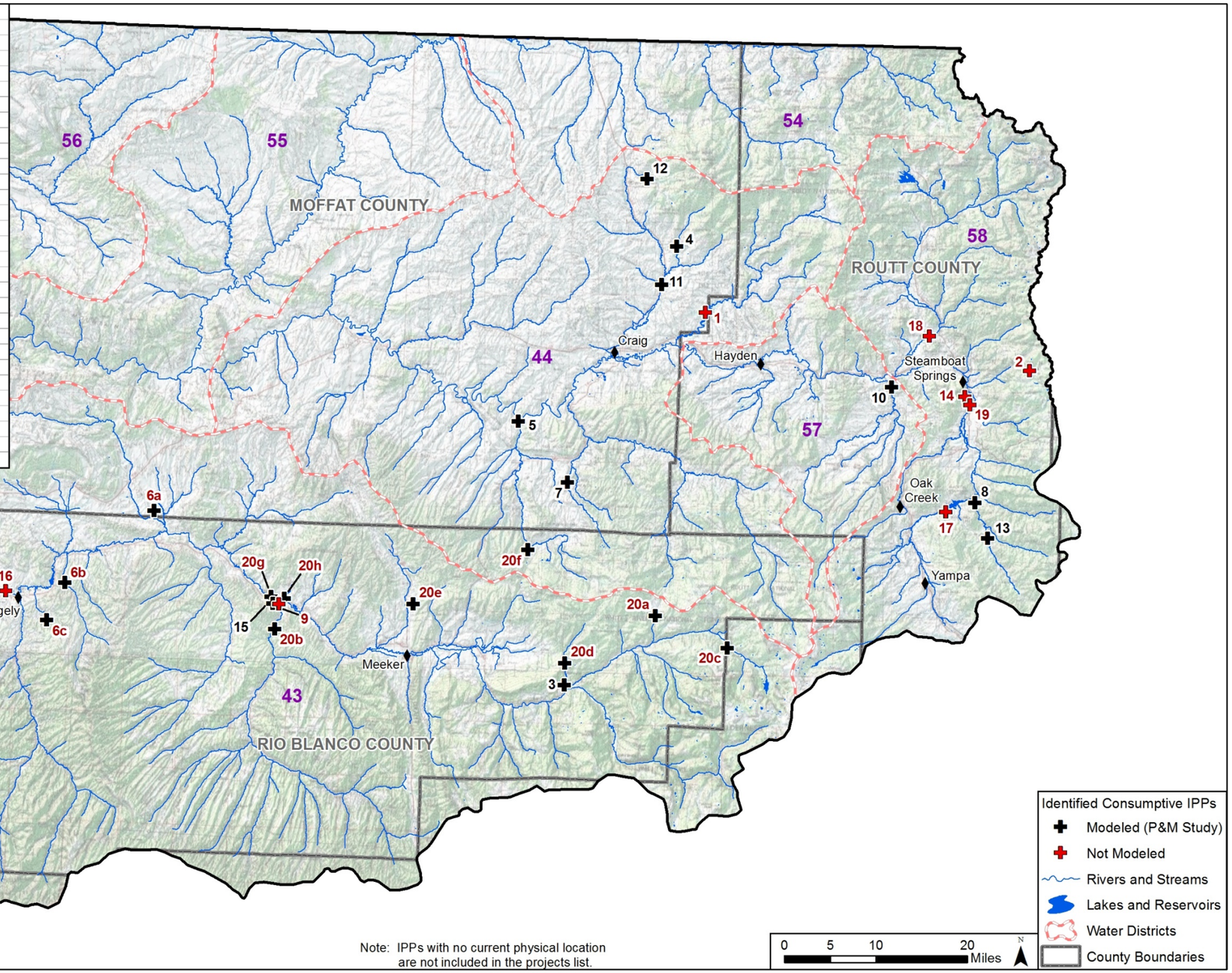

Figure 4-3 Location of M&I, SSI, Agriculture and Multi-Purpose IPPs

4.5 ENVIRONMENTAL AND RECREATIONAL IPPS

The Basin Roundtable identified a collection of IPPs that exclusively focus on environmental and recreational water needs and benefits. This collection of environmental and recreational IPPs was developed through a survey distributed to the Basin Roundtable and other stakeholders in the Basin in April and May of 2014.[5] The IPPs are highlighted in Table 4-5 while the locations of the IPPs are shown in Figure 4-4.

The majority of these IPPs are located in the environmental and recreational focus areas discussed in Chapter 2. It is important to note that while these projects are the currently foreseeable IPPs, Table 4-5 is not an inclusive list and does not address all of the environmental and recreational needs and shortages discussed in Chapters 2 and 3. The table will be modified to include additional IPPs as regional and local planning efforts continue throughout the Basin. Future projects will be developed for the existing focus areas, shown in Figure 4-4, as well as in other tributaries who demonstrate a need for environmental and recreational improvements.

[5] The environmental and recreational IPP list previously developed through SWSI and the Nonconsumptive Needs Assessments was not reviewed and approved by the BRT prior to publishing. During the BIP planning process, the BRT decided to develop a new updated IPP list based on input from Basin stakeholders.

Table 4-5 Environmental and Recreational IPPs

ID	Name of Project	Project Location	Study	Monitoring	Instream flow appropriation	Restoration	Species reintroduction	Structure improvement	Habitat restoration	Water quality	Stewardship	Water lease acquisition	Voluntary flow agreements	Management plan	Conservation easement	Non-native species management	Reservoir operations	Biological opinion	RICD	Other	Additional Details	Project Status	Projected Completion	Proponents	Partners	Project Cost	Funding Sources	Challenges
1	Upper Yampa backwater modifications	Initial projects located within Chuck Lewis SWA and within Steamboat Springs on the south end of city limits. However, multiple sites throughout the Upper Yampa River corridor could benefit from alterations of backwater habitats. Benefits to the Upper Colorado Endangered Fish Recovery Program by implementing one element of the program's non-native fish control strategy. Also benefits other environmental attributes of the riverine ecosystem. All other elements of the non-native fish control strategy are part of keeping the Yampa River Basin PBO in place below.	x	x		x		x	x	x	x					x					Stakeholders would develop multi-faceted projects implementing habitat modifications/restoration activities to alleviate unnatural backwater habitats to minimize non-native species recruitment and improve ecological functions of the riverine system. Multiple recreational benefits would be realized as well.	Ongoing	By 2020	CPW and USFWS per table 3a of the non-native fish control strategy.	Potential partners include: City of Steamboat Springs and Ski Corps	$150,000 - $750,000 depending on project	Potentially Colorado Parks and Wildlife, City of Steamboat Springs, Endangered Fish Recovery Program, Ski Corps, GOCO	Unknown
2	Loudy Simpson access and recreational river enhancements	Yampa River at Loudy Simpson Park in Craig, Colorado.																		x	Provide improved access to river and restoration/rebuild of riffle for non-consumptive needs specific to increasing recreational opportunities and float boating in the Yampa River at the park.	Ongoing (There is a project being worked on at a preliminary planning stage at the moment).	By 2018	Possible project proponent is Moffat County Tourism Association. Melody Villard, Tourism Director is a good contact: mvillard@moffatcounty.net	Possible partners are the Board of Moffat County Commissioners and the Craig City Council, Friends of the Yampa, American Whitewater	Unknown	Yampa-White-Green Basin Roundtable	Permitting
3	Upper Elkhead Creek Stream Restoration	Stream restoration will occur on approximately 16 miles of Elkhead Creek and its tributaries from the southern end of California Park upstream to the headwaters.		x		x			x	x											Indirect benefits to consumptive uses include a reduction in sediment entering Elkhead Reservoir.	Ongoing (The project began on Armstrong Creek, a tributary of Elkhead Creek, in 2012).	Beyond 2020 (The project is expected to take 15 years).	Forest Service	Trout Unlimited, Routt County Conservation District, and Colorado Parks and Wildlife	4 million dollars	Current funding has been provided by the partners, Yampa-White-Green Basin Roundtable, CWCB, and several other donors.	Unknown

ID	Name of Project	Project Location	Study	Monitoring	Instream flow appropriation	Restoration	Species reintroduction	Structure improvement	Habitat restoration	Water quality	Stewardship	Water lease acquisition	Voluntary flow agreements	Management plan	Conservation easement	Non-native species management	Reservoir operations	Biological opinion	RICD	Other	Additional Details	Project Status	Projected Completion	Proponents	Partners	Project Cost	Funding Sources	Challenges
4	Implementation of projects that improve instream and riparian habitat, irrigation infrastructure, and/or flows	Upper East Fork Williams Fork sub-basin, from the headwaters to the confluence with Poose Creek (and including Poose Creek)						x	x	x		x										Planned	By 2020	Trout Unlimited	Trout Unlimited, Forest Service	Up to $500k	Unknown	Unknown
5	Yampa River Structures Project	Downtown Steamboat Springs, Colorado from 9th Street at the foot bridge over the river then downstream to approximately above where Soda Creek enters the Yampa. This reach of river is approximately ¼ of a mile in river length.						x													Objectives: • To enhance/preserve the natural character of the Yampa River in downtown Steamboat Springs through river rehabilitation improvements • Improve upon and create additional recreational boating and fishing opportunities in the Yampa River in downtown Steamboat Springs. • To enhance the value of the River as a community amenity through access points and recreational use opportunities. • Improve public safety by rebuilding the D-Hole which was built with outdated methodology and isn't functioning properly.	Ongoing (Currently finalizing our plans that will be submitted to the Army Corps of Engineers).	By 2015	Friends of the Yampa	City of Steamboat Springs Yampa-White-Green BRT	$100,000	Friends of the Yampa, City of Steamboat Springs, Yampa-White-Green BRT	Potential for permit denial
6	Planning/restoration on the Yampa River through Morgan Bottom Creek	Yampa River from the Marshall-Roberts headgate to the Town of Hayden. (Morgan Bottom)				x		x													Watershed planning and implementation of riparian restoration, bank and channel restoration and irrigation infrastructure improvement projects through the Morgan Bottom reach. Stakeholders are developing multi- purpose projects that will restore riparian habitat, upgrade irrigation infrastructure and control erosion along this reach of the Yampa River.	Ongoing	Through 2020	The Nature Conservancy	Potential partners include 5 major ditch diverters, Colorado Parks and Wildlife, NRCS, Upper Yampa Watershed Group, The Nature Conservancy	Partially Funded	Shell, CPW, Packard, UYWCD and other funding pending	

ID	Name of Project	Project Location	Study	Monitoring	Instream flow appropriation	Restoration	Species reintroduction	Structure improvement	Habitat restoration	Water quality	Stewardship	Water lease acquisition	Voluntary flow agreements	Management plan	Conservation easement	Non-native species management	Reservoir operations	Biological opinion	RICD	Other	Additional Details	Project Status	Projected Completion	Proponents	Partners	Project Cost	Funding Sources	Challenges
7	Optimize flow protection and augmentation	Yampa and Little Snake rivers endangered fish flow reaches for the Yampa from Craig to its mouth and for the lower Little Snake to the confluence with the Yampa. Some non-native fish control occurs above these reaches and is not shown in Figure 4-2.	x		x							x				x	x	x			Optimize flow protection and augmentation for endangered fish recovery and other non-consumptive attributes for the same reaches in conjunction with new, in-basin consumptive IPPs and keep the Yampa PBO in place. The depletions and storage assumptions for the Yampa River PBO are out of date and the flow impacts of new, in-basin consumptive IPPs need to be re- assessed. The non-native fish control for this PBO also needs to be updated.	Ongoing	By 2020	The Nature Conservancy, Fish & Wildlife Service	USFWS, CPW, and other Endangered Fish Recovery Program partners. See table 3a of the non-native fish control strategy.	Partially funded	Partners in endangered fish recovery program (partially funded).	Unknown
8	Assess the flow regime for endangered fish recovery	White River from Rio Blanco Lake to the state line	x		x							x				x	x	x			Assess the flow regime for endangered fish recovery in conjunction with new, in-basin consumptive IPPs, protect or augment flows, and control non-native fish, all as needed for a PBO. A PBO is needed to provide certainty for new, in-basin consumptive IPPs and to assist with endangered fish recovery	Ongoing	By 2015	The Nature Conservancy, Fish & Wildlife Service	USFWS, CPW, and other Endangered Fish Recovery Program partners. See table 5a of the non-native fish control strategy.	Funded	Partners in endangered fish recovery program	Unknown
9	Flow protection & augmentation for warm-water fish & cottonwood	These reaches are the same as the endangered fish reaches above for IPP 7 and 8	x		x							x					x				Optimize flow protection augmentation in conjunction with new in-basin consumptive IPPs to reduce flow alteration risks to warm-water fish survival and cottonwood abundance	Proposed	By 2020	The Nature Conservancy	USFWS, CPW, TNC	Not funded	Not funded	Unknown
10	Augment instream flow shortages (Yampa)	ISF 582164, Yampa River within Steamboat Springs to RICD	x									x					x				Augment flows to reduce shortages to an ISF below Stagecoach and to a RICD in Steamboat Springs. Enhance flows during low flow periods to reduce temperature and increase D.O. for other non-consumptive attributes in the same reach. These water rights face shortages and could be augmented with the same upstream supply. This reach of the Yampa is on the 303D Monitoring & Evaluation List for temperature	Proposed	Unknown	City of Steamboat Springs		Not funded	Currently not funded. Potentially City of Steamboat Springs, Colorado Water Trust.	Unknown

ID	Name of Project	Project Location	Study	Monitoring	Instream flow appropriation	Restoration	Species reintroduction	Structure improvement	Habitat restoration	Water quality	Stewardship	Water lease acquisition	Voluntary flow agreements	Management plan	Conservation easement	Non-native species management	Reservoir operations	Biological opinion	RICD	Other	Additional Details	Project Status	Projected Completion	Proponents	Partners	Project Cost	Funding Sources	Challenges
11	Recreational, habitat & management strategy improvements	Yampa River within Steamboat Springs	x			x		x												x	Implement recreational and habitat improvements and management strategies to support ecosystem function as well as recreational needs within the Yampa River stream corridor through Steamboat Springs. Update the Steamboat Springs Yampa River Management Plan and Structures Master Plan as needed. Implementation of the Yampa River Management Plan and Structures Master Plan has been on-going since 2003. Implementation of remaining projects and/or re-evaluation of plans are warranted. Other uses: support recreational access.	On-going	Potentially City of Steamboat Springs, Friends of the Yampa, CPW	Potentially City of Steamboat Springs, Friends of the Yampa, CPW	Potentially City of Steamboat Springs, Friends of the Yampa, CPW	Partially funded	Potentially City of Steamboat Springs, Friends of the Yampa, CPW, GoCo, American Rivers, American Whitewater (partially funded)	Unknown
12	Augment instream flow shortages (Elk). Other instream flow water rights could be augmented wherever they are not fully supplied.	ISF 581355 & 582219	x									x					x				Both of these water rights face shortages and could be augmented by the same upstream supply	Proposed	Potentially CPW and CWT or TU	Potentially CPW and CWT or TU	Potentially CPW and CWT or TU	Not funded	Not currently funded. Potentially CPW and CWT or TU	Unknown
13	Cross Mountain Canyon Ranch - habitat and recreational improvements	Yampa River at Cross Mountain Canyon Ranch				x			x		x									x	BLM's 2013 acquisition of the Cross Mountain Canyon Ranch includes 2.5 miles of riverside property where river access is proposed. The BLM is now the property's long-term conservation steward and will look to install visitor facilities on the property among other maintenance and improvement work for recreational and habitat needs.	On-going	Unknown	BLM	Possibly Colorado Parks and Wildlife, Friends of the Yampa			
14	Sarvis Creek habitat and recreational access improvements	Yampa River below Sarvis Creek confluence						x	x		x									x	Establish new public fishing access and habitat improvements within and along a prime 1/8th of a mile stretch of the Yampa River.	On-going		Western Rivers Conservancy	BLM, Forest Service, Colorado Parks and Wildlife, Yampa River Stream Improvement Charitable Trust, Friends			

