Appendix E – Water Quality

South Platte Basin Implementation Plan

South Platte Basin Roundtable/Metro Basin Roundtable

Prepared by TDS Consulting, Inc.

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Contents

South Platte River Basin Implementation Plan Water Quality and Watershed-Health Aspects Executive Summary 1
1 Introduction 4
1.1 Background and Purpose 4
1.2 General Physical Setting 4
2 Approaches 4
3 Discussion 5
3.1 Basinwide Characterization 5
3.2 Upper South Platte River Basin 9
3.3 Chatfield (Reservoir) Basin 9
3.4 South Platte in the Denver Metropolitan Area 11
3.5 Bear Creek Watershed 14
3.6 Cherry Creek Basin 16
3.7 Upper Clear Creek Watershed/Standley Lake 16
3.8 Barr Lake/Milton Reservoir 18
3.9 St. Vrain Creek Watershed 19
3.10 Big Thompson River Watershed 20
3.11 Cache la Poudre River Watershed 20
3.12 Northern Plains Basin Tributaries (Lone Tree Creek & Crow Creek) 22
3.13 Southern Plains Basin Tributaries (Box Elder Creek, Kiowa Creek, and Bijou Creek) 23
3.14 Lower South Platte River Basin 23
3.15 Republican River Basin 23
4 Impaired and Threatened Waters 24
5 Summary and Conclusions 26
References 30

Tables

Table 1 - EPA Integrated Report Categories 8
Table 2 - Summary of Watershed/Regional/Subbasin Organizations, South Platte River Basin 26

Figures

Figure 1 - Distribution of Population Centers, South Platte River Basin (Dennehy and others, 1998) 6
Figure 2 - CDPHE Fish-Tissue Monitoring Sites 8
Figure 3 - Chatfield (Reservoir) Basin (Source: Tetra Tech, Inc., 2013) 11
Figure 4 - Sampling along the South Platte River in the Denver Metropolitan Area (Source: SPCURE website) 12

Figure 5 - SPCURE Water quality Monitoring Sites (www.spcur.org) 13
Figure 6 - South Platte River, Northern Denver Metropolitan Area (Source: CDPHE-WQCD, 2012, p. D-13) 14
Figure 7 - Seasonal variations of Total-Phosphorus Concentrations, South Platte River (Strontia Springs) vs. Bear Creek (above Harriman Ditch), Averages of 2000-2010 Data (Source: Hydros Consulting, Inc., 2011, p. 9)..... 15
Figure 8 - Barr Lake/Milton Reservoir Subarea (AMEC Earth & Environmental, 2008) 18
Figure 9 - Saint Vrain Watershed Catchments (Source: JW Associates)..... 19
Figure 10 - Seasonal Variations in Dissolved-Oxygen Concentrations, Big Thompson River at Loveland, CO (Source: J.D. Stednick, Colorado State University, written communication, July 30, 2010)..... 20
Figure 11 – Big Thompson – St. Vrain Watersheds Showing Wetland Sample Sites (Source: CDPHE-WQCD, 2012, p. 122)..... 22
Figure 12 - Irrigation-Diversion Ditch, Lower South Platte River (Source: LSPWCD website) 23
Figure 4-1. South Platte 303d Listed Waterways ..... **Error! Bookmark not defined.**

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South Platte River Basin Implementation Plan Water Quality and Watershed-Health Aspects Executive Summary

A bibliographic review was conducted provide information on water quality and watershed "health", based upon past and recent investigations completed in various watersheds of the South Platte River Basin or for the Basin in its entirety. A brief water quality overview is included for the Republican River Basin. This report summarizes study results and information available from a number of sources, including numerous websites and makes specific recommendations regarding information gaps and future water quality and water-related environmental issues facing the Basin's stakeholders in the future.

Watershed resources management includes stormwater and flood control. Innovative projects are being developed in the Basin that provide water quality and flood control benefits. In addition, numerous studies have dealt with water quality characterization and/or management for large parts of the South Platte River Basin or for the entire Basin. One primary example is the U.S. Geological Survey's study of the Basin's water resources under the auspices of its National Water quality Assessment (NAWQA) Program. The Basin has been delineated into a total of 18 eight digit hydrologic unit codes (so-called HUCs). Only subareas approximately covering the first 12 HUCs are included this review, with descriptions of available information and data provided generally in an upstream-to-downstream order.

This review identifies the range of water quality monitoring data and related information available for the various subareas of the South Platte Basin. A number of the subareas surrounding the Denver metropolitan area, including plains and mountain tributaries, have watershed plans, monitoring reports, source water protection plans, and other investigation reports describing specific issues of concern in water quality or watershed health. The intent of this review was to highlight, subarea by subarea (watershed by watershed) conditions of concern for these attributes and, in some cases, remedial projects or mitigation measures for maintaining or improving these conditions. The concept of sustainable watershed water resources management underlies many of the watershed or subarea based studies cited in this review.

Sustainable management for environmental and recreational attributes is interrelated with water supply complexities and land use changes affecting water quality and land cover, the latter factor being especially critical in the forested, mountain tributary streams flowing into the South Platte River. In this respect, institutional consideration (e.g., Federal vs. private land ownership) plays a role. The role of land management Federal and State agencies, as well as the water resources and environmental protection agencies requiring compliance with the NEPA, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and the Clean Water Act (CWA) regulations is critical to the goal of sustainable water- resources management. In

addition, the Colorado Department of Health and Environment (CDPHE) monitors water quality throughout the State.

From a water quality perspective in the South Platte Basin, the following examples demonstrate the diversity of concerns relative to current and future Statewide planning:

1. Wastewater treatment and reuse are important facets of the Basin's water supplies. Innovative systems are being developed in the Basin to increase water availability for various beneficial uses.
2. Water quality changes, generally beneficial, due to West Slope transfers of water into the Basin.
3. The occurrence and areal extent of agricultural related chemicals (nitrogen or phosphorus compounds, herbicides and insecticides) affecting shallow groundwater resources and eventually downstream streamflow quality.
4. Mountain communities relying upon bedrock wells, providing limited supplies and impacting in some areas by cross-contamination from individual wastewater treatment systems.
5. The threat of emerging contaminants (including pharmaceuticals and personal care products) being only partially removed by current state-of-the-art wastewater technologies and potentially being introduced into water bodies downstream of wastewater treatment facility discharges and septic systems. To date, these types of contaminants remain unregulated, due to low detection limits. However, water supply providers in the Basin are beginning to gather baseline information on these substances.
6. Forested areas of mountain tributaries of the South Platte Basin are being impacted by climate variability, diseases and disturbances affecting trees. This degradation of forested lands is resulting in increased wildfire potential, contribution of organic decomposition and nonpoint source nutrients, and challenges in tree-kill diseases and control of wildfires and increased nutrients.
7. A few of the mountain tributaries have been impacted by historical mining and mine-related activities. These cases (primarily involving the North Fork of the South Platte River, Clear Creek, Boulder Creek, and St. Vrain Creek watersheds), along with the presence of a mineralized zone transecting these watersheds, result in concerns of trace metals concentrations and controls to reduce these through various forms of remedial actions.
8. Cherry Creek and other plains streams move great quantities of sand through their respective watershed each year, increasing sediment and releasing phosphorus.
9. Water supplies provided by municipal water utility entities are regulated by the U.S. Environmental Protection Agency (EPA) and in recent years, these entities have been required to document the water quality of these supplies in annual reports. These reports are important, in that, from year to year, supply sources may well vary, depending on both surface water and groundwater sources.
10. Water resources management includes groundwater resources in the Basin, both alluvial systems interactive with streams and deeper groundwater systems. Bedrock

aquifers of the Denver Basin Aquifer system are a key part of overall supplies in the Denver metropolitan area. Bedrock aquifers in mountainous areas of the Basin provide sufficient supplies for individual wells. Water quality concerns with these groundwater sources may exist and should be taken into account.

11. There are salinity concerns related to wastewater treatment plant discharges and salted roads. These salinity issues can impact both surface water and groundwater supplies.
12. Changing regulatory temperature standards can create additional consumptive use for the additional cooling water needed to meet these standards.
13. Stormwater controls, the need to integrate Clean Water Act (CWA) and Safe Drinking Water Act (SDWA) requirements, and impacts from individual sewage disposal systems (septic systems) are also concerns that merit future consideration.

This report review attempts to cover many, but not all, of the examples provided above. It is hoped that the information contained herein is sufficient to promote deliberations involving these topics, to help to prioritize future investments in maintaining or improving the water quality and watershed health of the South Platte Basin, and to contribute to the overall Statewide water planning process.

1 Introduction

1.1 Background and Purpose

This report, to be appended to the South Platte BIP, is intended to provide information on water quality and watershed "health", based upon past and recent investigations completed in various watersheds of the South Platte River Basin or for the Basin in its entirety. This report summarizes study results and information available from a number of sources, including several websites. The report's last section summarizes the general present conditions involving water quality and watershed health and makes specific recommendations regarding information gaps and future water quality and water related environmental issues facing the Basin's stakeholders in the future.

1.2 General Physical Setting

The South Platte River Basin (Basin) comprises approximately 24,000 square miles (mi^2) and is located principally in the northeastern quadrant of the State of Colorado. Relative small parts of the Basin are located in states of Nebraska and Wyoming. These minor areas impact the lower stream reaches of the South Platte River and are not included within the scope of this assessment. Also, the western part of the Republican River Basin is included in the areal extent of water quailty/watershed health characterization effort documented herein.

2 Approaches

Through his professional experience and personal contacts, the principal investigator (PI) of this study is generally familiar with water quality conditions as well as watershed health issues facing many parts of the Basin. Information regarding these attributes has been supplemented through fairly intensive web-based searches for watershed- or subarea-based entities, data, and information dealing with the issues addressed in this study. The intent is to provide some indication of the range of water quality data, information, and studies providing a comprehensive water quailty/watershed health depiction of the Basin's areal extent.

Numerous studies have dealt with water quality characterization and/or management for large parts of the South Platte River Basin or for the entire Basin. One primary example is the U.S. Geological Survey's study of the Basin's water resources under the auspices of its National Water quality Assessment (NAWQA) Program. Example highlights of several investigations are given later.