ID	Name of Project	Project Location	Study	Monitoring	Instream flow appropriation	Restoration	Species reintroduction	Structure improvement	Habitat restoration	Water quality	Stewardship	Water lease acquisition	Voluntary flow agreements	Management plan	Conservation easement	Non-native species management	Reservoir operations	Biological opinion	RICD	Other	Additional Details	Project Status	Projected Completion	Proponents	Partners	Project Cost	Funding Sources	Challenges
																									of the Yampa			
15	Duffy Canyon river access and riverside camping	Duffy Canyon																		x	Project would establish on-river camping opportunities for float boaters that is currently lacking and additional improvements to river access within Duffy Canyon	Proposed		BLM	Friends of the Yampa, Colorado Parks and Wildlife			
16	Wolery Ditch diversion structure rebuild	Yampa River at Wolery Ditch below James Brown Bridge					x	x												x	Friends of the Yampa has been working with the owners of the Wolery Ditch to prepare for a structural project that would rectify the need to build a push up dam for the ditch every few years. Location would be optimal for an agricultural/recreational partnership as diversion structure would be built to accommodate both attributes.	Proposed	Unknown	Friends of the Yampa/Wolery Ditch owners	Trout Unlimited			
17	New decreed instream flows	Stream reaches throughout the Basin			x																This includes all newly decreed instream flow adjudications applied for by the CWCB (i.e. Red Creek instream flow is currently going through the water court process). Note while these junior decreed reaches may provide protection from future development, regional/system-wide solutions are needed to meet existing instream flow shortages.	On-going	not applicable	stakeholders who sponsor an instream flow for CWCB review	not applicable			

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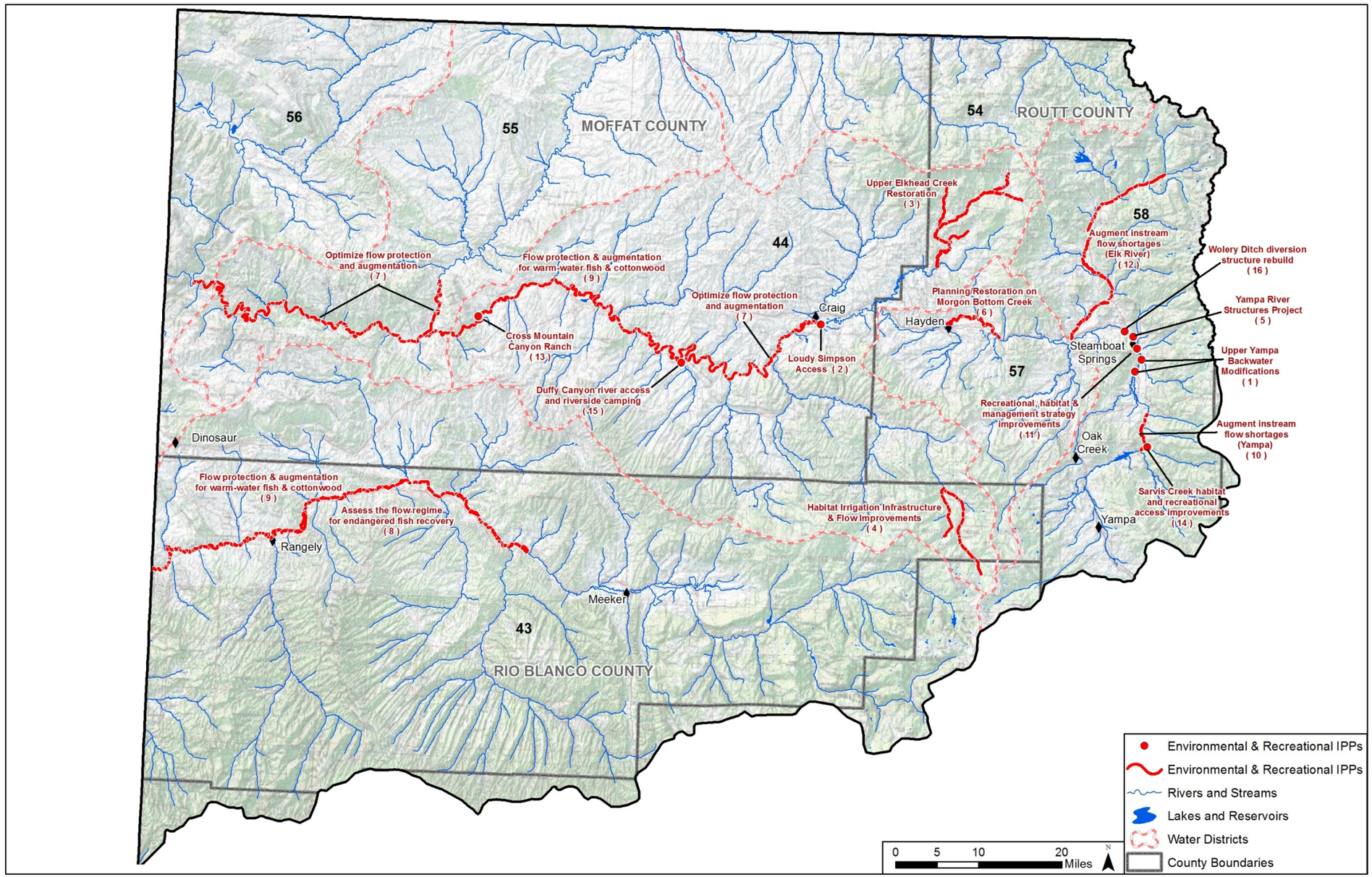

Figure 4-4 Environmental and Recreational IPPs

Table of Contents

SECTION 5.0 STRATEGIES FOR THE PROJECTS AND METHODS

This chapter provides an overview of the YWG Basin's strategies related to the projects and methods. The information presented in this chapter includes:

- The approach for engaging the public and building consensus among the project sponsors, residents, and other stakeholders in the YWG Basin as projects and methods are developed and implemented;
- Identification of funding mechanisms and partnerships/sponsors; and
- Identification of additional studies, recommendations and next steps that will help facilitate the Basin Implementation Plan's (BIP) goals moving forward.

Highly specific timelines and deadlines are not included to allow the Basin Roundtable the flexibility needed to successfully build consensus among stakeholders, encourage public participation, and assist in implementing projects and methods. It is important to note again that development of the BIP is an ongoing process. It is a document representing a snapshot in time with no true finalization date. With the ongoing process of water supply planning, the Basin Roundtable will continue to strive to balance the future needs of the region while integrating important considerations such as addressing certainty of existing uses, enabling modest future growth and retaining important recreational and environmental values. These core ideas will be considered throughout the process as projects and methods are developed and implemented to ensure reliable water supplies for the region now and in the future. An additional consideration is that parties on the east slope have expressed interest in diversions from the YWG Basin. Downstream states have delivery needs that are partially met from the YWG Basin. This interest, coupled with the river basin's desire for a negotiated equitable apportionment of its native flow for in-basin use and future development, forms an extremely important consideration for the Basin Roundtable as it moves forward with long-term water supply planning. The Basin Roundtable will continue its willingness to discuss the preservation of environmental and recreational flows that also deliver needed water to downstream obligations, but also stresses the importance of assuring non-curtailment of its existing water use and protecting water for future uses in state-wide discussions.

5.1 FACILITATION OF PUBLIC PARTICIPATION AND CONSENSUS BUILDING

The ultimate responsibility for completing the IPPs falls with the project sponsors and will therefore be a locally-driven process. However, the Basin Roundtable will serve as a facilitator of the IPPs to assist in moving projects and methods forward, but it will not be a decision-making body. The Basin Roundtable recognizes the importance of including constituents and stakeholders in the YWG Basin in the process of developing and implementing IPPs and will therefore serve as a forum for this process and a source for information exchange. Participation in the public process will be encouraged at the Basin Roundtable level to provide transparent information and open dialogue amongst all involved parties.

The Basin Roundtable can also facilitate public awareness of the projects and help to build consensus among all parties considering that some IPPs can present water management challenges as well as opportunities. For example, IPPs can impact streamflows both upstream and downstream of the project location. The Basin Roundtable can address these types of challenges and how impacts may be felt outside of the immediate project location by educating stakeholders and bringing all affected parties together.

5.2 FUNDING MECHANISMS AND PARTNERSHIPS/SPONSORS

While development of IPPs and identification of funding is up to the project proponent, the Basin Roundtable will facilitate funding discussions at the Roundtable level where it is feasible and appropriate. Additionally, identification of partnerships and sponsors will also be the project proponents' responsibility but the Basin Roundtable can assist by providing a forum for open discussions related to developing these interactions.

5.3 ADDITIONAL STUDIES, RECOMMENDATIONS AND NEXT STEPS

The Basin Roundtable will continue its efforts in developing the BIP after the draft is submitted to CWCB in July 2014. Specifically, additional effort will occur to refine the water right operations modeling, provide more detailed information regarding the operations of the full suite of current IPPs, and identify opportunities for additional multi-use projects. It is expected that this work will commence shortly after the Draft BIP is submitted to keep the momentum going with the BIP development process. It is possible that additional shortage areas will be identified after July 2014 through this follow-on modeling and/or during future updates to the BIP. Discussions will therefore continue on how to best meet these shortages throughout the basin. Information developed as a result of the additional modeling will be incorporated into future versions of the BIP as the opportunity arises. An initial summary of next steps for the YWG Basin Roundtable associated with BIP development and refinement are presented here.

- Refine the P&M Study Model and reevaluate scenarios to be addressed with future modeling.
- Add new IPPs to the model and re-assess the results.
- Look for opportunities for multi-purpose projects.
- Facilitate public engagement and education to help build consensus on the IPPs.

A great amount of additional effort and continued dedication will be required to add to and refine this work. This BIP lays the foundation for understanding and articulating the policies, processes and projects that can occur in the future to maintain and enhance the region's water supplies. These next steps will facilitate a greater understanding related to the future water supply planning needs of the YWG Basin.

SECTION 6.0 HOW THE PLAN MEETS THE GOALS AND MEASURABLE OUTCOMES

This section informs SWSI and the Colorado Water Plan on how the YWG Basin Roundtable plans to meet our municipal, industrial, agricultural, environmental and recreational gaps in a meaningful way. Where applicable, specific IPPs are identified, while in other cases plans for further refinement of conceptual solutions are described. The IPPs and conceptual solutions are dynamic and will be refined in SWSI as demands are updated, but this summary provides an initial benchmark against which measurable progress can be determined.

Table 6-1 How the BIP meets the Goals

Goals	How met
Protect existing decreed and anticipated future water uses in the YWG basin	Section 4 describes 21 multi-purpose IPPs and 17 environmental and recreational IPPs that will help reduce shortages to decreed uses and protect anticipated future water uses. A Colorado River Compact water bank is identified as an IPP to provide an alternative transfer mechanism to protect existing senior agricultural water supplies. Section 1 requests a negotiated equitable apportionment of water use in the Yampa/White/Green basins to protect relatively junior decreed uses and future uses.
Protect and encourage agricultural uses of water in the YWG basin within the context of private property rights Improve agricultural water supplies to increase irrigated land and reduce shortages	Current and future agricultural needs are identified in Section 2.3 Agricultural shortages are discussed in Section 3.4.1 IPPs described in Chapter 4 include reservoir enlargements, new storage projects, municipal water conservation, and expansion of municipal supply well fields. These will supply growing M&I and SSI needs and reduce pressure for transfer of agricultural water rights. Ten IPPs have agricultural supplies identified as a primary use, and an additional two IPPs have agricultural supplies identified as a possible secondary benefit.
Identify and address municipal and industrial water shortages.	Current and future M&I and SSI shortages are analyzed in Section 3.4 IPPs described in Chapter 4 include reservoir enlargements, new storage projects, municipal water conservation, and expansion of municipal supply well fields. Nine IPPs have municipal water supplies as a primary purpose. An additional nine IPPs have SSI water supply as a primary purpose.
Quantify and protect non-consumptive water uses	Environmental and recreational needs are identified in Section 2.4 To help meet environmental and recreational water supply needs 17 environmental and recreational IPPs are identified in Chapter 4. In addition, five of the

Goals	How met
	consumptive IPPs identified in Chapter 4 include non-consumptive purposes and an additional seven include non-consumptive purposes as a possible secondary benefit. The Basin Roundtable will continue to explore additional multi-purpose opportunities where they may exist through future planning efforts.
Maintain and consider the existing natural range of water quality that is necessary for current and anticipated water uses	No measures yet identified.
Restore, maintain, and modernize water storage and distribution infrastructure	20 of 21 consumptive IPPs involve improvements to storage or distribution infrastructure. Environmental and recreational IPP #4 includes "Implementation of projects that improve…irrigation infrastructure." Environmental and recreational IPP #6 includes "watershed planning and implementation of…irrigation infrastructure improvement projects through the Morgan Bottom reach."
Develop an integrated system of water use, storage, administration and delivery to reduce water shortages and meet environmental and recreational needs	Water management and water administration in the YWG Basin are discussed in Section 3.2, and some of the challenges in the YWG Basin are recognized there. The YWG Basin has identified a number of measures to improve administration and will refine these through SWSI.

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APPENDIX A

PROJECT AND METHODS STUDY OVERVIEW

Table of Contents

APPENDIX A PROJECTS AND METHODS STUDY OVERVIEW

The State and YWG Basin has conducted a series of recent studies to develop a better understanding of their consumptive, environmental and recreational needs in the basin. The BIP draws from these planning efforts to provide a comprehensive overview of the Basin's current and future water needs and the actions necessary to meet such needs. This appendix introduces the previous studies conducted and provides a comprehensive overview of the Project and Methods Study (P&M Study), which is the most recent study conducted by the Basin and the primary study used to inform the BIP.

A.1 Overview of Yampa/White/Green Studies

Table A-1 provides a summary of the basin-wide studies conducted for the YWG Basin since the initial Statewide Water Supply Initiative (SWSI) in 2003. These studies encompass assessments of current and future M&I, energy, agriculture, environmental and recreational needs, and the modeling exercises conducted to evaluate water supply shortages, future water supply projects, climate change and impacts to instream flows.

Table A-1 Previous Studies

Year Study Completed	Study	Summary
2004	SWSI	Identified Colorado's current and future water needs and examined a variety of approaches Colorado could take to meet those needs. SWSI implemented a collaborative approach to water resource issues by establishing SWSI roundtables. SWSI focused on using a common technical basis for identifying and quantifying water needs and issues.
2008	Energy Development Water Needs Assessment Phase I	Developed future demand estimates through the 2050 planning horizon for the oil shale, natural gas, coal, and uranium energy sectors.
2010	Updated SWSI	Updated the original SWSI to include new data and develop projections through a future planning horizon of 2050.
2010	Nonconsumptive Needs Focus Mapping Report	Development of environmental and recreational focus maps and attribute tables to further characterize the environmental and recreational needs within the State's Basins.
2011	Basin Needs Assessments	Summarizes information developed through the SWSI process for the YWG Basin.
2011	Energy Development Water Needs Assessment Phase II	Updated the oil shale demand from the Phase 1 Energy Development Water Needs Assessment.
2011	Yampa/White Agricultural Water Needs Assessment Report	Refined and updated previous estimates of current agricultural uses and supplies, evaluated future agricultural demands, assessed climate change and energy development sector impacts on agricultural water availability, and developed alternatives to satisfy shortages.
2012	Colorado River Water Availability Study	Provides a common platform to determine consumptive and nonconsumptive uses throughout the western slope. StateMod models developed under the Colorado's Decision Support Systems (CDSS) for the Colorado River main stem, Gunnison River, Dolores/San Juan/San Miguel Rivers, and the Yampa-White-Green Rivers were used in the development process. Current demands, operations, and historical hydrology as well as a suite of climate change demands and hydrologies were used to determine the current and potential future state of water availability along the western slope of Colorado.

Year Study Completed	Study	Summary
2012	Yampa-White Basin Roundtable Watershed Flow Evaluation Tool Study	Applied ecology-flow metrics to identify environmentally and recreationally significant areas and determine the risk levels associated with those areas. The associated risk metrics characterize the impacts of increased water use within the basin on trout, warm water fish, cottonwoods and boating.
2013	CWCB Nonconsumptive Use Toolbox	Provides a framework to evaluate existing information and identify opportunities and challenges regarding implementation of environmental and recreational projects.
2014	YWG Projects and Methods Study (Draft Final February 27, 2014)	Evaluates the M&I, energy, agricultural and environmental and recreational needs and shortages in the YWG Basin using the StateMod model.
2014	Yampa Basin Alternative Agricultural Water Transfer Methods Study	Identified several locations where alternative agricultural transfer methods meeting the needs of both the environment and consumptive uses could be implemented. These temporary water leasing arrangements could offer substantial benefit to both consumptive and nonconsumptive interests if their associated challenges can be overcome.
2014	Energy Development Water Needs Assessment Update Phase III	Assess current and projected energy water demands provided in the Phase I and Phase II Energy Development Water Needs Assessment. Where appropriate, estimates will be revised to reflect the most up-to-date data trends. Emphasis is placed on updating the natural gas and oil shale demands.