Also, the Basin has been delineated into a total of 18 eight digit hydrologic unit codes (HUCs); this delineation is used by the U.S. Geological Survey and other organizations for dealing with the various subareas of the major river basins of the U.S. Of these 18 HUCs, only subareas associated with the first 14 HUCs are considered within the scope of this study. In particular, relatively more interest and information is available for the first seven HUCs (for this Basin, identified as 10190001 through 10190014), located in the upstream (southern) and western (mountain tributaries) areas of the Basin. The

descriptions of available information and data for 12 of these HUCs are provided generally in an upstream-to-downstream order. No information was found for the downstream-most tributary HUCs 10190013 (Beaver Creek) and 10190014 (Pawnee Creek). The HUC-delineated methodology is a logical way to discuss water quailty/watershed health conditions or issues; however, various water quality oriented stakeholder entities do not follow these delineations exactly. Accordingly, the details provided in this assessment generally follow the upstream-to-downstream sequence offered by the 12 HUCs of the Basin but are modified to include information for the various watershed or subarea based organizations dealing with conditions and issues for smaller subareas of the Basin.

3 Discussion

3.1 Basinwide Characterization

An overview of historical water quality conditions was provided in a broader South Platte River Basin assessment study for the Colorado Water Conservation Board by Woodward-Clyde Consultants (1982, pp. 35-40). A USGS bibliography (Dennehy and Ortiz-Zayas, 1993) provides a more extensive list of study reports. As noted above, a primary, more-recent source for the topic of this study is provided by the USGS' NAWQA Program. Many of the USGS studies under this program were completed in the 1990s; therefore, some of the topics addressed in several technical reports are proposed for updating. Nonetheless, water quality issues identified during these investigations are judged largely relevant today and in the future. Four examples of water quality issues were identified and warrant some consideration herein:

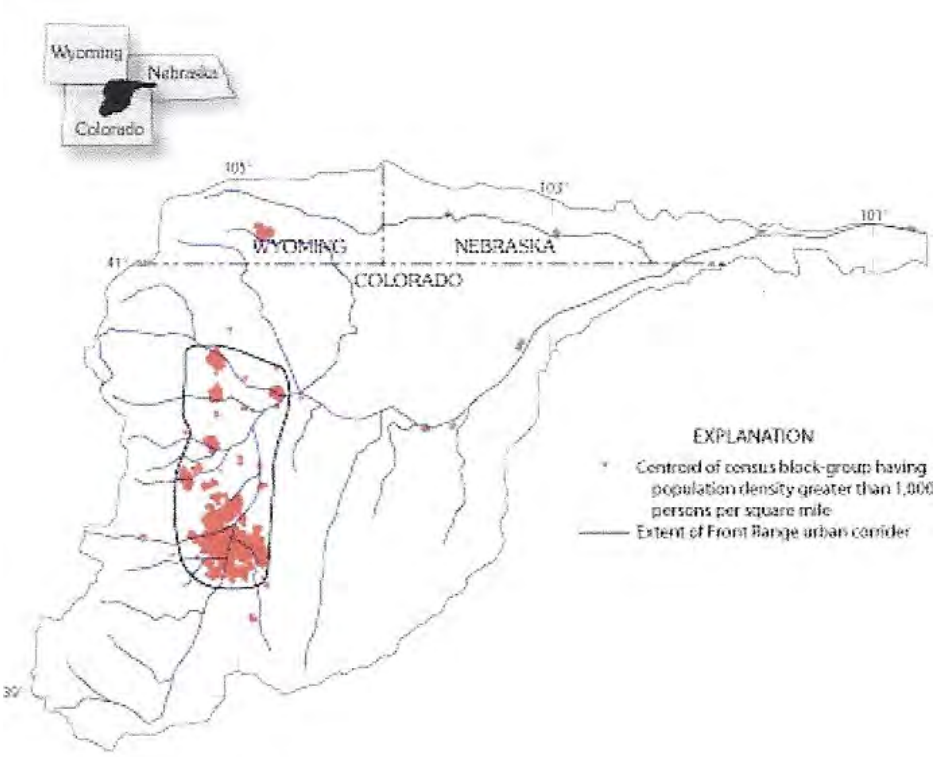
1. Water development and water quality.—Water development began in 1870 in the Basin (Dennehy and others, 1998, p. 8), when the first irrigation ditches were constructed. Over the past 140+ years, irrigated agriculture in the Basin and trans-basin water conveyance into the Basin has significantly altered the "natural" (historical) hydrologic system. These alterations, in addition to increased population growth with needs for water supply and wastewater treatment, have affected the quantity and quality of water in the South Platte River. Besides direct water quality impacts, changes have resulted in a substantial decrease in channel width of the South Platte River, to a greater degree prior to 1938. Considering ground water/surface water interactions is critical to effective water management, especially in the upper and lower stream reaches of the South Platte River.

2. Because agriculture accounts for about 37 percent of the land use in the Basin, impacts of agricultural chemicals (herbicides and pesticides) are of increasing concern. In the NAWQA study, it was estimated that 2 million pounds of active pesticide ingredients have been applied annual in the Basin (Dennehy and others, 1998, p. 16). This trend is due to greater water demands in populated zones (primarily the Denver metropolitan area), requiring innovative water exchange systems in alluvial recharge/withdrawal areas downgradient of these zones in which water is pumped, conveyed by pipeline, and treated for municipal water supplies. Addressing levels of agricultural chemicals, as well as other chemicals of concern,

will be of increasing importance to assure good water quality for potable water supplies.

3. Municipal wastewater treatment plants (WWTPs) are permitted to discharge limited amounts of nutrients. Over the recent two decades, largely due to the total maximum daily load (TMDL) assessment process by the CDPHE, nutrient discharge limits are becoming more stringent. In the basin in the 1990s, 25 WWTPs along the Front Range urban corridor discharged approximately 275 million gallons per day (gpd) of effluent, constituting about 95 percent of the total daily effluent discharge in the Basin (Dennehy and others, 1998, p. 18). About 7,000 tons of nitrogen and 1,200 tons of phosphorus were discharged by WWTPs into the Basin (Litke, 1996). These estimates have decreased in recent years, due to increased WWTP treatment through denitrification and phosphorus removal technologies (www.lewwtp.org/our-process/denitrification).

Figure 1 - Distribution of Population Centers, South Platte River Basin (Dennehy and others, 1998)



4. A NAWQA study examined the effects of different land uses (agriculture, forested, urban, and mixed urban/agriculture) on water quality, using a combination of physical, chemical, and biological information on streams and aquifers (Dennehy and others, 1998, p. 20). Customized ranking schemes and indices were used with each land use classification for assessing land use/water quality interactions impacting different categories of chemical constituents or physical/biological characteristics.

A recent Ph.D. dissertation completed at CSU (Haby, 2011) included an extensive use of available streamflow and water quality (dissolved solids) to assess areal variability and

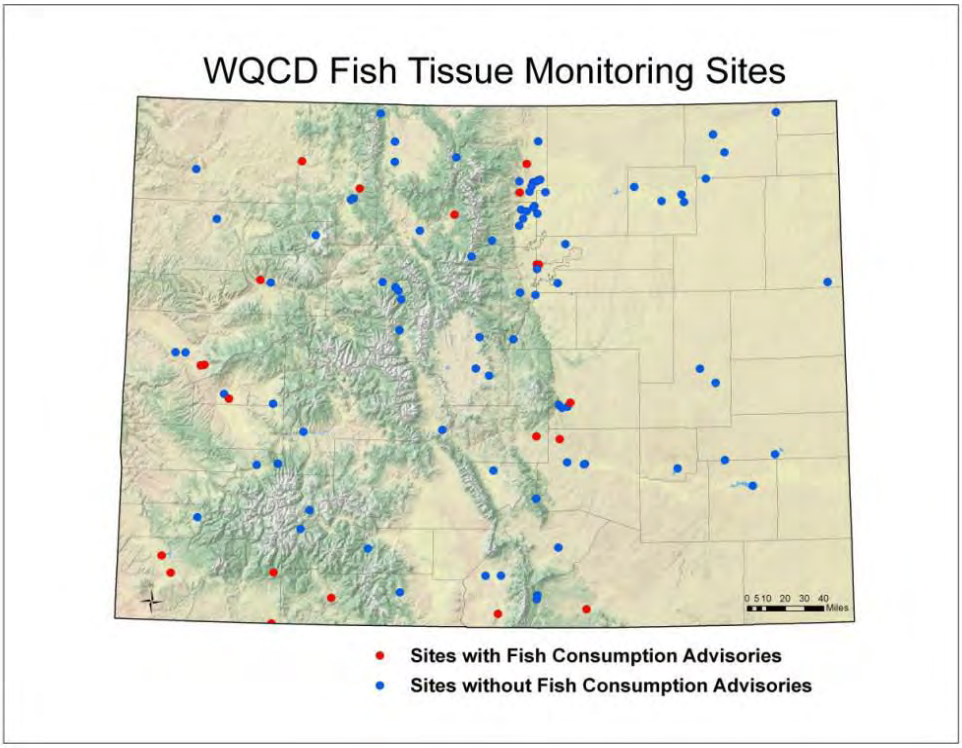
time trends in concentrations and loads of this indicator variable. Another, quite innovative CSU study evaluated the use of fauna species as indicators of groundwater quality (Ward and others, 1989), as applied to the South Platte River system.

A statewide water quality management plan (SWQMP) was developed (CDPHE, 2011) to provide a forum for water quality planning using a watershed based framework. This "living" document (presuming periodic updates are forthcoming as proposed by CDPHE-WQCD) is to assist water policymakers, managers, and others (stakeholders) in setting priorities, developing strategies, and evaluating progress in water quality protection and restoration efforts. Chapter 11 of this initial SWQMP document deals with the Platte River Basin (including the part of the North Platte River in Colorado). This is a useful compendium of information on water quality information as well as ecology, stream standards, and completed total maximum daily loads (TMDLs) assessment studies and plans for implementation. *[Note: These are separate phases in the TMDL process; few implementation plans are known to have been developed to date.]*

Many municipalities and water districts conduct their own water quality assessments. Some of those entities include Denver Water, Aurora Water, Northern Water, and Greelwy.