A.2 Introduction to the P&M Study

The P&M Study was the primary study used to inform the BIP regarding future water supplies, demands, and shortages including projections of demands and alternative hydrologic conditions. It was conducted by the YWG Basin Roundtable (BRT) to:

- Develop a common understanding of consumptive, recreational and environmental water needs in the Yampa-White Basin.
- Analyze river operations of the Yampa and White Basins, including alternative model scenarios.
- Evaluate water right priorities of Statewide SWSI Alternatives relative to those of the YWG Basin.

The study used the StateMod modeling platform which is Colorado's water allocation model maintained by Colorado Decision Support Systems (CDSS). StateMod is the water allocation model in CDSS that is used for the primary purpose of modeling water rights and allocating water to those rights. StateMod uses strict prior appropriations (i.e., first in time, first in right) to model diversions. The model was initially developed in 1994 and has been continually updated as new studies and data becomes available. The 2009 release for both the Yampa and White basins were used for this study. The model uses a monthly time-step. A variety of previous studies were used to inform the modeling effort.

The P&M study evaluated baseline conditions and six modeling scenarios. As shown in Figure A-1, these scenarios consist of a combination of demands, hydrology and the presence of IPPs. The demand inputs include the current and future 2050 water needs for the M&I, energy, agriculture, environment and recreation sectors at specific modeling nodes in the StateMod model. Information on how the demands were developed for each of these sectors is summarized below. The P&M Study results present the average annual water shortages or flow risks at each of the respective StateMod nodes and for each of the sectors both in tables and spatial figures.

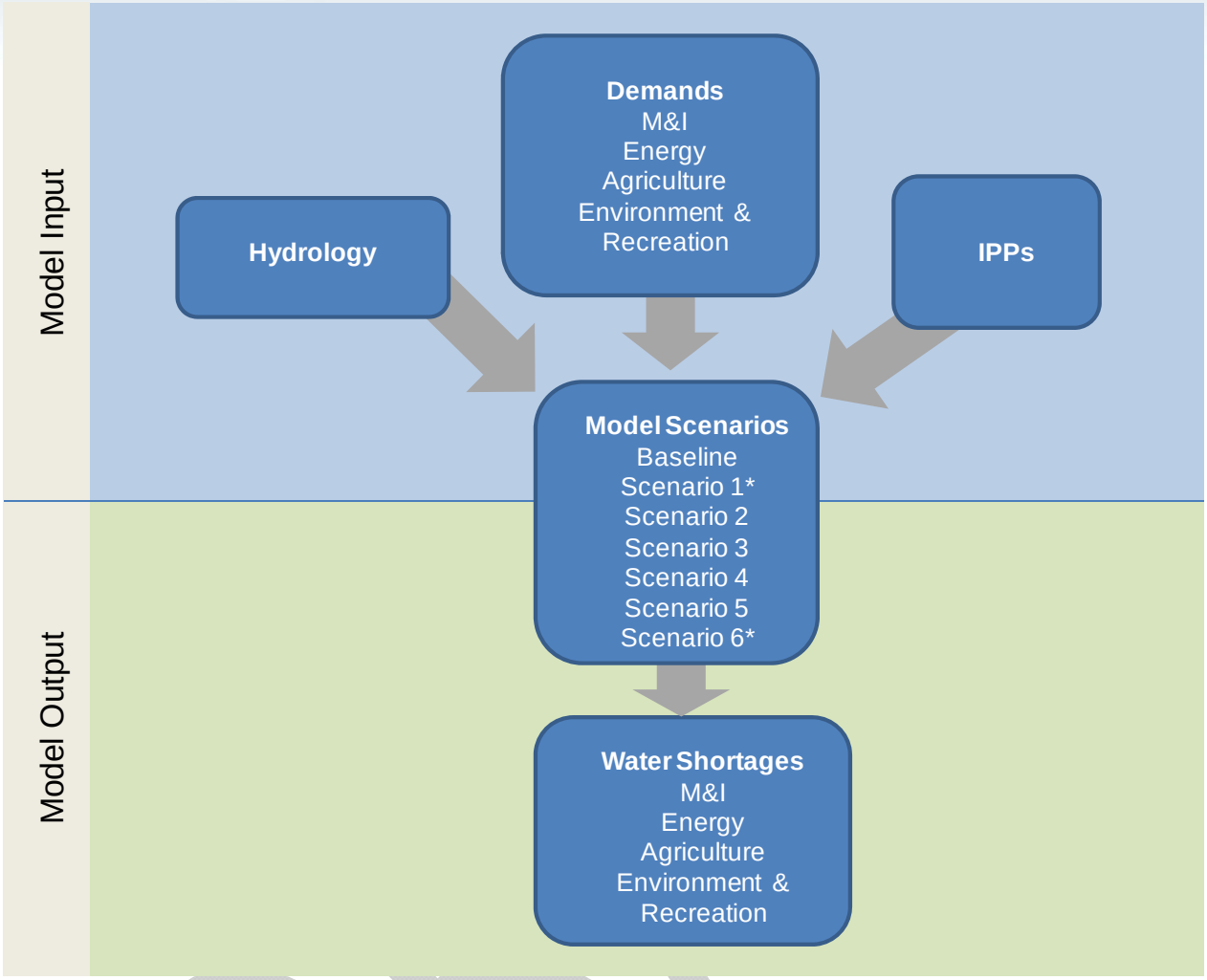


Figure A-1 Elements of the Model Scenarios

Table A-2 shows the elements for each of the respective scenarios. The modeled baseline (current) represents current conditions and operations. This includes all existing reservoirs, water rights, imports, diversions, and return flows while incorporating the historical hydrology and climate over the period 1950 through 2005. It provides a means to compare the other scenarios (e.g., supply projects, climate change, new demands, etc.). Scenarios 1, 2 and 3 were selected during the July 17, 2013 BRT technical subcommittee meeting. Scenarios 4, 5, and 6 were selected after the results from the first three scenarios were presented during the October 3, 2013 BRT subcommittee meeting. These scenarios incorporate a range of demands, hydrology types and means to assess the implications of whether new IPPs are implemented.

Table A-2 Model Scenarios

BIP Scenario	Nomenclature in the P&M Study	Hydrology	Demands	IPPs
Baseline	Baseline	Historical	Existing demands	No IPPs Selected
Dry Future IPP Scenario	Scenario 1	Dry	High	All IPPs Selected
Dry Future Scenario	Scenario 6	Dry	High	No IPPs Selected

The baseline condition and Dry Future IPP Scenario and Dry Future Scenario were selected for further evaluation in the BIP. These scenarios entail high demands and the dry hydrology which provides a conservative planning framework to best guarantee that the Basin can meet their future water needs. The remainder of this appendix provides detailed information on the demands, hydrology and IPPs used in both the P&M Study and BIP.

A.3 Hydrology

Three 56-year sequences of climate adjusted hydrology (based on the historical records from 1950 to 2005) were selected for both the Yampa and White Basin StateMod P&M modeling effort. The CRWAS final report provides details on the development of these hydrology sequences. The hydrology sequences were selected from seven of the original ten climate change hydrology scenarios used in the CRWAS study.[1, 2] For both the Yampa and White basins, a wet, average and dry-year hydrology was selected for simulation using the basins' StateMod models. These three hydrology sequences represent the following scenarios:

- Wet hydrology - more water exists in the future than historically
- Average hydrology - average annual flows most similar to historical flows
- Dry hydrology - less water exists in the future than historically.

The hydrology sequences were selected based on the mean annual volume of water at the Maybell (USGS ID 09304500) and Meeker (USGS ID 09251000) gages for the Yampa and White basins, respectively. The hydrology with the greatest volume of water was selected as the wet hydrology, the hydrology with the smallest total volume was selected as the dry hydrology and the hydrology closest to historical conditions was selected as the average hydrology.

A.4 Sector Demands and Shortages

A.4.1 M&I

Baseline and Future Needs

The YWG Basin BIP Subcommittee chose the high demand, low supply scenario from the P&M Study to be analyzed for the BIP. Table A-3 presents the SWSI 2010 and Basin Needs Assessment Report county-level M&I population and needs for baseline conditions and the future high demand level which reflects expected increases in population. The high economic growth scenario includes a 550,000 barrel per day oil shale industry; therefore, the population in the YWG Basin is expected to more than triple by the year 2050 under this scenario.

Table A-3 Baseline and Future M&I Demands

County	Baseline Population	Baseline Water Demand (AFY) 2008	Future Population 2050 High	Water Demand with Passive Conservation (AFY) 2050 High
Moffat	14,600	3,200	31,000	6,400
Rio Blanco	6,700	2,000	59,000	17,000
Routt	23,800	6,500	63,000	16,000
Total	**45,100**	**12,000**	**153,000**	**39,000**

Source: Yampa-White Basin Needs Assessment Report, 2011; SWSI, 2010

[1] This did not include paleo records because such records were not available for the White River.

2 CWCB. 2012. Colorado River Water Availability Study, Phase I Report.

To evaluate baseline conditions and the six modeling scenarios for M&I demands in StateMod, the P&M Study took these county-level demands projected out to 2050 and applied them to specific model nodes using a variety of methods depending upon data availability. In general, the follow approach was taken:

- Major M&I demand areas: demands and water rights, historical use and reservoir data for population centers were explicitly modeled , e.g., Craig
- Minor M&I demand areas: demands were aggregated together for the entire basin into one location, e.g., existing M&I demand for Water District 55 (Little Snake River) was grouped and modeled on the Little Snake River in Moffat County (55_AMY003)

This methodology resulted in 9 aggregate M&I nodes in the YWG Basin as shown in Table A-4.

Table A-4 Node-based M&I Demand Locations

Diversion Name	Basin/Stream (Water District)
	Moffat County
Craig Water Supply Plant (440581)	Lower Yampa (44)
District 44 Aggregate Existing M&I (44_AMY001)	Lower Yampa (44)
District 55 Aggregate Existing M&I (55_AMY003)	Little Snake (55)
	Rio Blanco County
Rangely Water (430889)	White (43)
Meeker Demand (950810)	White (43)
District 43 Aggregate Existing M&I (43_AMW001)	White (43)
	Routt County
District 57 Aggregate Existing M&I (above Craig) (57_AMY001)	Middle Yampa (57)
District 58 Aggregate Existing M&I (Steamboat Springs) (58_AMY001)	Upper Yampa (58)
Fish Creek Municipal Intake (580642)	Upper Yampa (58)

Source: P&M Study, 2014

To represent baseline conditions on a monthly basis, the P&M Study indicates it used a 12-month demand pattern reflecting average demands from historical periods, e.g., demands from the Town of Craig are averaged over the period 1999 to 2004. However, it is not clear how this approach relates to the SWSI 2010 and the Basin Needs Assessment Report data, or if demands for other M&I nodes were developed from other historical periods[3].To evaluate future consumptive M&I demands for 2050, low, medium, and high demands were split up by county into their respective existing M&I demand nodes. A "driver multiplied rate of use" approach was used to develop the low, medium and high demands which considered factors from SWSI such as job growth and estimated population. Node demands were scaled up n proportion to the projected growth of basin-wide, or county-wide demands. An example of this scaling approach is provided in Table A-5.

Table A-5 Example of Scaling Approach to Develop Future M&I Demands by Node

Node	Baseline Demands (AFY)	Future Demands* (AFY)
1	100	200
2	900	1,800

*Future total county demands = 2,000 AFY (node 1 = 10% or 200 AFY; node 2 = 90% or 1,800 AFY)

[3] The approach for developing baseline demands will be clarified in future BIP work.

The future M&I demand estimates include passive conservation which mainly reflects water demand reductions due to policy measures such as those requiring manufacture of more efficient toilets, washing machines and dishwashers and the subsequent installation, or retrofit, of these appliances into existing housing and commercial buildings.

Shortages

As discussed in Chapter 2, M&I demands are small compared to agricultural demands in the YWG Basin. As shown in Table A-6 under Baseline Conditions, no shortages exist to M&I demand nodes due to generally adequate water supply and augmentation from reservoirs.

Future M&I shortages are evaluated in the BIP by assessing the Dry Future IPP and Dry Future Scenarios which both reflect high demand, low water supply scenarios. The IPPs presented in the P&M Study do not include augmentation for existing M&I demands; therefore, both scenarios show M&I gaps as shown in Table A-6.

Table A-6 Future M&I Demand Shortages

Diversion Name	Baseline Average Annual Water Demand (Diversions)[1] (AFY)	Average Annual Percent Short		
		Baseline	Dry Future IPP Scenario	Dry Future Scenario
Moffat				
Craig Water Supply Plant (440581)	2,200	0.00%	0.00%	0.00%
District 44 Existing M&I (44_AMY001)	740	0.00%	0.00%	0.00%
District 55 Existing M&I (55_AMY003)	10	0.00%	0.00%	0.00%
Moffat County Total	**2,950**			
Rio Blanco				
Rangely Water (430889)	1,710	0.00%	3.02%	2.48%
Meeker Demand (950810)	370	0.00%	8.35%	6.78%
District 43 Existing M&I (43_AMW001)	1,100	0.00%	2.53%	2.37%
Rio Blanco County Total	**3,180**			
Routt				
District 57 Existing M&I (above Craig) (57_AMY001)	480	0.00%	0.00%	0.00%
District 58 Existing M&I (Steamboat Springs) (58_AMY001)	1,340	0.00%	0.04%	0.06%
Fish Creek Municipal Intake[2] (580642)	2,910	0.00%	0.00%	0.00%
Routt County Total	**4,730**			
Total	**10,860**			

Source: P&M Study, 2014
[1]Amounts presented are diversion amounts.
[2]The Fish Creek Municipal Intake (580642) includes Fish Creek direct flow rights (1892) that are pre-1922 with Fish Creek Reservoir storage rights (1946, 1964, 1996) and Yampa wellfield rights (1977, 1992) that are post-1922 and that seasonally pump about 600 AFY.

While M&I shortages exist under the high demand, low water supply scenarios of the Dry Future IPP Scenario and the Dry Future Scenario, the shortages remain below 10%. Identifying additional IPPs for M&I use would likely decrease M&I shortages at these locations, particularly for the White River Basin which has a lack of storage.

A.4.2 SSI

Similar to previous reports, the P&M Study evaluated consumptive water demands for thermoelectric power generation and energy development separately. However, it did not evaluate large industrial as a separate category as previous reports have[4]. A discussion for each of these categories follows based on results from the P&M Study.

Thermoelectric Power Generation

Baseline and Future Needs

Since thermoelectric power demands are related to needs of the population served, it will trend in a similar manner to changes in population, i.e., M&I demands. As stated for M&I demands, the BIP is presenting the high demand, low supply scenario results from the P&M Study. County-level thermoelectric baseline and future (high demand) needs from SWSI 2010 and the Basin Needs Assessment Report are shown in Table A-7.

Table A-7 Baseline and Future Thermoelectric Power Generation Demands

County	Baseline Water Demand (AFY) 2008	Water Demand with Passive Conservation (AFY) 2050 High
Moffat	17,500	26,900
Rio Blanco	0	0
Routt	2,700	17,100
Total	**20,200**	**44,000**

Source: Yampa-White Basin Needs Assessment Report, 2011; SWSI, 2010

Using a methodology similar to the M&I demands, thermoelectric power generation demands were modeled explicitly in the P&M Study by representing each existing thermoelectric power generation facility - Craig Station in Moffat County and Hayden Plant in Routt County - as a specific model node. All thermoelectric demand for Moffat County was applied to Craig Station and similarly all demand for Routt County applied to Hayden Plant since only one plant exists in each county. Consequently, this approach assumes these facilities will meet all future power generation needs and that no new plants will be required. Both plants have redundant water supplies in addition to their more junior water rights with in the form of releases from Steamboat Lake (Hayden Plant), Stagecoach Reservoir (Craig Station), and Elkhead Reservoir (Craig Station), and since no flows return back to the stream, both plants are modeled as fully consumptive.

Since Craig Station has three units that are supplied by both Stagecoach Reservoir (unit 1) and Elkhead Reservoir (units 1 and 2), the P&M Study modeling effort split Craig Station into two separate nodes; one representing units 1 and 2 and the other representing unit 3. This was done due to limitations with the model in order to accurately reflect the even split in demand that each unit has, i.e., each unit comprises one-third of the total Craig Station demand. In the model, Elkhead Reservoir makes releases to the first node with two-thirds of the demand (units 1 and 2) and Stagecoach Reservoir makes releases to the second node with one-third of the demand (unit 1).