One means of tracking progress of the goal of the SWQMP is through the Integrated Water quality Monitoring & Assessment Report – the most recent of a series of State of CO (305(b) reports in fulfillment of this section of the Clear Water Act (CDPHE, 2012). This document provides a broad range of water quality related information, including key topics such as impacts on wetlands, funded 319 grants for nonpoint source projects, approved TMDLs, and aquatic species. CDPHE fish tissue monitoring sites are indicated in the following map of Colorado:

Figure 2 - CDPHE Fish-Tissue Monitoring Sites



Finally, a section of this report summarizes assessment results for the South Platte River Basin (CDPHE, 2012, Appendix D, pp. 134-135), in terms of use support according to USEPA's system of five integrated report (IR) categories (CDPHE, 2012, pp. 5-8) for fully supporting water bodies in the state by basin:

Table 1 - EPA Integrated Report Categories

Table 25: Individual Use Summary for the South Platte River Basin.

EPA IR Category	River Miles	Lake Acres
1 - Fully Supporting	7,042	19,248
2 - Some Uses Supporting	1,582	13,375
3 - Insufficient Data, including waters on the M&E list	10,214	68,410
4a – TMDL Completed and Approved	123	0
4b – Impaired no TMDL Necessary	0	0
4c - Impaired Naturally, Placed on the M&E list	0	0
5 - Impaired and TMDL Necessary	3,139	13,047

For example, category (IR) 1 means a stream reach is attaining water quality standards; for category 2, only some classified uses are attained, etc. Category 5 triggers the need for a TMDL.

A statewide strategic plan for the protection of wetlands and riparian areas has been developed by the Colorado Parks and Wildlife (CPW, 2011). An early South Platte conference (Woodring, 1993) focused on the theme of defining ecological and sociological integrity of the Basin. Institutional aspects of water quality management (Nichols and others, 1972) focused on the South Platte River Basin.

This information overview document now will describe a range of examples of water quality and watershed health study results on a watershed- or subarea-delineated basis, in a general upstream-to-downstream order. In the summary and conclusions section of this report, a tabulation of watershed/subarea based organizations and contact information is provided.

3.2 Upper South Platte River Basin

For water quality and watershed health purposes, the Coalition for the Upper South Platte (CUSP) was organized in 1998. Its areal extent covers a land area of 2,600 square miles (mi^2) from the Continental Divide to Strontia Springs Reservoir southwest of the Denver metropolitan area. This area encompasses all of HUC 10190001 and part of HUC 10190002 *(water-usgs.gov/GIS/huc-name.html#Region10)*. This upper Basin watershed is heavily used for recreation (fishing, camping, hiking, etc.) and supplies municipal water for about $3/4^{th}$ of the State's residents *(www.uppersouthplatte.org/watershed.html)*, including the Centennial Water & Sanitation District serving the Highlands Ranch (TDS Consulting Inc., 2001). The South Park area within this sub-basin has recently been the focus of oil and gas development (Johnson, 2012). A source water protection plan study is being developed for water supplies for downstream municipalities (Beth Nielsen, CUSP, *written communication*, March 24, 2014). A Water Quality Assessment of the Upper South Platte was conducted by consultants for Denver Water in September 2013. The study identified potential impacts to water quality from mine discharges, fires, and recreation (Denver Water, September 2013).

3.3 Chatfield (Reservoir) Basin

The Chatfield Watershed Authority (CWA) was created in 1984. A draft watershed plan for this area encompassing Chatfield Reservoir, the Plum Creek tributary subwatershed, and the reservoir South Platte inflow/outflow points has been prepared for the Chatfield Watershed Authority (CWA) (Tetra Tech, Inc., 2013). A related watershed planning process brochure outlines priority projects for this watershed. Historically, a long term monitoring program (since 1983) has collected data on surface water quality (in-Reservoir, inflows/outflow), as well as groundwater quality for some Plum Creek alluvial wells) (ASI, 1994). Annual water quality reports (CWA, 2013a) and a "roadmap" for attaining water quality goals (CWA, 2013b) are examples of watershed management. Also, a nonpoint source investigation has been completed for the Plum Creek subwatershed, and a water quality model application was done for Chatfield Reservoir. A

more recently completed environmental impact statement (EIS) involving evaluating impacts of designating a part of the Reservoir's volume for water supply (storage reallocation for its primary designation for flood control) was completed by the U.S. Army Corps of Engineers (2013); ambient water quality conditions as well as changes due to Reservoir operations by this reallocation were included in this NEPA impacts assessment. Two example of an upstream Plum Creek phosphorus study is given by Kunkel and Steele (1993) and TDS Consulting Inc. (2000). A summary of historical data is given in DRCOG (1997). Comparisons of total phosphorus-chlorophyll-*a* relationships for several Denver Metropolitan area reservoirs (Chatfield, Bear Creek, Cherry Creek, and Standley Lake) are reported in Steele and others (1991) and updated in Lorenz and others (1995). As part of the RCRA Part B regulations, groundwater quality conditions were evaluated at the Martin-Lockheed facility located southwest of Chatfield Reservoir (WCC, 1983).

Figure 3 - Chatfield (Reservoir) Basin (Source: Tetra Tech, Inc., 2013)

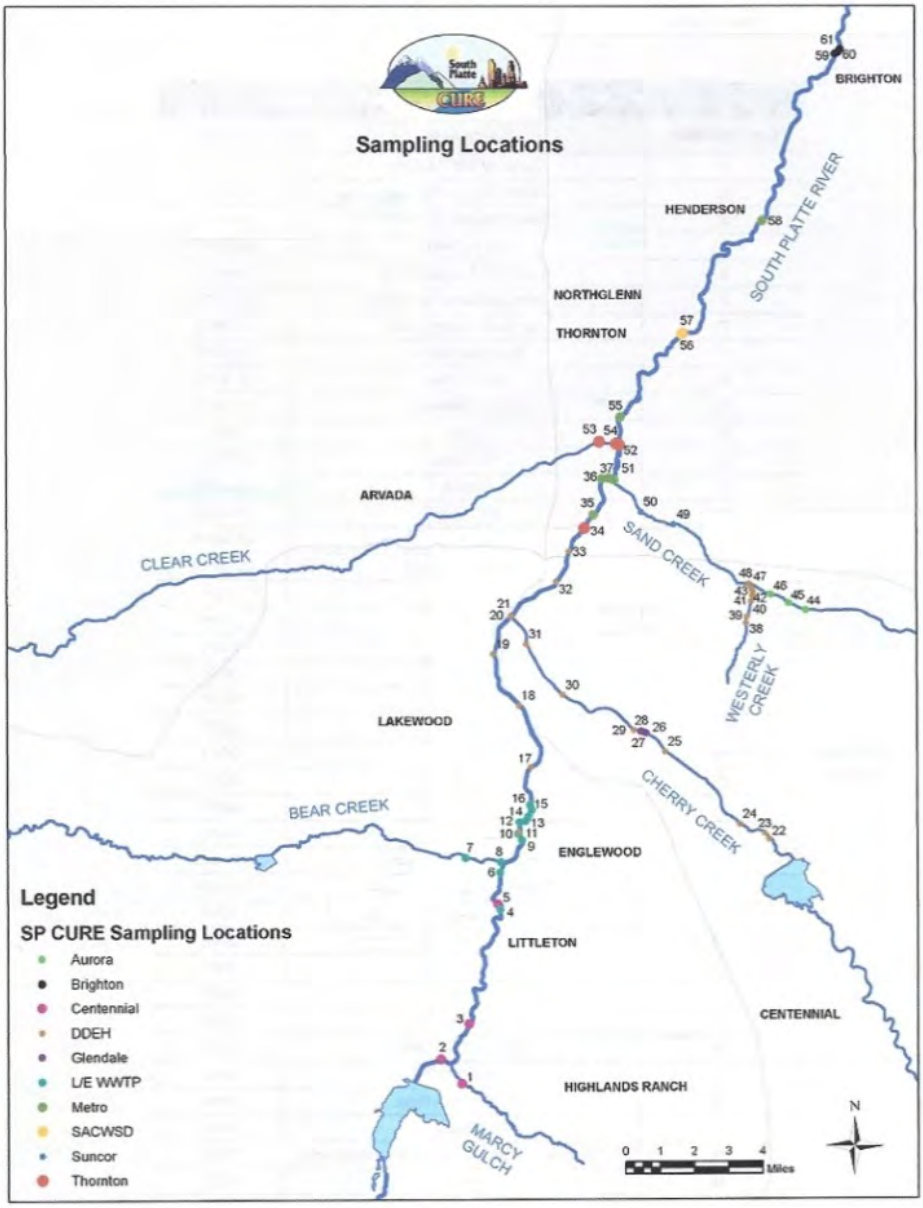
3.4 South Platte in the Denver Metropolitan Area

The primary water quality planning agency for this region/subarea is the South Platte Coalition for Urban River Education (SPCURE). Technical issues overseen by SPCURE

include water quality monitoring, modeling, TMDLs, load allocations (LAs), and wasteload allocations (WLAs). It works through coordination with other local governmental entities.

Figure 4 - Sampling along the South Platte River in the Denver Metropolitan Area (Source: SPCURE website)

Figure 5 - SPCURE Water quality Monitoring Sites (www.spcur.org)



Beginning in this subarea and downstream along the South Platte River, nitrates in both streamflow and groundwater have been investigated by the USGS (Litke, 1996; McMahon and others, 1996). Pesticides also have been of concern (Kimbrough and Litke, 1996; 1998). Focus included assessing conditions in the South Platte River alluvial aquifer between Denver and Greeley, covering an area of about 75 mi^2. This critical resource is impacted by both WWTF discharges upstream and use of fertilizers on adjacent agricultural lands. The USGS study objective was to assess the extent to which naturally occurring processes in the aquifer might reduce nitrate concentrations, thereby decreasing the effects of irrigated agriculture on water quality of the South Platte River. Water-sediment chemistry along the South Platte River in the Denver Metropolitan Area has been characterized (Steele and Doerfer, 1983). Farther downstream along the South

Platte River, municipal water-supply pumpback schemes (Aurora Water, *undated;* CO District Court, 2011) have been developed or are being expanded).