Shortages

Similar to M&I, under currently defined Baseline Conditions, thermoelectric power generation shortages are virtually non-existent as shown in

[4] Future BIP work will include understanding whether baseline large industrial demands were included in the P&M Study model.

Table A-8. Only in the driest years under currently defined Baseline Conditions and when SSI users rely upon redundant water supplies are demands not met through supplemental releases from the reservoirs discussed above.

To evaluate future shortages, the Dry Future IPP and Dry Future Scenarios model thermoelectric power generation demand using redundant water supplies from Steamboat Lake for the Hayden Plant and Elkhead and Stagecoach Reservoirs for Craig Station.

Table A-8 indicates that minor shortages exist in the Dry Future IPP and Dry Future Scenario for Hayden Station and units 1 and 2 at Craig Station.

However, SSI water users consider their water supply short when they must rely upon redundant water supplies. Further discussions will take place on the most appropriate Baseline Conditions and the assessment of shortages in light of drought, climate change and evolving power generation technologies.

Table A-8 Future Thermoelectric Power Generation Demand Shortages

		Average Annual Percent Short		
Diversion Name	**Average Annual Simulated Diversion (AFY)**	**Baseline**	**Dry Future IPP Scenario**	**Dry Future Scenario**
Moffat				
CRAIG STATION D & PL (Units 1&2) (440522)	8,040	0.0%	0.12%	0.12%
Tri-State (Unit 3) (440522b)	4,020	0.0%	0.0%	0.0%
Moffat County Total	**12,060**			
Routt				
COLO UTILITIES D & PL (Hayden Station) (570512)	4,890	0.0%	0.14%	0.14%
Routt County Total	**4,890**			
Total	**16,950**			

Source: P&M Study, 2014.

Energy Development

Baseline and Future Needs

The potential for energy resource development in northwest Colorado has driven specific studies to be completed to analyze the baseline and future water requirements of the industry. As mentioned in Chapter 2, two phases of the Energy Development Water Needs Assessment have been completed and another update was recently completed. Water needs related to the coal, oil shale, natural gas and uranium mining energy sectors have been developed for the following three components:

- Direct Water Demands: include the water required for the construction, operation, production, and reclamation needed to support the energy extractions and development processes
- Indirect Water Demands: water demands that result from the increase in the region's population due to the energy development and production
- Thermoelectric Power Generation Demands: energy development direct water demands are tied closely to increases in thermoelectric power generation demands, i.e., increased mining typically requires an increase in electrical needs and subsequently an increase in thermoelectric power generation water demands.

Indirect water demands have already been considered in the M&I demands discussed above from SWSI 2010 and the Basin Needs Assessment Report because they reflect the demands associated with an area's population, i.e., population growth directly attributable to the energy sector workforce. Similarly, the related impact on thermoelectric power generation demands due to increased energy workforce population are included in the demands for Craig Station and the Hayden Plant. Direct water demands associated with energy demand are in a separate category and were evaluated in Phase I and II of the Energy Development Water Needs Assessments. Phase II continued the work performed in Phase I of the study and calculated low, medium, and high demand projections for short-term, mid-term, and long-term planning horizons.

The recently completed Energy Development Water Needs Assessment Study Phase III reviewed and updated the direct water uses for energy development. The Phase III study carries forward the Phase I water use estimates for the coal and uranium sectors (because there is no new information or development prospects in those sectors) and updates water use estimates for the oil shale and oil and gas sectors. Since the Phase II report was published, both Chevron and Shell have ended their oil shale research projects in Colorado. The National Oil Shale Association markedly reduced water use estimates mainly because the large in situ projects proposed by Chevron and Shell were discontinued. Therefore, the Phase III reports new water use estimates for oil shale. Additionally, the Phase III report updates the direct water uses associated with oil and gas well drilling and completions since new information on drilling activity and resource development planning is available since 2008.

Because the BIP is focusing on the high demand, low supply scenario, future energy development corresponding to the high production level for the four energy sectors are presented in Table A-9 and discussed below.

Table A-9 Future Energy Sector Development Direct Demand Forecast

Energy Sector	Water Demand Levels (AFY) 2050 High Production
Natural Gas and Oil	6,000
Uranium	130
Coal*	6,000
Oil Shale	76,000
Total	**88,000**

Source: Phase III Energy Water Development Needs Study, 2014.
*Updated with information from Peabody Coal feasibility planning for Peabody-Trout Creek water supply project.

Natural Gas

The majority of natural gas related water demands are due to the hydraulic fracturing process (fracking). However, the P&M Study indicates that because water for fracking is typically sourced from areas that would not affect existing or future direct diversions, e.g., water from another state, leased or purchased irrigation water, treated or raw water leased or purchased from a municipal water provider, etc., water demands related to natural gas production was not included in the P&M Study. Further, the process only occurs at the beginning of natural gas well installation; therefore permanent water rights are not necessary. However, water supplies for drilling and well completion will in part be sourced via direct diversions. The Energy Development Water Needs Assessment Update will be updating natural gas estimates and will be adding demands for oil so that data will be incorporated into the BIP as available.

Uranium

Coupled with small water demands even at the high production level and uncertain future locations, uranium mining was not included in the P&M Study.

Coal

Water demands associated with coal mining are difficult to estimate because they are economically driven and therefore may occur in varying levels at existing locations or at a completely new location. As a result, locations for coal development were indistinct in the Energy Development Water Needs Assessment. More refined information was since made available, and subsequently used in the P&M Study, in the Peabody-Trout Creek Project Study. This study evaluated a water supply project on Trout Creek upstream of the confluence with the Yampa River to help Peabody Energy meet 6,000 AFY of energy development demands as part of the Peabody-Trout Creek Project[5].

Oil Shale

The Phase II Energy Development Water Needs Assessment focused on the supply availability of oil shale development, with production mainly occurring in the Piceance Creek area in the White Basin. For the 110,000 AFY demand level for the high production scenario presented in Table A-9 above, Piceance Creek cannot reliably provide enough water to consistently meet the demand. As a result, water would need to be sourced elsewhere, including from storage and undecreed water right diversions. Three StateMod water allocation modeling scenarios were developed as part of the Phase II study to determine feasible supply options and are discussed further in the IPP section below.

Recently, the certainty of oil shale development in northwest Colorado has changed with research activities slowing and even completely stopping, e.g., Shell Energy in Rio Blanco County. Due to the lower likelihood that an oil shale industry will develop in the area, at least at the previously projected level, the Energy Development Water Needs Assessment Update updated the oil shale water demands as presented in Table A-9.

Shortages

The P&M Study does not assess shortages to the energy development industry.

A.4.3 Agriculture

Irrigation Demands

The Basin's P&M Study and Agricultural Water Needs Study relied upon the same estimates of irrigation demands in the Basin. The irrigation demands were developed using the CDSS 1993 coverage,[6] historical diversion data and the CDSS consumptive use model called StateCU. Groundwater use for irrigation is relatively minor when compared to surface water diversions in the basin and is not considered in the modeling. The StateCU model was used to estimate the irrigation water requirement (IWR) using the modified Blaney-Criddle method. For application with StateMod, the IWR was divided by the irrigation efficiency corresponding to each respective diversion structure (i.e. model node) to determine the irrigation water demand diverted from the stream at the diversion structure.[7,8] The irrigation water efficiencies were limited to a minimum of 30 percent and a maximum of 50 percent which were assumed to be reasonable efficiencies in the rugged mountain environment. This approach allows IWR to drive demands instead of historical diversions and enables various levels of irrigation demands to be modeled. The irrigation demands presented in Chapter 2 of the BIP represent the irrigation demands at the diversion structure/model node.

[5] It is being clarified how these demands were modeled and if they are in addition to those scaled up from SWSI 2010.

[6] The State of Colorado developed a year 2000 irrigated acreage coverage, but CWCB staff indicated that this coverage is not as reliable as the 1993 coverage and recommended using only the 1993 acreage (meeting with CWCB staff, May 2009). Additionally, a 2005 irrigated acreage coverage has also been developed by CWCB, however, since the period of record of the study ends in 2005, this coverage has not been included in the CDSS models at the time of this study.

[7] Average monthly structure efficiencies were calculated using the baseline scenario where the diversion structure efficiencies equaled the historical IWR divided by the historical water demand at the diversion structure ($IWR/Demand_{historical}$).

[8] The irrigation demands for the baseline scenario were calculated as the maximum of the recorded historical diversion at the diversion structure or the StateCU generated IWR divided by the irrigation efficiency. Irrigation demands for all other scenarios were simply based on the IWR divided by efficiency.

For StateMod modeling purposes, the P&M Study used 43 nodes to represent all of the agricultural demands in the Basin. Diversions greater than 5 cfs in the Yampa and 4.8 cfs in the White, were explicitly modeled. Diversions with decreed rates less than the aforementioned rates were aggregated with other diversions of a similar rate that were in the same drainage upstream of the nearest baseflow node. Nodes were also disaggregated where necessary to differentiate diversions specifically located on a modeled stream (A- aggregates) and tributaries (B-aggregates) to the modeled stream. Conceptually the irrigation demand at the B-aggregate nodes is limited to the amount of water physically available in the tributary. For purposes of modeling, this was assumed to be the maximum historical diversions at these nodes. Therefore it was assumed that the irrigation demands at the B-aggregates could not exceed the historical diversions at each respective node.

The high demand scenarios (Dry Future IPP and Dry Future) include the development of 14,805 acres of irrigation land on the Oxbow of the Yampa River. The oxbow diversions were treated as an aggregated agricultural diversion at the downstream end of the modeled reach with a 2013 junior water right.[9] These additional demands were estimated using the StateCU model. However, the SWSI estimates of irrigation reductions discussed in Section 2.3.2, were not included in the P&M Study, given the uncertainty on the magnitude and location of reductions. Such estimates include a reduction of 1,000 to 2,000 acres as a result of urbanization in 2050 and a reduction in 3,000 to 64,000 acres due to transfers to address the M&I gap.

The StateCU and StateMod models were refined to include the Denver Water High Altitude crop coefficients for pasture grass/hay fields above 6,500 feet. In order to be consistent with CRWAS and common State Engineer Office practices, an elevation adjustment of 10% per 1,000 meters above sea level was made for all crops. When compared to previous SWSI IWR estimates, the IWR requirement increased by 54 percent basin-wide when the high –altitude coefficient for the grass/hay was included and by 65% when the elevation adjustment and high altitude crops were incorporated.

Irrigation Shortages

StateMod calculates the following types of irrigation shortages:

- Total/diversion shortages (at the headgate) - Difference between the irrigation demand at the diversion structure (model node) and the amount of water physically and legally available in the stream.
- Consumptive use shortage at the place-of- use - Difference between IWR and the amount of water actually diverted and multiplied by the diversion's maximum application efficiency. This represents the difference between the amount of water required to meet the crop irrigation requirement and the amount of water delivered to the crops.

For purposes of this BIP, the shortages are reported at the diversion point on the stream as opposed to the P&M Study which presented the shortages at the place-of-use. These shortages include losses and inefficiencies incurred from the point of diversion to the user end use. This provides a more direct means in evaluating the need for new IPPs by showing the demand/shortage directly incurred on the stream.

A.4.4 Environmental and Recreational

The YWG Basin evaluated the recreational and environmental needs in the Basin through the P&M Study and Watershed Flow Evaluation Tool (WFET). The WFET provides series of criteria to quantitatively measure and compare environmental and recreational flow risks based on existing and modeled flow conditions in the Yampa and

[9] The Agricultural Water Needs Study modeled the base flows resulting from existing irrigation and storage as senior to any new water rights for diversions to supply this expanded acreage (p. 5-28). This modeling was consistent with the hydrologic analysis for the Yampa PBO that relied on the continued availability of such existing base flows in setting the targets at the Maybell gage with access to only 7,000 AF of augmentation releases from an enlarged Elkhead Reservoir. The P&M Study did not use this approach. This is discussed in further detail below.

White basins. This methodology is incorporated into the P&M Study to assess environmental and recreational risks associated with the P&M Study model runs.

The P&M Study specifically addresses the target at the Maybell gage for augmenting existing base flows to assist in endangered fish recovery,[10] and instream flow shortages, and incorporates a series of risk-based ecology and flow relationship metrics to assess how current and potential future flows could impact the ecology and boating at specific locations within the Basin.

Instream Flows and RICDS

The instream flows and Steamboat RICD is operated in very similar manner in the StateMod model. Figure 2-10 shows the decreed instream flows within the YWG Basin and the instream flows modeled for the P&M Study. Only 30 of the 38 decreed instream flow reaches are modeled using the existing StateMod Yampa and White models. Instream flow and RICD rights are generally administered at a designated DWR or USGS gage. StateMod simulates instream flows and RICDs using the following criteria.

- Flows are calculated at the upstream and downstream terminus of the instream flow/RICD reach as well as at each intervening structure between the two ends.
- If the instream flow/RICD is in priority, it calls out junior diversion(s) upstream of the lower terminus and the model recalculates flows.
- If the instream flow is short, but has access to storage in a reservoir, releases are made (i.e. Steamboat Lake makes late season releases to Elk River and Willow Creek).

RICD and instream flow shortages are calculated as the difference between the decreed instream flow water right and the lowest flow within the reach.

Yampa Endangered Species Fish Flow Target

The P&M Study modeled the ability to meet the instream flow targets presented in Table 2-16. When flows at Maybell were below the targeted streamflows presented in Table 2-16, up to 50 cfs was released from the 5,000 acre-feet Elkhead Reservoir storage pool to meet the monthly flow targets at Maybell. In the modeling, releases from Elkhead Reservoir are dictated by flows at Maybell. If the flow target is being met at Maybell, but not along other areas of the reach, the model did not release more water from Elkhead Reservoir even though the flows are lower at other location(s) along the reach. This is consistent with how the PBO is currently operated for existing irrigation and storage. The specific operational criteria used by the model are summarized below.

- Releases are made from Elkhead Reservoir at a rate of up to 50 cfs until the permanent 5,000 acre-feet of CWCB storage is depleted.
- The model does not release water from Elkhead Reservoir if the flow target is being met at Maybell without releases. This occurs even if an existing diversion made downstream of Maybell causes the flow somewhere within the reach to fall below the target. This consistent with the way the operations of Elkhead Reservoir are written in the Yampa PBO for existing irrigation and storage. Releases are based upon the flow targets being met at the Yampa River gage at Maybell, CO.
- The model does not include the 2,000 acre-feet pool under the long-term, renewable lease.
- The model operates in such a manner where releases from Elkhead Reservoir are not diverted by any intervening water rights within the endangered species fish flow reach.[11]

[10] The P&M Study did not address the rest of the rest of the flow regime that may be necessary for endangered fish recovery on this reach of the Yampa, on the lower Little Snake, on the Yampa River in Dinosaur National Monument, and on the Green River. These flow needs were addressed by the WFET by replicating the full flow assessment of the existing and future depletions covered by the Yampa PBO.

[11] As storage releases decreed for instream use, such releases cannot be diverted even by senior water rights, as noted above. Senior water rights can divert the underlying base flows, but have an established pattern of historic use that was factored into the hydrologic analysis for the PBO.

- This flow augmentation in the Yampa PBO is based on existing storage and a current depletion of 125,271 acre-feet above the Little Snake River with a projected increase in depletion of 30,104 acre feet by 2045[12]. The P&M Study depletions estimates and new storage above the Little Snake River are significantly higher than this. Unlike the Agricultural Water Needs Study, the P&M Study awards new water rights and assumes the perfection of conditional water rights for diversions of base flows that the PBO relied on to meet the endangered fish flow targets at Maybell. Additional information on this topic is provided in Chapter 4.

Fisheries and Cottonwood Flow-Ecology Relationship Risks

The WFET developed a series of flow-ecology metrics to measure the ecological risk associated with decreased flows in the Yampa and White basins. These metrics were originally applied as a pilot study in the Roaring Fork and Fountain Creek watersheds and have been updated for the Yampa and White basins. The metrics are applied to 19 nodes shown in Figure 2-11 which encompass the focus areas shown in Figure 2-9. The metrics provide a means to assess the stream's ability to support trout, warm water fish and cottonwood populations using modeled streamflows relative to the natural flows of the stream prior to human development.[13]

Trout Flow-Ecology Relationship

This relationship compares modeled monthly flows in August and September relative to the annual natural flows. The lower the percentage of average August and September flows, the higher the risk of a particular location. The relationship estimates the ability for a stream to support trout based on the following equation:

$$Trout\ Flow-Ecology\ Relationship = \frac{\text{Mean August } Q_{\text{Existing}} + Mean\ September\ Q_{Existing}}{2} \Big/ Mean\ Annual\ Q_{natural}$$

Warm Water Fish Flow-Ecology Relationship

The flow-ecology metric for native bluehead sucker and flannelmouth sucker fish is represented by the following equation:

$$\%\ maximum\ native\ sucker\ potential\ biomass = 0.1025 \times 30 - day\ \min\ flow^{0.3021}$$

The risk associated with Warm Water Fish Flow-Ecology metric is calculated as a relative percent change from natural conditions to existing conditions. This equation below represents the relative reduction in maximum native sucker potential biomass due to the impacts of development. The greater the relative reduction in maximum native sucker potential biomass, the higher the risk.

$$Warm\ Water\ Fish\ Flow-Ecology\ Relationship = \frac{\%\ maximimum\ potential\ biomass_{Natural} - \%\ maximimum\ potential\ biomass_{Existing}}{\%\ maximimum\ potential\ biomass_{Natural}}$$

Cottonwood Flow-Ecology Relationship

The WFET and P&M Study refer to the "cottonwood flow-ecology" metric as the "riparian flow-ecology" metric. This metric has been renamed for purposes of the BIP to reflect that the metric exclusively assesses cottonwood as opposed to other riparian species.

Diversion of the underlying base flows by new water rights would undercut the hydrologic assumptions for the PBO, however, and make it difficult to keep the keep the PBO in place.

[12] The cooperative agreement implementing the management plan for the PBO also provides: "When the first increment of depletions in Colorado [of 30,104 acre feet] approaches full development, the impacts of developing a second increment [of 20,000 acre-feet] and the status of the endangered fish species at that time will be re-evaluated pursuant to the PBO for this Agreement to implement the Management Plan.".

[13] Source: Arthington et al, 2006.

The cottonwood flow-ecology metric expresses the relationship between high peak flows under natural conditions relative to modeled flow conditions in April through June. The P&M Study assessed cottonwood abundance in unconfined settings in moderate-energy confined geomorphic settings and at elevations less than 8,700 feet. The flow metric for unconfined settings is based on the change in the 90 maximum flow in wet years between current and natural flows and is expressed as:

$$\% \text{ abundance} = 1.038 \times \% \text{ flow alteration} + 1.005$$

The WFET evaluated cottonwoods for two riparian types: 1) cottonwoods on low and moderate grade, meandering unconfined rivers and 2) moderate-gradient rivers in confined valleys or high-gradient rivers in unconfined valleys. The P&M Study does not incorporate the second riparian type because the metric relies upon daily flows which are not available using the StateMod model that is based on a monthly time step. Cottonwood abundance for unconfined conditions was used as a proxy for all locations evaluated for the cottonwood flow-ecology relationship.

Each of the metrics above produce a percentage which provides means to assess the risk levels of trout, warm water fish and cottonwood riparian habitat relative to natural conditions. The WFET assigned risk levels to the range of percentages shown in Table A-10. These risk levels were developed by the TNC and members of the YWG Basin Roundtable.

Table A-10 Risk Levels for the Flow-Ecology Metrics

Metric	Low Risk	Minimal Risk	Moderate Risk	High Risk	Very High Risk
Trout Flow - Ecology Relationship	>55%	25% - 55%	15% - 25%	10% - 15%	<10%
Warm Water Fish Flow - Ecology Relationship	<10%		10% - 25%	25% - 50%	50% - 100%
Cottonwood Flow-Ecology Relationship	0% - 15%		15% - 30%	30% - 50%	50% - 100%

A.5 Summary of IPPs in the P&M Study

IPPs are strategies developed by water providers to assist in meeting future water supply needs that have been identified in previous studies for the YWG Basin. IPPs are grouped into the following categories:

- Permanent agricultural water transfers
- Reuse of existing fully consumable supplies
- Growth into existing supplies
- Regional in-basin projects
- New transbasin projects
- Firming in-basin water rights
- Firming transbasin water rights

The IPPs that were modeled as part of the P&M Study contained the following elements:

- Project Proponent – Acts as a source of information, i.e., reports, project stakeholder, etc.
- Location
- Physical Characteristics
- Permanent Operations
- Water Rights – Either conditional water rights, or new yet to be decreed water rights, were assumed as a proxy for new consumptive uses but not for new instream flow protection or restoration.

If the IPPs did not possess all of these elements, they were not modeled. These criteria excluded short or long-term water leases, other alternative transfer methods, and some optimized operations to avoid buying out and permanently drying up irrigated land and to improve stream flows. A summary of the IPPs modeled in the P&M Study is presented in Table A-11 below.

Table A-11 IPPs modeled in the P&M Study

Name	Type	Description	Location	Capacity	Storage Right	Operations	Additional Source
Little Bear 1 Reservoir	Reservoir	Little Bear I Reservoir was originally identified as part of the Yampa River Basin Small Reservoir Study – Phase 2 (Montgomery Watson 2000). It was one of three reservoirs carried forward from the Phase 2 study as a need was determined and upon a field visit, no fatal flaws were found. A location, capacity, and yield were determined as part of the study.	Yampa: Fortification Creek Basin	800 AF	No conditional storage rights, junior right assumed	Releases are made to three aggregate diversions (Node ID 440511, 440612, and 440688), which were identified as the three diversions to which Little Bear I Reservoir could release water as described in the Agricultural Water Needs Study.	
South Fork II Reservoir	Reservoir	South Fork II Reservoir was originally identified as part of the Yampa River Basin Small Reservoir Study – Phase 2. It was one of three reservoirs carried forward from the Phase 2 study as a need was determined and upon a field visit, no fatal flaws were found. A location, capacity, and yield were determined as part of the study.	Yampa: Fortification Creek Basin	1,700 AF	No conditional storage rights, junior storage right assumed	Releases are made to seven aggregate diversions (Node ID 440511, 440612, 440647, 440650, 440681, 440688 and 440998), which were identified as the seven diversions to which South Fork II Reservoir could release water as described in the Agricultural Water Needs Study.	
Monument Butte Reservoir	Reservoir	Monument Butte Reservoir was originally identified as part of the Yampa River Basin Small Reservoir Study	Yampa: Morapos Creek Basin	4,390 AF	No conditional storage rights, junior storage right assumed	Releases are made to four aggregate diversions (Node ID 440590, 440651, 440814, and	

Name	Type	Description	Location	Capacity	Storage Right	Operations	Additional Source
		– Phase 2 (Montgomery Watson 2000). It was one of three reservoirs carried forward from the Phase 2 study as a need was determined and upon a field visit, no fatal flaws were found. A location, capacity, and yield were determined as part of the study.				aggregate diversion 44_ADY016A), which were identified as the diversions to which Monument Butte Reservoir could release water to as described in the Agricultural Water Needs Study.	
Rampart Reservoir	Reservoir	Rampart Reservoir was originally identified as part of the Yampa River Basin Small Reservoir Study – Phase 2. Based upon preliminary field reconnaissance and subsequent screening, Rampart Reservoir was not recommended for further analysis due to being a historical area[14], sediment load, extent of dam, need to relocate Highway 13, and location on federal land (Bureau of Land Management). During the October 3, 2013 subcommittee meeting, Tom Gray suggested that due diligence was recently	Yampa: Lower Fortification Creek upstream of Wisconsin Ditch	12,133 AF	▪ A first fill water right with administration number 41126.00000 and conditional storage of 12,133 AF ▪ A second fill water right with administration number 47905.00000 and conditional storage of 11,692 AF	▪ Since Rampart Reservoir is only located upstream of two potentially short water diversions (the oxbows aggregate diversion and Node ID 440511), releases are made to the oxbows aggregate diversion and Node ID 440511 ▪ The second set of operations for Rampart Reservoir is to exchange water upstream to South Fork II and Little Bear I ▪ The last set of	

[14] Fortification Rocks are a historic landmark and were used as fortresses by Native Americans.

Name	Type	Description	Location	Capacity	Storage Right	Operations	Additional Source
		performed on a conditional storage right for Rampart Reservoir and that it should be considered as an IPP.				operations for Rampart Reservoir is to exchange water upstream to each individual diversion on Fortification Creek	
Peabody Trout Creek Reservoir	Reservoir	Peabody-Trout Creek Reservoir was identified as part of a supply project to meet energy development demands for the Peabody energy development demands described in Section 3.2.1.4. Modeling for the Peabody-Trout Creek Reservoir supply project was performed by ERC. A model was received from ERC and details of the modeling were clarified through personal communications (Thompson 2013).	Yampa: Trout Creek upstream of the confluence with the Yampa River	11,720 AF	A first fill water right with administration number 43575.00000 and conditional storage of 15,000 AF	The sole purpose of the Peabody-Trout Creek Reservoir is to meet the 6,000 AFY energy development demands (which do not have a direct diversion water right) that are also part of the Peabody-Trout Creek Project	
Milk Creek Reservoir	Reservoir	Details for Milk Creek Reservoir were discussed through personal communications with Tri-State Generation & Transmission Association (Chartrand 2013). Milk Creek Reservoir is part of a potential industrial supply project to meet future	Yampa: Milk Creek Reservoir upstream of the confluence with the Yampa River	70,000 AF	▪ An existing conditional water right with a 1976 date of decree of 70,000 AF; however, this is only for industrial beneficial uses. At the request of the BRT subcommittee, Milk	▪ Similar to Rampart Reservoir, Milk Creek Reservoir cannot release to any water short diversions on upper Milk Creek; however, releases are made to the Yampa River oxbows	▪ Additional Source – Yampa River - Milk Creek Pipeline - The Yampa River - Milk Creek Pipeline is also part of the Milk Creek Project. The Yampa River - Milk Creek Pipeline is used to fill Milk Creek Reservoir using water from the Yampa River.

Name	Type	Description	Location	Capacity	Storage Right	Operations	Additional Source
		energy development demands. Although Milk Creek Reservoir currently has storage rights for industrial beneficial uses only, the BRT subcommittee requested that Milk Creek Reservoir be modeled for both industrial uses and agricultural uses.			Creek Reservoir was modeled for agricultural and industrial uses. For the Projects and Methods Study, this conditional right maintained its 1976 water right date, but the industrial storage was reduced to 35,000 AF. ▪ The remaining 35,000 AF of storage is filled using an undecreed water right for agricultural uses.	diversion. ▪ Milk Creek Reservoir also exchanges to all diversions upstream on Milk Creek if exchange capacity exists on the creek. ▪ No operations were defined for the industrial storage account	- The following characteristics were determined from case number 08CW86: the pipeline has a 400 cfs conditional water right (administration number = 45923.00000). However, this water right is for industrial beneficial uses only (similar to the storage right for Milk Creek Reservoir). The pipeline water right was also split in half to fill both storage accounts (industrial and agricultural). The industrial half retained its water right seniority, but the rate was reduced to 200 cfs. The agricultural portion uses an undecreed water right also with a 200 cfs rate.
Morrison Creek Reservoir	Reservoir	Details for Morrison Creek Reservoir were discussed through personal communications with UYWCD through their modeling team from AMEC (Musleh 2013). The modeling approach used to include Morrison Creek	Yampa: Morrison Creek	4,965 AF	There are two storage rights for Morrison Creek Reservoir, a first fill and a second fill. The first fill right has a 4,965 AF conditional water right (administration number = 41272.39991) and the second fill has a 5,655 AF	▪ Releases to augment Stagecoach reservoir supplies ▪ Releases to Craig ▪ Releases to Walker Irrigation Ditch ▪ Releases to Mount Werner Water ▪ Releases are made	▪ Additional Source – Morrison Creek Pipeline - A 50 cfs conditional water right (administration number = 52959.00000) above Morrison Creek Reservoir was studied by the UYWCD. The modeling received from AMEC that

Name	Type	Description	Location	Capacity	Storage Right	Operations	Additional Source
		Reservoir into the Projects and Methods model was directly derived from the modeling used in the UYWCD model sent via email (dated 7/26/2013). Morrison Creek Reservoir is part of a potential supply project to meet future demands in a similar manner to Stagecoach Reservoir.			conditional water right (administration number = 57676.00000).	to Steamboat Wells A, G, and H from the "First Fill" pool ▪ A bypass to the Willow Spring & Pond ISF	was used in this study did not have any operations assigned and did not transfer water within the model.
Lake Avery Enlargement	Enlargement	The Lake Avery Enlargement was identified in the Energy Development Water Needs Assessment as part of the oil shale production supply system. The Lake Avery Enlargement is the secondary source of supply used in the oil shale production supply system (after direct diversions from the White River).	Expansion to Big Beaver Reservoir (Avery Lake)	48,274 AF + 7,658 AF (original capacity of Big Beaver Reservoir)	▪ The purpose of the Scenario 2 and 3 models of the Energy Development Water Needs Assessment was to reliably meet oil shale production demands with rights junior to all other diversions in the basin. That methodology was also used in the Projects and Methods Study. Therefore it is modeled with an undecreed water right. ▪ The Lake Avery Enlargement is filled	The only operation for the Lake Avery Enlargement is making direct releases to meet oil shale production demands	

Name	Type	Description	Location	Capacity	Storage Right	Operations	Additional Source
					both by a pipeline diverting water from the White River upstream of Big Beaver Creek and a direct storage right on Big Beaver Creek.		
Wolf Creek Reservoir	Reservoir	Wolf Creek Reservoir was identified in the Energy Development Water Needs Assessment as part of the oil shale production supply system. The Energy Development Water Needs Assessment recognized that under current conditions, oil shale production demands can be met using the other elements in the oil shale production supply system (Lake Avery Enlargement, Diversion from White River to fill Lake Avery, Direct Diversion from the White River (above Piceance Creek) to meet Oil Shale Demands). However, Wolf Creek Reservoir was used as an IPP in the model to demands under some of the Modeling Scenarios with drier hydrologies.	On the White River downstream of the confluence with Piceance Creek	162,400 AF	▪ The purpose of the Scenario 2 and 3 models of the Energy Development Water Needs Assessment was to reliably meet oil shale production demands with rights junior to all other diversions in the basin. That methodology was also used in the Projects and Methods Study; therefore, it is modeled with a 2013 water right. ▪ The only water right Wolf Creek Reservoir uses to store water is an undecreed water right on the White River	Water from Wolf Creek Reservoir is transported upstream via carrier to directly meet oil shale production demands.	

APPENDIX B

PUBLIC EDUCATION MATERIALS

AND PUBLIC COMMENTS

Table of Contents

To: Hanna Sloan
Engineer, AMEC

July 24, 2014

From: Marsha Daughenbaugh, Executive Director
Community Agriculture Alliance

Subject: Yampa-White-Green Rivers BIP Outreach Report

Basin Implementation Plan Outreach for Public Review and Input

Notification Included:

Print Ads in Craig Press and Steamboat Pilot

Radio Ads and PSAs on KRAI

Email postcards (for further outreach distribution) to:

Round Table members, three county + eight community governments, chambers of commerce, CSU Extension offices, 36 different organizations in Moffat, Rio Blanco and Routt Counties

YAMPA-WHITE-GREEN RIVERS BASIN ROUND TABLE

IS SEEKING PUBLIC INPUT ON THE

BASIN IMPLEMENTATION WATER PLAN

The document can be found on the Colorado Water Conservation Board (CWCB) website at:
http://www.colorado.gov/pacific/cowaterplan/yampa-white-green-river-basin

Written comments may be submitted in any of the following ways:

1. Add comments to the documents from the CWCB website and email to hillary.king@amec.com by July 21 (preferable way)
2. Print, mark-up the documents, scan and email to hillary.king@amec.com by July 21
3. Email comments to hillary.king@amec.com by July 21
4. In Person: Round Table Meeting, Wednesday July 23, American Legion Hall, Craig; 6PM

The Yampa-White-Green Basin Implementation Plan will become a part of the Colorado Water Plan. Information about the Colorado Water Plan can be obtained at the CWCB web link:
www.coloradowaterplan.com

Public review and input is encouraged and will be reviewed by the Yampa-White-Green Round Table at their October 15, 2014 meeting.