Figure 6 - South Platte River, Northern Denver Metropolitan Area (Source: CDPHE-WQCD, 2012, p. D-13)

The USGS has conducted a recent, extensive evaluation of the Denver Basin aquifer system (Paschke, 2011), which includes a large middle part of the South Platte River Basin. This aquifer system is a key component of water management and water use activities in the Basin. Although the focus of this document is on water availability and management, the USGS NAWQA program for the South Platte Basin listed two studies for assessing groundwater quality in Denver Basin domestic and public supply wells *(http//co.water.usgs.gov/projects/CO255/ index.html)*. A series of USGS hydrologic atlases (Robson and Romero, 1981a; 1981b; Robson and others, 1981a; 1981b; Robson and Banta, 1995) include water quality data assessment of the four aquifer units comprising the Denver Basin bedrock system. Management of groundwater use from these units continues to be a challenge to water resources decision makers. More recently, conjunctive surface water/groundwater uses through recharge and subsequent withdrawals are being considered by several water providers.

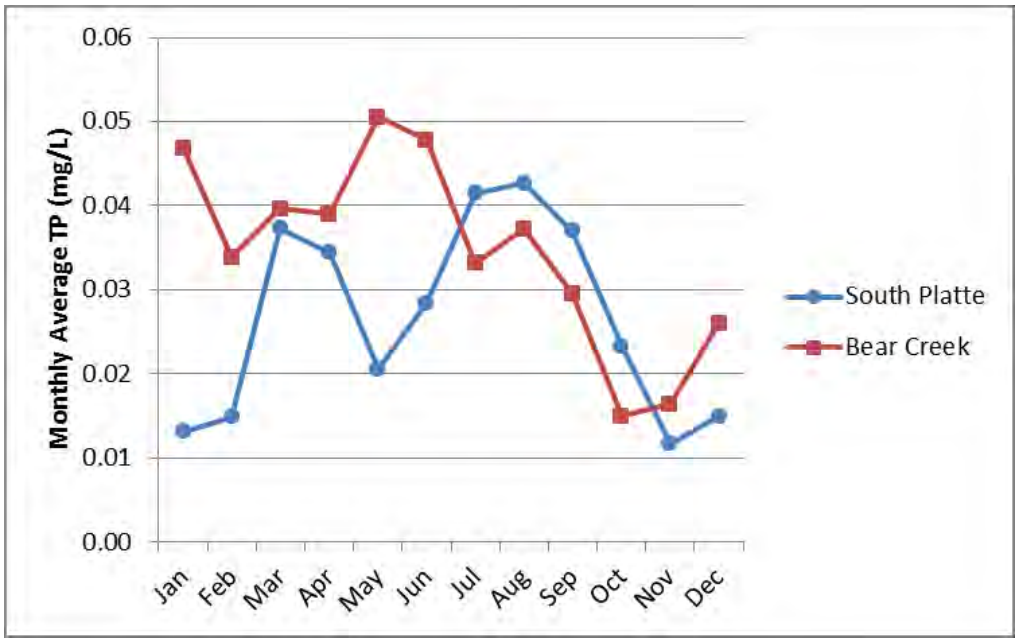
3.5 Bear Creek Watershed

The Bear Creek Watershed Authority (BCWA), established in 1981, “protects and restores water and environmental quality within the Bear Creek watershed …” Its primary focus is on dealing with water quality upstream from Bear Creek Reservoir. The BCWA has conducted a long term monitoring program of inflow streams as well as in-Reservoir water quality conditions for areal characterization and evaluation of time trends. CDPHE-WQCD Control Regulation #74 designates the BWCA as the “water quality management” agency” and specified phosphorus targets (both concentration limits and loads) for

WWTF dischargers in the watershed. In addition, the BWCA submits annual reports to describe the watershed's water quality status.

Evergreen Lake was dredged in the 1980s (WCC, 1980). Hydros Consulting, Inc. (2011) conducted a water quality assessment and water treatment alternatives cost analysis of the Bear Creek/Turkey Creek watershed of behalf of the Denver Water Department (DWD). Two technical memoranda document their study findings. An example of seasonal (monthly) variations in total-phosphorus (TP) concentrations from the second report is given as follows:

Figure 7 - Seasonal variations of Total-Phosphorus Concentrations, South Platte River (Strontia Springs) vs. Bear Creek (above Harriman Ditch), Averages of 2000-2010 Data (Source: Hydros Consulting, Inc., 2011, p. 9)



Seasonal variations of Total Phosphorus Concentrations, South Platte River (Strontia Springs) vs. Bear Creek (above Harriman Ditch), Averages of 2000-2010 Data *(Source: Hydros Consulting, Inc., 2011, p. 9)*

A watershed plan is in progress for the lower reach of Bear Creek, downstream from Bear Creek Reservoir to the confluence with the South Platte River *(groundworkcolorado.org website)*.