YAMPA-WHITE-GREEN RIVERS BASIN ROUND TABLE

IS SEEKING INPUT ON THE BASIN IMPLEMENTATION WATER PLAN

The document can be found on the Colorado Water Conservation Board (CWCB) website at:
www.colorado.gov/pacific/cowaterplan/yampa-white-green-river-basin

Written Comments may be submitted in any of the following ways:

1. Add comments to the documents from the CWCB website and email to hillary.king@amec.com by July 12 (preferred).
2. Print, mark-up the documents, scan and email to hillary.king@amec.com by July 21.
3. Email comments to hillary.king@amec.com by July 21
4. In Person: Round Table Meeting, Wednesday July 23, American Legion Hall, Craig; 6pm

The Yampa-White-Green Basin Implementation Plan will become a part of the Colorado Water Plan. Information about the Colorado Water Plan can be obtained at the CWCB weblink: www.coloradowaterplan.com

Yampa-White-Green BIP
Response to Public Comments Matrix

Commenter Name	Organization	Date received	Comment	Response to Comments	Change in Plan? Y/N	e-mail address
Anthony D'Aquila		3/12/2014	GOAL #1: No new inter-basin transfers or withdrawals from the Yampa/White/Green River Basin unless all reasonable alternatives have been fully implemented, to include water conservation programs, demand management programs, tiered water pricing policies, and reclaim / re-use programs.			adaquila@tampabay.rr.com
			GOAL #2: The Colorado Legislature to establish and approve mandatory daily water consumption goals for every public and otherwise regulated water utility in the state to strive to achieve. Recommended goal is 120 gallons per person per day or less.			
			GOAL #3: That Colorado's state and federal legislators will represent these goals in their negotiations with our neighboring states, the federal government, and the various regional and national planning and water regulatory commissions and agencies. State and federal legislators should object to additional out-of-state water supply commitments from Colorado unless receiving entities have likewise adopted more stringent water conservation and demand reduction measures.			
			GOAL #4: Water policy and planning in our Yampa-White-Green Basin and preferably state-wide must be integrated and holistic, considering the full spectrum of impacts and benefits to ecosystems, communities, and businesses.			
Ben Beall	Yampa River System Legacy Partnership / America's Great Outdoors	3/14/2014	GENERAL PRINCIPLES: Protect the flows in the Yampa River and its tributaries, all of which support agriculture and the outdoor and water-based recreation economies of communities found throughout the Yampa River Basin. (Requirement One of Gov. Hickenlooper's Executive Order for the CWP.)			
			Protect the flows of the Yampa River and its tributaries in order to protect the natural resources and ecology of Northwest Colorado for future generations. (Requirement Three of Gov. Hickenlooper's Executive Order for the CWP.)			
			Protect current and future flows of the Yampa River in light of the potential effects of Compact Calls or climate change.			
			SPECIFIC PRINCIPLES: Protect agricultural water in order to preserve agricultural lands.● Encourage preservation of irrigated agricultural lands through voluntary, incentive-based programs such as conservation easements and alternative agricultural water transfer methods (interruptible supply agreements).			
			Protect the flows of the Yampa River to preserve the native riparian habitat that supports native (and non-invasive, non-native) fish and native birds and native wildlife. ● This includes protection of the globally rare riparian habitat found along certain reaches of the Yampa.			
			Protect the flows of the Yampa River in order to ensure the survival of the four endangered fish. ● Support the goals of the Endangered Fish Recovery Program and the agreement captured in the Yampa River Programmatic Biological Opinion (1999-2000).			
			Protect the flows of the Yampa River to ensure both existing and future recreational opportunities will be viable throughout the entire reach of the Yampa River, including opportunities for boaters, hunters, anglers and wildlife watchers. ● The rapidly expanding outdoor recreation industry based around the Yampa River (recreation, retail, manufacturing and travel-related businesses) is a significant component of the Northwest Colorado economy.			
Kevin McBride	Upper Yampa Water Conservancy District	4/10/2014	Letter from John V. Redmond approving of the process of the Upper Yampa Water Conservancy District, Yampa-White-Green Basin Roundtable's White Paper. Identified need for equitable apportionment, opposes trans-mountain diversions from CO River Basin			

Yampa-White-Green BIP
Response to Public Comments Matrix

Commenter Name	Organization	Date received	Comment	Response to Comments	Change in Plan? Y/N	e-mail address
Stephanie Scott	Colorado Trout Unlimited	5/2/2014	Proposed 4 guiding principles for the State of Colorado as a whole: 1. The Colorado Water Plan must include meaningful efforts to protect and restore healthy rivers and streams and environmental and recreation uses of water.			
			2. Basin implementation plans need to help refine the municipal supply "gap" at a local level.			
			3. Filling the municipal water supply gap requires a balanced strategy emphasizing efficient use of Colorado's limited water supplies. **3.a.** High water conservation targets should be reflected in basin implementation plans. **3.b.** Water re-use should be an increasing part of meeting future water needs. **3.c.** Alternative transfer mechanisms and improved agricultural efficiency should be used to meet growing needs while maintaining agriculture and protecting Colorado's environment. **3.d.** Better integration of water supply systems can help increase efficient use of Colorado's water. **3.e.** Structural projects to bolster water supply should avoid harmful effects to rivers and local communities. **3.f.** A new large trans-basin diversion from the Colorado River is not the answer for meeting Front Range needs.			
			4. Laws and policies to facilitate creative water management should be encouraged.			
Marsha Daughenbaugh	Community Agriculture Alliance	6/18/2014	Agricultural water rights in Northwest Colorado should be protected and enhanced by the CWP. Existing agricultural water rights, both pre-Colorado River and post Compact water rights, must be protected.			
			Agriculture in Northwest Colorado must be viewed equally with agriculture and industry throughout the state of Colorado. The agricultural interests in one part of the state should never be elevated over the agricultural interests in another part of the state.			
			Agriculture water rights in Northwest Colorado proved a cornerstone of all other economies in the region; recreation, environment, retail, social, municipal, residential and industrial. Agriculture water must be protected and enhanced for the other sectors to succeed.			
			Future agricultural needs in Northwest Colorado must be considered and planned for in the CWP.			
			The principal of equal apportionment of water resources throughout the state must be a corner stone of the CWP to protect the Yampa, White and Green basin in Northwest Colorado from disproportionate impacts of a Colorado river Compact call.			
			Any consideration of the "New Supply" in the form of transmountain diversions from the West Slope to the East Slope should not threaten western slope water rights, including increasing the chances of a Colorado River Compact call.			
			The CWP should promote water conservation in each basin to fully utilize the available water supply within each basin before any "new supply" trans-basin diversions are considered. Under no circumstances should agriculture be penalized for more efficient water use methods.			
			The importance of non-consumptive benefits provided by flood irrigation should not be under-estimated in the CWP. The historic use of agriculture water rights provides a river flow regime that helps maintain wetlands, recharge alluvial aquifers, provide late season flows to downstream users and augment minimal stream flows which help mitigate environmental concerns, including threatened and endangered species.			
			Water quality and quantity are inextricably linked. Therefore, water quality as well as quantity must be considered a fundamental goal of the CWP. The health of all stakeholders can only be served if the quality of the water continues to support healthy agriculture and ecosystems through which it flows.			
			Future municipal and industrial water supply projects that incorporate agricultural and non-consumptive water supplies must be prioritized over single- or limited-use water supply projects.			
			The stewardship that agriculture continues to provide to wildlife and riparian habitat through the use of Best Management Practices (BMPs) by maintaining open space through authentic working landscapes and conservation easements must be protected and enhanced in the CWP.			

Yampa-White-Green BIP
Response to Public Comments Matrix

Commenter Name	Organization	Date received	Comment	Response to Comments	Change in Plan? Y/N	e-mail address
John Adams (submitted by Thomas Korver)		7/21/2014	In summary, the Morrison Creek Reservoir is inconsistent with the goals of preserving agriculture and agricultural water use and no demonstrable need for Morrison Creek Reservoir should be fully demonstrated, and the impacts of the Reservoir should be fully addressed, before there is any further consideration of the Reservoir as an IPP. Unless such additional analysis is undertaken, Morrison Creek Reservoir should be removed from the IPP list.			tkorver@petros-white.com
Kari Harden (on behalf of Lou Dequine, the Dequine family, the Germaine family, and Kim Singleton)		7/21/2014	As the landowners (for multiple generations) of close to 90 percent of the property proposed for conversion into Morrison Creek Reservoir, we are open to the idea of the project on the condition that it operates and functions in a manner that is reasonable, respectful, sustainable, and aesthetic. We have been in discussion with the Upper Yampa Water Conservancy District (UYWCD) for many years about the potential reservoir, and as families whose homes and livelihoods depend on this land, have carefully considered the personal tradeoffs. The proposed site of the reservoir includes valuable agricultural and recreational land, as well as favorite fishing grounds and the wedding locations of our daughters and granddaughters. We have been engaged throughout this process with the UYWCD regarding the specifics of the construction and operation of the reservoir. One primary concern discussed has been minimizing the draw down in order to minimize mudflats in the shallow areas. We have also agreed upon non-motorized recreational use, minimal traffic impacts, and private shoreline. Upon weighing the costs and benefits of the project as it relates to the land to which we are all deeply devoted, we have worked to also keep at the forefront what is best for the Yampa Valley community and state of Colorado. We support the Morrison Creek Reservoir project – but only with the inclusion of the aforementioned matters that relate directly to our continued quality of life on the land we have fought to preserve and the natural resources we have worked to conserve.			kari.deq.harden@gmail.com lou@dequine.com
Richard Saterdal		7/21/2014	We at the Morrison Divide Ranch subdivision, along with our neighbors, have been following the proposed Morrison Creek Reservoir with great interest since we first heard about this project in 2007. There is quite a bit of information available regarding this reservoir including information that is pertinent to the Yampa-White-Green Basin Implementation Plan (YWG BIP). The proposed Morrison Creek Reservoir is given prominence in the draft YWG BIP by being one of only five projects and processes called out by name in the executive summary. This reservoir is described in Chapter 4 where its purpose, capacity, storage right, cost and challenges are addressed in Table 4-4 of the draft YWG BIP. But much of this information has not been filled in yet in this table. For instance, Table 4-4 does not include a cost estimate for this project. However, Resource Engineering prepared a reservoir feasibility study report for the Upper Yampa Water Conservancy District (UYWCD) in 2009 that estimated the cost of this project to be $20,300,000. Many of the challenges to making this reservoir a viable project and to getting the necessary permits and approvals are also known and should be included in Table 4-4. Construction of the proposed Morrison Creek Reservoir will destroy wetlands and encroach into the Sarvis Creek Wilderness area, requiring a challenging permitting and approval process. This reservoir will also destroy prime agricultural hay and meadowlands, as shown below, as well as inundate areas designated by the Colorado Division of Wildlife as severe winter elk habitat.			cleanwater@pcisys.com

Yampa-White-Green BIP
Response to Public Comments Matrix

Commenter Name	Organization	Date received	Comment	Response to Comments	Change in Plan? Y/N	e-mail address
			The proposed Morrison Creek Reservoir will also disrupt and deplete the natural flow of the outstanding trout stream below the Morrison Creek dam, especially since the UYWCD wants to transfer via pipeline the water stored in this reservoir out of the Morrison Creek basin and into Stagecoach Reservoir. The water rights that the UYWCD has for Morrison Creek water are very junior water rights, and for this reason there is a substantial risk that the UYWCD will be unable to store water in Morrison Creek Reservoir in dry years or periods of high demand. There is also community opposition, technical and cost challenges that the project must overcome. The benefits of this reservoir must outweigh the drawbacks in order for it to be a viable project. These issues should be listed in Table 4-4 to convey some of the challenges that the proposed reservoir project must overcome.			
			Chapter 2 of the draft YWG BIP discusses environmental needs, including instream flows. It is my understanding that the Colorado Water Conservation Board (CWCB) has in recent years obtained decreed instream flow water rights for Morrison Creek downstream of the proposed Morrison Creek Reservoir for the protection of aquatic life, but that these rights are junior even to the UYWCD's water rights. This reservoir will therefore not be required to be operated in a way that maintains minimum flows in the creek. The CWCB has discussed instream flows below the reservoir with the UYWCD and should be able to provide an accurate assessment of the potential impacts of the reservoir on instream flows for the YWG BIP.			
			Table 2 14, Attributes of Major Stream and Lake Segments, does not include Morrison Creek. However the UYWCD has done a study that identified wetland plant communities at the proposed Morrison Creek Reservoir site that will require a U.S. Army Corps of Engineers 404 permit before the reservoir can be built. The section of Morrison Creek below the proposed reservoir site is also an excellent trout stream.			
			Table 2 15, Annual Instream Flow Target and Baseline Modeled Flows, does not list instream flow targets and baseline flows for Morrison Creek below the proposed reservoir, nor is this stream segment listed in Table 2 16, Monthly Instream Flow Targets and Percentage of Modeled Years that Reached the Target. Morrison Creek instream flow modeling results are also not included in Section 3.4.2, Environmental and Recreational Shortages. These things should all be provided for Morrison Creek in the YWG BIP in order to help evaluate the potential impacts of Morrison Creek Reservoir.			
			Figure 2-10 indicates that Morrison Creek below the proposed reservoir was not modeled. For this reason, when instream flows are discussed in Section 3.4.2, there are no impacts shown or discussed for Morrison Creek below the reservoir for any of the modeling scenarios. Since this reservoir will have enormous impacts on the instream flows below it, that section of Morrison Creek should be modeled and included in the YWG BIP. For the time being, in the absence of modeling results, the CWCB assessment of reservoir impacts should be summarized in the YWG BIP so that readers of the report do not get the mistaken impression that the reservoir will not have any impacts on instream flows.			
			Chapter 3 discusses current and future water shortage analyses, including the Dry Future Identified Project and Process Scenario (IPP) which includes projects such as the proposed Morrison Creek Reservoir, and the Dry Future Scenario, which does not include projects such as the Morrison Creek Reservoir. The conclusion that many of the readers of the YWG BIP may come to is that each of the identified projects and processes modeled contribute to some of the benefits gained by implementing all of these identified projects and processes. But this is not necessarily true. Since the water rights that the UYWCD has for Morrison Creek water are very junior water rights, the UYWCD may be unable to store water in Morrison Creek Reservoir in dry years or periods of high demand. So this reservoir may not be able to provide any benefits in these scenarios.			

Yampa-White-Green BIP
Response to Public Comments Matrix

Commenter Name	Organization	Date received	Comment	Response to Comments	Change in Plan? Y/N	e-mail address
			The YWG BIP results need to show what benefits each individual project and process provide in each scenario in order to determine whether or not an individual project or process is effective. The YWG BIP also needs to describe important operational assumptions for the projects, such as whether or not Morrison Creek Reservoir was modeled to protect instream flows. Operational assumptions could be briefly described in Table 4-4 or in Chapter 3 where the modeling scenarios are discussed. When the Colorado Water Plan is presented to the governor it needs to provide sufficient information to serve as a basis for determining which projects are effective and how they should be operated in order to achieve the desired mix of goals. Based on the information provided in the draft YWG BIP it is impossible to tell whether or not the proposed Morrison Creek Reservoir provides any benefits in the scenarios modeled. The addition of further relevant information for projects such as the proposed Morrison Creek Reservoir and discussion of what benefits each individual project and process provide in each scenario will add tremendous value to the YWG BIP.			
Robert L. Tobin	USGS Hydrologist (retired)	2/24/2014	Plans for effective and optimal water management for the beneficial uses by residents within a river basin should include water quality and quantity information. The YWG BIP does not address these issues. A USGS summary report of water quality characteristics and variations for a 15 year period for the White River was included with the comment.			

COLORADO'S WATER PLAN

coloradowaterplan.com

cowaterplan@state.co.us

Direct 303-866-3441

Cover Sheet for Input Document, Item #10

The document listed below was submitted as formal input for Colorado's Water Plan. A summary of the document, including a staff response and/or recommendation is included in the master spreadsheet included within this packet.

Date: March 12, 2014

Input provided by: Anthony D'Aquila

Method of submission: Online General Input Webform at www.coloradowaterplan.com

Summary of Input: Comments regarding the Yampa/White/Green Basin Implementation Plan.

Documents Submitted for Review: Comments in attached letter

Staff Response: CWCB Staff will forward the attached letter to the Yampa/White Green Basin Roundtable for review.

Comments to the Yampa/White/Green River Basins Roundtable

I wish to provide the following initial comments to the Basin Implementation Planning process. You have a tremendous responsibility, as in my perspective, this undertaking is perhaps the most crucial public planning effort Colorado will face in this century.

To bring the key points of my comments up front, I propose the following three goals.

GOAL #1: No new inter-basin transfers or withdrawals from the Yampa/White/Green River Basin unless all reasonable alternatives have been fully implemented, to include water conservation programs, demand management programs, tiered water pricing policies, and reclaim/re-use programs.

GOAL #2: The Colorado Legislature to establish and approve mandatory daily water consumption goals for every public and otherwise regulated water utility in the state to strive to achieve. Recommended goal is 120 gallons per person per day or less.

GOAL #3: That Colorado's state and federal legislators will represent these goals in their negotiations with our neighboring states, the federal government, and the various regional and national planning and water regulatory commissions and agencies. State and federal legislators should object to additional out-of-state water supply commitments from Colorado unless receiving entities have likewise adopted more stringent water conservation and demand reduction measures.

GOAL #4: Water policy and planning in our Yampa-White-Green Basin and preferably state-wide must be integrated and holistic, considering the full spectrum of impacts and benefits to ecosystems, communities, and businesses.

Background

For too long water policy focused on the supply-side of the argument. Demand-side programs need to be the primary mechanism in resolving our water shortages and developing long term solutions.

Colorado is the leader in the Mountain West in many areas of innovation and technology. We must be the leaders in terms of water policy and water conservation as well.

All aspects of water conservation should be investigated and applied vigorously where appropriate. All water users must be party to water conservation efforts. This includes the agricultural sector, ranchers and farmers. Antiquated methods of irrigation, such as open-ditch transport of water or broadcast spraying, must be phased out and replaced with best management practices (BMP's) such as drip irrigation and moisture content-controlled application, that conserve water, utilize reclaimed water, and minimize loss and waste.

Goal 1 is meant to convey a serious message concerning short-sighted water policy planning. Increasing supply before implementing alternative solutions to reduce demand is a short-sighted policy decision. Moving water from a remote basin to provide increased supply in another region in not only wasteful of resources, it is contrary to good policy or planning. Aiming to increase supply without addressing demand management is treating the symptom and not the cause. The streamflow that exist in a system

such as the Yampa River is not a “surplus” resource, it is an intrinsic component of that particular ecosystem and plays a role in all receiving downstream communities. Withdrawal and removal from those systems will be detrimental and cause economic and ecological harm. It would be detrimental to our community, to our ranchers and farmers, and to our businesses dependent upon a robust summer and winter outdoor recreation industry. Further, any use of such a mechanism as a future withdrawal and inter-basin transport should be as a last recourse, after all alternative mechanisms available to the proposed receiving basin have been fully implemented, and then only if a requirement still exists.

Key to achieving reduced potable water demand is to implement policies and programs to encourage demand reduction. That is the purpose behind Goal 2. As reported within the SWSI, the per capita daily consumption throughout the whole of Colorado exceeds 200 gallons per day. That is far out of line with the water consumption standard many, many other communities across the nation have already achieved. For a state hovering on the brink of water supply disaster, it is critical to reduce our per capita demand. We can do better, and need to implement programs to drive that demand for water down to the 120 gallon per capita per day average. Tiered water pricing strategies and programs to encourage water savings, such as rebates for low flow toilets and water saving appliances, must be considered. Likewise, planners need to recognize we live in an arid environment. Xeriscaping and severe limitations on lawn irrigation must be implemented. Our metropolitan areas and urbanized areas serviced by advanced wastewater treatment systems must implement reclaimed and recycled water programs and begin to distribute reclaimed water to industrial users and for residential lawn irrigation. Those initiatives need to be supported by the state legislature and provided funding as necessary.

If we as Coloradans are successful in implementing these water conservation and demand management programs, then our state and federal legislators will have more standing to defend Goal 3, holding the line on more withdrawals from our state to other regions.

Implementing good water policy and programs need not require us to choose between agriculture and urban users, or to short change the environment. If we use integrated management and careful analysis of benefits and impacts, we can achieve balance. We do not need to choose between the lesser of two evils, if we plan better and seek mutually compatible and supportive results. For example, a surface water impoundment can exist as a system of ponds and wetlands beneficial to wildlife and outdoor recreation use.

Thank you for the opportunity to express these opinions.

Sincerely,

Anthony J. D’Aquila
2315 Ski Trail Lane, #21
Steamboat Springs, CO 80478
adaquila@tampabay.rr.com

mailing address:
P.O. Box 771239
Steamboat Springs, CO 80477-1239

COLORADO'S WATER PLAN

coloradowaterplan.com

cowaterplan@state.co.us

Direct 303-866-3441

Cover Sheet for Input Document, Item #12

The document listed below was submitted as formal input for Colorado's Water Plan. A summary of the document, including a staff response and/or recommendation is included in the master spreadsheet included within this packet.

Date: March 14, 2014

Input provided by: Ben Beall, Yampa River System Legacy Partnership/America's Great Outdoors

Method of submission: Email to cowaterplan@state.co.us

Summary of Input: Text from email: "I have attached a letter that the Yampa River System Legacy Partnership/ America's Great Outdoors as requested by Jay Gallagher which the Legacy Partnership sent to Jacob Bornstein, Program Manager, CWCB. Last Wednesday, March 12, 2014 the Legacy Partnership submitted a similar letter concerning the CWP to the Yampa/White/Green Roundtable. Thanks for your consideration of the Legacy Partnership Principles in regards to the Yampa River for the CWP."

Documents Submitted for Review: Comments in attached letter

Staff Response: CWCB Staff will forward the attached letter to the Yampa/White Green Basin Roundtable for review.

YAMPA RIVER SYSTEM LEGACY PARTNERSHIP AMERICA'S GREAT OUTDOORS

Continuing the Legacy of the Yampa River

March 6, 2014

Jacob Bornstein, Program Manager
Colorado Water Conservation Board
1580 Logan St., Suite 200
Denver, CO 80203

Mr. Bornstein,

Please find attached comments from the Yampa River System Legacy Partnership to the Yampa/White/Green Basin Roundtable regarding the Basin Implementation Plan and the Colorado Water Plan.

Thank you.

For the Yampa River System Legacy Partnership – America's Great Outdoors

Terry Carwile, Vice-Chairman Legacy Partnership and Mayor, City of Craig on behalf of Ben Beall, Chairman Legacy Partnership and Alternate for Routt County

cc: Yampa/White/Green Basin Roundtable
cc: Governor Hickenlooper

YAMPA RIVER SYSTEM LEGACY PARTNERSHIP
AMERICA'S GREAT OUTDOORS

Continuing the Legacy of the Yampa River

Comments to the Yampa/White/Green Basin Roundtable Regarding Basin Implementation Plan and Colorado Water Plan

The Yampa River System Legacy Partnership – America's Great Outdoors (Legacy Partnership), formed in 1995, is one of the longest established, if not *the* longest, community-based, conservation-oriented organization composed of local, state and federal partners representing both the Upper and Lower Yampa River Basins. The Legacy Partnership operates under a Memorandum of Understanding, which was revised and expanded in 2011 to include goals of the America's Great Outdoors Initiative. The eighteen Partner representatives (along with alternates) from both Routt and Moffat Counties include; county and municipal elected officials; state and federal representatives; conservation, agricultural, business and recreation community members; youth and outdoor job and outdoor education proponents; and public lands and Yampa River advocates. These Partners bring to the Legacy Partnership diversity in experience from both Routt and Moffat Counties that serve the entire Yampa River Basin.

The revised 2011 Legacy Partnership Mission states: *"The Yampa River System Legacy Partnership is a voluntary collaborative, incentive-based project designed to protect and enhance the health of the Yampa River and its tributaries; adjacent agricultural lands and ecosystems; and the wildlife supported by these lands and waters. The YRSLP advances this mission through land conservation activities while providing recreational opportunities compatible with the natural environment of the Yampa Valley. This Legacy mission is closely aligned to and consistent with the recently announced America's Great Outdoors Initiative and is herein updated and revised to address AGO's expanded focus on connecting youth to the natural environment through jobs, environmental education and outdoor experiences along with AGO's focus on river restoration."*

The Yampa River and its surrounding lands are at the core of Legacy's mission and the rationale in submitting the following comments and principles to the Yampa/White/Green Roundtable, the Colorado Water Conservation Board (CWCB), and other interested stakeholders. The Basin Implementation Plan and the Colorado Water Plan (CWP) must take into consideration current and future water needs, both consumptive and non-consumptive, of the Yampa River Basin.

The Yampa River Legacy Partnership's two-decade long commitment has been focused on the importance of the Yampa River, its water and flows, in both the Upper and Lower Yampa River Basins. Legacy's successful program includes projects related to protection of the environment and important wildlife habitat; appropriate river recreation uses; and conservation of the valley's agricultural lands. Thousands of acres of agricultural lands have been conserved

through the Legacy program and over a hundred-thousand acres conserved in the region that complement Legacy's work.

A Non-Consumptive Needs Assessment was completed by the Yampa/White/Green Basin Roundtable. This Assessment identifies and maps key environmental and recreational attributes and activities that are directly tied to the Yampa River and its flows (CWCB 2011 and 2012). The report highlights the importance of protecting the flows of the Yampa River that are critical to sustaining the environmental health of the Yampa River along with those needed to support the river-related outdoor recreational economies of the region. The implications of the study lead to the understanding of the far-reaching significance that the Yampa River has to the region, more than are captured by the report. The Yampa River serves as the foundation for an ever-expanding economy developed around outdoor recreational activities, industries and travel related businesses – all defined as "non-consumptive uses" that depend on the lifeblood of water that the Yampa River provides.

The Legacy Partnership, a local, community-based collaboration, has demonstrated success in addressing projects along the entire reach of the Yampa River. The Partners strongly believe the following principles are important to planning for future water needs in the Yampa River Basin for the citizens of Colorado, those that live in the Yampa Basin and to future generations of Colorado residents. The principles outlined herein address two of the three requirements as mandated in Gov. Hickenlooper's Executive Order for the CWP (D2013-005). The Colorado Water Plan must incorporate: (1) "a viable productive economy including a productive agriculture . . . recreation and tourism industries"; and (2) "a strong environment that includes healthy watersheds, rivers, streams, and wildlife." These requirements align with Legacy's mission and mission success for the Legacy Partnership is dependent on these requirements being met.

Principles for Future Water Needs Planning in the Yampa Basin

General Principles:

1. Protect the flows in the Yampa River and its tributaries, all of which support agriculture and the outdoor and water-based recreation economies of communities found throughout the Yampa River Basin. (Requirement One of Gov. Hickenlooper's Executive Order for the CWP.)

2. Protect the flows of the Yampa River and its tributaries in order to protect the natural resources and ecology of Northwest Colorado for future generations. (Requirement Three of Gov. Hickenlooper's Executive Order for the CWP.)

3. Protect current and future flows of the Yampa River in light of the potential effects of Compact Calls or climate change.

Specific Principles:

1. Protect agricultural water in order to preserve agricultural lands.
   - Encourage preservation of irrigated agricultural lands through voluntary, incentive-based programs such as conservation easements and alternative agricultural water transfer methods (interruptible supply agreements).

2. Protect the flows of the Yampa River to preserve the native riparian habitat that supports native (and non-invasive, non-native) fish and native birds and native wildlife.
   - This includes protection of the globally rare riparian habitat found along certain reaches of the Yampa.

3. Protect the flows of the Yampa River in order to ensure the survival of the four endangered fish.
   - Support the goals of the Endangered Fish Recovery Program and the agreement captured in the Yampa River Programmatic Biological Opinion (1999-2000).

4. Protect the flows of the Yampa River to ensure both existing and future recreational opportunities will be viable throughout the entire reach of the Yampa River, including opportunities for boaters, hunters, anglers and wildlife watchers.
   - The rapidly expanding outdoor recreation industry based around the Yampa River (recreation, retail, manufacturing and travel-related businesses) is a significant component of the Northwest Colorado economy.

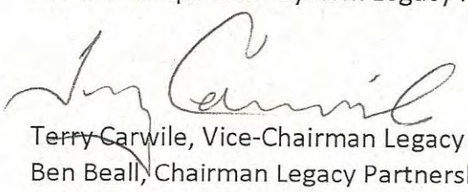
<u>The Future of the Yampa River</u>

The Legacy Partnership understands the importance of water for the Yampa Basin and its residents, economy and visitors. The future of our basin is in jeopardy if we, the citizens and members of the Yampa/White/Green Roundtable, do not accurately evaluate and plan for *all* our future water needs – both consumptive and non-consumptive. If this opportunity to plan appropriately into the future is missed, the Legacy Partnership's accomplishments will be at risk. We also risk the opportunity to secure significant financial resources from local, state and federal partners that have invested in the past and are poised to make additional investments to protect the future of the Yampa Basin, its lands and wildlife.

We are confident the Yampa/White/Green Roundtable will understand the importance of the Yampa River as the only relatively free-flowing river system in Colorado and understand why the Legacy Partnership shares its history, mission and accomplishments in support of the Yampa River. Please let our mission and accomplishments guide your deliberations to ensure that both consumptive and non-consumptive water uses on the Yampa River are protected within the Colorado Water Plan. The Legacy Partnership is proud of our accomplishments and we will continue to advance our mission, to which the Yampa River is critical. The Yampa River

is our legacy and is the foundation upon which the future of the entire Yampa River Valley is based.

For the Yampa River System Legacy Partnership – America's Great Outdoors



Terry Carwile, Vice-Chairman Legacy Partnership and Mayor, City of Craig on behalf of Ben Beall, Chairman Legacy Partnership and Alternate for Routt County

YAMPA RIVER SYSTEM LEGACY PARTNERSHIP – AMERICA GREAT OUTDOORS PARTNERS:

VOTING PARTNERS:
Routt County
Moffat County
City of Steamboat Springs
City of Craig
Town of Hayden
Bureau of Land Management
Colorado Parks and Wildlife (Wildlife Representative)
Colorado Parks and Wildlife (Parks Representative)
Yampa Valley Land Trust
The Nature Conservancy
Agricultural Representative Routt County
Agricultural Representative Moffat County
Recreation Representative
Business Representative
Youth and Outdoor/Environmental Education Representative
Youth and Outdoor Environmental Jobs Representative
Public Lands Representative
Yampa River Representative

NON-VOTING PARTNERS:
US Forest Service
Dinosaur National Monument
US Fish and Wildlife Service
US Geological Service
US Bureau of Reclamation
Colorado Department of Natural Resources
Northwest Colorado Watershed Partnership
Veterans Green Jobs
Routt County Conservation District

COLORADO'S WATER PLAN

coloradowaterplan.com

cowaterplan@state.co.us

Direct 303-866-3441

Cover Sheet for Input Document, Item #48

The document listed below was submitted as formal input for Colorado's Water Plan. A summary of the document, including a staff response and/or recommendation is included in the master spreadsheet included within this packet.

Date: April 10, 2014

Input provided by: Kevin McBride, Upper Yampa Water Conservancy District

Method of submission: Online General Input Webform at www.coloradowaterplan.com

Summary of Input: Letter to the Yampa/White/Green Basin Roundtable (YWGBRT) regarding their support for the YWGBRT's White Paper.

Documents Submitted for Review: Comments in attached letter

Staff Response: The CWCB will send the Upper Yampa Water Conservancy District's letter to the YWGBRT. These comments also helped inform the IBCC discussion during the April 29, 2014 IBCC meeting.

Upper Yampa Water
Conservancy District

April 15, 2014

Mr. Jon Hill,
Chairman, Yampa/White/Green Basin Roundtable
Via email

RE: Yampa/White/Green Basin Roundtable, White Paper

Dear Chairman Hill

The Upper Yampa Water Conservancy District (UYWCD) Board has reviewed and approves of the Yampa White Green Basin Roundtable's (YWGRT) White Paper. The UYWCD Board wants to stress that it agrees with the need for an equitable apportionment for use of local waters. With regards to any additional Trans-Mountain Diversion (TMD) of water from the Colorado River Basin, given concerns about the Colorado River Compact and operational difficulties at Lake Mead and Powell, we are opposed to such diversions.

Before additional TMD's should be considered, some amount of the water resources of local rivers must be available first to those who live here; and that must be agreed upon prior to any additional TMD from the Colorado Basin at any location. The operation of any proposed Trans Mountain Diversion and its impacts on our Basin must be thoroughly understood prior to any agreement. Finally, the construction of such a project must be funded by the beneficiaries of the project and not by State taxpayers.

As the State of Colorado seeks to create a Colorado Water Plan it should not lose sight of the geographic diversity within the State, the variability of water supplies through time, and of particular interest to the Upper Yampa Water Conservancy District, the unique situation in the Yampa River Basin. As the UYWCD seeks to fulfill its mission:

"To lead water resource management within the District's boundaries by responsibly conserving, protecting, developing, providing and enhancing the water resources of the Yampa River Basin. The District will initiate and participate in projects that embody and promote the protection of water rights, provide broad benefits to District constituents and develop projects that provide responsible conservation, responsible growth, beneficial water storage and usage, and public awareness within the Upper Yampa Water Conservancy District".

We appreciate that the State seeks a Basin Implementation Plan that is truly a "bottom up" process, so that local entities can truly lead the process.

Sincerely,

John V. Redmond
President, Upper Yampa Water Conservancy District

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COLORADO'S WATER PLAN

coloradowaterplan.com

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Direct 303-866-3441

Cover Sheet for Input Document, #74

The document listed below was submitted as formal input for Colorado's Water Plan. A summary of the document, including a staff response and/or recommendation is included in the master spreadsheet included within this packet.

Date: May 2, 2014

Input provided by: Stephanie Scott, Colorado Trout Unlimited

Method of submission: Email to Kate McIntire, forwarded to cowaterplan@state.co.us

Summary of Input: Text from email: "Thank you for the opportunity to submit materials to the CWCB Board and also for the time to speak to them at the board meeting. Attached are the final packets that Trout Unlimited has prepared that are specific to each basin. These packets are our suggested content for the basin implementation plans. While we intended on developing comments for all 9 basin we realized that it was best to focus on just the ones attached. We have combined the South Platte and Metro comments into one packet. For the basins that do not have comments we are still pushing our TU Water Plan Principles to be incorporated into the BIP and our members will be involved at the meetings. Those principles are attached to this email in a separate document. After speaking with roundtable representatives it was suggested that we included both broad level and specific detailed comments. Per this request we have gathered and organized the packets into 3 sections to make it easier for the roundtables to incorporate the comments.

· The first section includes broad principles that Trout Unlimited would like to see incorporated into all of the BIPs throughout CO.

· The second includes bullet point comments that are specific to each of the basins.

· The third section lays out each of those bullet points in more detail.

I will be the one speaking at the CWCB Board meeting. I will be presenting these packets to the board and explain the outreach that Trout Unlimited has done on the water plan, emphasize the opportunity for the CWCB Board and Trout Unlimited to work together and give a brief overview of our high level principles. Please let me know if there is anything else that you need."

COLORADO'S WATER PLAN

coloradowaterplan.com

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Documents Submitted for Review: Comments in attached letters

Staff Response: Staff appreciates the considerable work Trout Unlimited (TU) put into the comments provided and will pass each of the basin-specific documents to the respective BRTs. With regard to TU's Water Plan Principles, "meaningful efforts to protect and restore healthy rivers and streams" will be incorporated into Section 5.9 and the BIPs. The CWCB expects that the BIPs will help refine the municipal supply gap and Colorado's Water Plan will emphasize efficient use of Colorado's Water supplies in Section 5.6. The initial draft of Chapter 5.6, released in May for public review, explores conservation and reuse. Colorado's Water Plan suggests that at a minimum and in the near term, Colorado should seek to implement "medium" conservation practices while acknowledging that in the future "high" levels of conservation may be needed depending on which scenario presents itself in Colorado. Section 5.7 is also now available for public review on Alternative Transfer Methods and the BIPs will explore the integration of water supply systems. Overall, TU's Water Plan Principles are consistent with the values expressed in Colorado's Water Plan and the plan will encourage multi-purpose projects. With regard to new transmountain diversion projects, the IBCC is exploring innovative ways to address this issue in a balanced manner. Lastly, CWCB will consider the laws and policies suggested by TU to facilitate creative water management when drafting Section 5.11.

Trout Unlimited's Comments for Colorado's Water Plan

Trout Unlimited's Statewide Colorado Water Plan Principles

Colorado Trout Unlimited's board of directors, which includes representation for 24 local chapters statewide, supported the following core principles as measures that should be reflected in the Colorado Water Plan.

1. **The Colorado Water Plan must include meaningful efforts to protect and restore healthy rivers and streams and environmental and recreation uses of water.** Just as it is important to address consumptive water supply "gaps", the State must also document and address its environmental and recreational supply gap. Healthy rivers are vital to communities, promote property values, support a strong recreation economy, and contribute to the quality of life that makes Colorado a great place to live. Beyond identifying focus reaches with key values for protection and restoration, the Colorado Water Plan should lay out specific actions to assess and quantify environmental and recreational needs in each basin, timelines for implementation of both the needs assessments and projects to provide for those needs, and resources to complete them. By way of illustration, projects could include restoration of river and wetland habitat, appropriation and acquisition of instream flows to protect, enhance and restore the environment, management of new and existing water supply projects to enhance flows, and collaborations with irrigators to increase efficiency and keep more water in-stream. Colorado's Water Plan should ensure that our State continues to enjoy the many ecological, social, and economic benefits of healthy rivers.

2. **Basin implementation plans need to help refine the municipal supply "gap" at a local level.** Planning to meet future water demands depends on understanding what the needs are at a local level, so that strategies can be designed to provide water when and where it is actually needed.

3. **Filling the municipal water supply gap requires a balanced strategy emphasizing efficient use of Colorado's limited water supplies.**

a. **High water conservation targets should be reflected in basin implementation plans.** Water efficiency is the cheapest, fastest, and least environmentally-damaging way to meet growing municipal water needs in communities across Colorado. As technology improves, and with use of incentives to further promote xeric landscaping, water conservation can go a long way in helping fill Colorado's future water supply gap. State policies should promote such conservation efforts throughout Colorado. Our water

resources are limited, and maximizing the efficiency with which they are used must be a cornerstone of statewide water policy.

b. **Water re-use should be an increasing part of meeting future water needs.** Where water can legally be reused to extinction (transbasin water, already converted consumptive use water, non-tributary groundwater), it should be. This is part of maximizing the use of existing (or new) water supplies to meet demands. Necessary infrastructure for treatment and delivery of re-use water should be incentivized with state funding.

c. **Alternative transfer mechanisms and improved agricultural efficiency should be used to meet growing needs while maintaining agriculture and protecting Colorado's environment** Irrigated agriculture provides far-reaching benefits to the economy, environment and quality of life in Colorado**.** The state should support water sharing arrangements – from water banks to rotational fallowing – that can help meet municipal supply needs and maintain healthy rivers while avoiding the social, economic and environmental impacts associated with traditional "buy and dry" transfers. The focus should be on temporary transfers, not permanent fallowing of irrigated ground. State support could include funding support as well as legal and policy changes to reduce the burdens and risks associated with such nontraditional water sharing agreements. The state should also support infrastructure improvements to benefit agricultural operations, healthy flows, recreation, and local communities.

d. **Better integration of water supply systems can help increase efficient use of Colorado's water.** Collaborative efforts among water suppliers can help use strengths in one supply system to bolster weaknesses in another, and vice versa – which will help increase the overall efficiency and reliability with which water can be provided for present and future demands. Partnerships such as those envisioned with the WISE project between Denver Water and south-metro-area suppliers can help responsibly meet water needs more efficiently and effectively than a "go-it-alone" approach.

e. **Structural projects to bolster water supply should avoid harmful effects to rivers and local communities.** Where structural projects are needed to firm water supplies, provide storage for managing water yielded from other strategies like reuse, and otherwise assist in meeting future needs, they should be designed to avoid adverse impacts to environmental and community values. Given the importance of healthy rivers to Colorado's economy and quality of life, it is critical that future projects protect, and where possible enhance, non-consumptive water values. Projects that can provide multiple benefits should be encouraged. Partnerships – such as those under the Colorado River Cooperative Agreement and associated agreements – can be a key part of managing water supplies to provide those multiple benefits.

f. **A new large trans-basin diversion from the Colorado River is not the answer for meeting Front Range needs.** Local, focused projects (such as conservation, re-use, temporary agricultural transfers, and small-scale storage) can be tailored to address community-specific "gaps" in future supply in ways that large, costly transbasin

diversions cannot. Such diversions also create risks of over-development of Colorado's compact entitlements, cause significant environmental impacts, and threaten West Slope agriculture and communities. These projects generate great controversy and conflict, and can result in lengthy, costly permitting processes with uncertain outcomes. Colorado will be better served by the other water supply strategies described above.

4. **Laws and policies to facilitate creative water management should be encouraged.** Current law and policy may be an obstacle to many of the water supply strategies discussed above. Transaction costs and risks to existing water rights can be major roadblocks to creative solutions to better meet Colorado's water needs. Colorado should adopt legislation and policy to help encourage rather than discourage creative arrangements for efficient water supply and water sharing. Current legislative efforts to encourage agricultural efficiency and protect instream values (SB 23) or to allow flexible marketing of water generated through changes within agricultural operations (HB 1026) are examples of changes that can help promote creative solutions for better meeting Colorado's future water supply needs.

TROUT UNLIMITED

To: Yampa, White, Green Rivers Basin Round Table June 18, 2014

LEAD community GROW agriculture CREATE alliance

Agriculture in northwest Colorado is of vital importance, both locally and state wide. Agriculture has provided the economic and cultural engine that has shaped Northwest Colorado for the past 150 years. Much of the region's current diversity is built on the foundation that Agriculture continues to provide economically, socially, recreationally, and environmentally. Therefore, maintaining and expanding the future viability of Agriculture in Northwest Colorado should be a top priority in the Colorado Water Plan.

To that end Community Agricultural Alliance of Northwest Colorado endorses the following principles and values to be incorporated in the Colorado Water Plan ("CWP"). These principles are of equal worth and are not listed in any order of importance.

- Agricultural water rights in Northwest Colorado should be protected and enhanced by the CWP. Existing agricultural water rights, both pre-Colorado River Compact and post Compact water rights, must be protected.
- Agriculture in Northwest Colorado must be viewed equally with agriculture and industry throughout the state of Colorado. The agricultural interests in one part of the state should never be elevated over the agricultural interests in another part of the state.
- Agriculture water rights in Northwest Colorado provide a cornerstone of all other economies in the region; recreation, environment, retail, social, municipal, residential and industrial. Agriculture water must be protected and enhanced for the other sectors to succeed.
- Future agricultural needs in Northwest Colorado must be considered and planned for in the CWP.
- The principal of equal apportionment of water resources throughout the state must be a corner stone of the CWP to protect the Yampa, White and Green basin in Northwest Colorado from disproportionate impacts of a Colorado River Compact call.
- Any consideration of "New Supply" in the form of trans-mountain diversions from the West Slope to the East Slope should not threaten western slope water rights, including increasing the chances of a Colorado River Compact call.
- The CWP should promote water conservation in each basin to fully utilize the available water supply within each basin before any "new supply" trans-basin diversions are considered. Under no circumstances should agriculture be penalized for more efficient water use methods.
- The importance of non-consumptive benefits provided by flood irrigation should not be under-estimated in the CWP. The historic use of agriculture water rights provides a river flow regime that helps maintain wetlands, recharge alluvial aquifers, provide late season flows to downstream users and augment minimal stream flows which help mitigate environmental concerns, including threatened and endangered species.

Community Agriculture Alliance
PO Box 774134
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- Water quality and quantity are inextricably linked. Therefore, water quality as well as quantity must be considered a fundamental goal of the CWP. The health of all stakeholders can only be served if the quality of the water continues to support healthy Agriculture and Ecosystems through which it flows.
- Future municipal and industrial water supply projects that incorporate agricultural and non-consumptive water supplies must be prioritized over single- or limited-use water supply projects.
- The stewardship that agriculture continues to provide to wildlife and riparian habitat through the use of Best Management Practices (BMP's) by maintaining open space through authentic working landscapes and conservation easements must be protected and enhanced in the CWP.

Thank you for the opportunity to provide input on the Basin Implementation Plan. The Board of Directors and Advisors for Community Agriculture Alliance are greatly appreciative of the time, effort and resources expended by each of the Yampa-White-Green Round Table members to assure the protection of water resources in Northwest Colorado.

Sincerely,

Marsha Daughenbaugh
Executive Director

February 24, 2014.

TO: Committee Members Colorado Water Plan

FROM: Robert L. Tobin, Retired USGS Hydrologist

PO Box 1065, Meeker, CO. 81641-1065

(970) 878-4205

RE: Water Quality in the Basin Implementation Plan

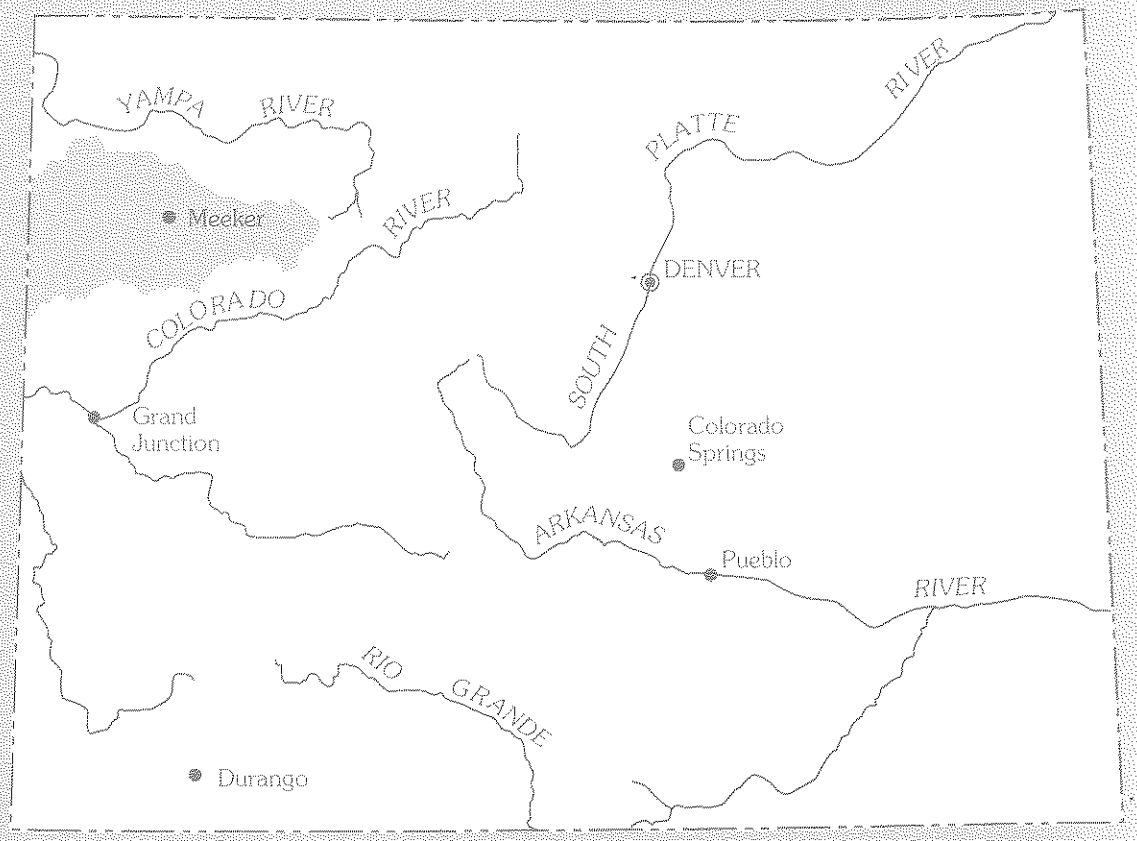
The scope of the Basin Implementation Plan for the Yampa and White River basins, as presented in the handouts at the recent Craig meeting, does not address water quality issues.

Plans for effective and optimal water management for the beneficial uses by residents within a river basin should include water quality and quantity information. The nature of dissolved and suspended constituents that define the water quality of surface and tributary ground water sources, and the variations that occur with changes in flow and seasonal activities, are very important factors for the proper management of both sources. The implementation and /or incorporation of water quality information was not included in the above mentioned handouts.

Enclosed for your information and potential use is a summary report of water quality characteristics and variations for a 15 year period for the White River. The period includes years of record high and low flows in the basin.

SEDIMENT TRANSPORT AND WATER-QUALITY CHARACTERISTICS AND LOADS, WHITE RIVER, NORTHWESTERN COLORADO, WATER YEARS 1975-88

U.S. GEOLOGICAL SURVEY



Water-Resources Investigations Report 92-4031

Prepared in cooperation with the
YELLOW-JACKET WATER CONSERVANCY DISTRICT,
WATER USERS ASSOCIATION NO. 1,
RIO BLANCO COUNTY, and the
COLORADO RIVER WATER CONSERVATION DISTRICT