The Turkey/Bear Creek watershed, as well as several other mountain stream watersheds flowing into the South Platte River, has critical groundwater resources used primarily by mountain homes and small communities. A multiyear water quality monitoring program was conducted for CDOT for assessing during construction impacts of U.S. Highway 285 improvements along Turkey Creek (TDS Consulting Inc., 2003). An assessment was for the Turkey Creek watershed was completed for Jefferson County by its zoning department and the U.S. Geological Survey, comparing historical versus current (2001) water quality conditions (USGS and JeffCo, 2001, Table 1). Earlier studies investigated interactions between domestic wells and septic fields, indicating cases of *e-Coli* and nutrient contamination. An example of one study done in the Kinney Park area is given

by In-Situ (1986). These studies have resulted in recommended spacing between wells and septic systems to minimize the possibility of well contamination in fractured bedrock. A mountain area aquifer sustainability study (CDM, 2010) was conducted for the CWCB.

3.6 Cherry Creek Basin

The Cherry Creek Basin Water Quality Authority (CCBWQA) goals include achieving and maintaining a chlorophyll-a standard (18 ug/L) for Cherry Creek Reservoir, reducing sediment loads from the watershed, and maintaining and enhancing the overall diversity of habitat in the watershed (www.cherrycreekbasin.org/cc_goals.aspx). Its 2012 watershed plan (Leonard Rice Engineers, Inc., 2012) is in the process of being updated. Its monitoring program, begun in the early 1980s (Steele and others, 1989), has evolved over time, and data results and interpretation, along with other watershed protection and restoration activities, are incorporated in a series of annual reports (Advanced Sciences, Inc., 1994; Leonard Rice Engineers, Inc. and others, 2012). Examples of stormwater runoff projects and effectiveness are given by Mulhern and Steele, 1988; Kunkel and others, 1992; and Kunkel and Steele, 1992). Later reports on effectiveness of sediment detention basins are available.

3.7 Upper Clear Creek Watershed/Standley Lake

The Upper Clear Creek Watershed Association (UCCWA) was created in 1993; a primary function of this organization is to represent the watershed's "upper basin" stakeholders as well as to provide a forum for addressing water quality issues and concerns for downstream ("tributary basin" and "Standley Lake") entities. The framework for this coordination is through the Clear Creek/Standley Lake Watershed Agreement (Hydros Consulting, Inc., 2012, Appendix A). A watershed wide monitoring program began in February 1994; a monitoring plan was developed for describing monitoring sites, sample scheduling, and variables to be measured in the field or analyzed in the laboratory. The monitoring plan has been dynamic, with the most recent status comprising two components: one focusing on nutrients/sediment related/physical variables (Hydros Consulting, Inc., 2012, Appendix B); the second involving trace metals and supported by the USEPA. This separation into two monitoring components began in 2005. As with most watersheds, other water quality data are being collected in this watershed by other entities (Steele, 2012). Watershed agreement annual reports to the CDPHE's Water Quality Control Commission have included basic data appendices for both monitoring program components; however, recent reports have not included the trace metals data.

A useful "state-of-the-watershed" report on the upper Clear Creek watershed was prepared by Norbeck and Flineau (1997). Funded by the USEPA, a watershed advisory group (WAG) dealing with mine impacts existing in the late 1990s; the group's findings are given in a final report (Board of Upper Clear Creek Watershed Advisory Group, 2001). The original upper Clear Creek watershed plan (TDS Consulting Inc., 2006), which focused upon trace metals and associated stream standards and prioritization of mining related remediation projects, has been updated and enhanced by Clear Creek Consultants and Matrix Design Group (2014).

The Clear Creek Watershed Foundation (CCWF) was created to develop and implement projects in the watershed for the protection and restoration of water quality and watershed health. A watershed sustainability report outlined various management techniques applicable to the watershed (CCWF, 2007). Over the past two decades, a number of USEPA and 319 grants have been managed by the CCWF for improving conditions, primarily involving historical mine impacted areas.

Numerous study reports completed over the past two decades document a wide range of the watershed's water quality and watershed health conditions. Examples include the following:

- Advanced Sciences, Inc. (1993)–watershed/Standley Lake water quality data assessment
- Steele and Clayschulte (1997) – water quality assessment summary for the watershed
- Huyck and others (1999) – metals and fauna studies for mine site remediation
- Bell (1999) – collation of physical, chemical, and biological watershed data
- Herron and others (2001) – reclamation feasibility, Virginia Canyon
- Abel and Steele (2002) – seasonal variability in trace metals concentrations
- Woodling and Ketterlin (2002) – CDOW biological monitoring program update
- TDS Consulting Inc. (2002) – trace metals data assessment for CDPHE-HMWMD
- Szewczyk and Emerick (2002) – CSM study of stream habitat quality
- Wildeman and others (2003) – CSM mine waste-pile/sediment characterization study
- Medine (2004) – USEPA-funded model development and application, WASP4-Meta4
- Butler (2005) – CSM trace metals study of the North Fork Clear Creek
- Matrix Design Group (2013) – CDOT-funded sediment control action plan (SCAP)
- JW Associates, Inc. (2013) – watershed/wildfire assessment and prioritization study
- TDS Consulting Inc. (2013) – latest addendum, trace metals data/loads assessment

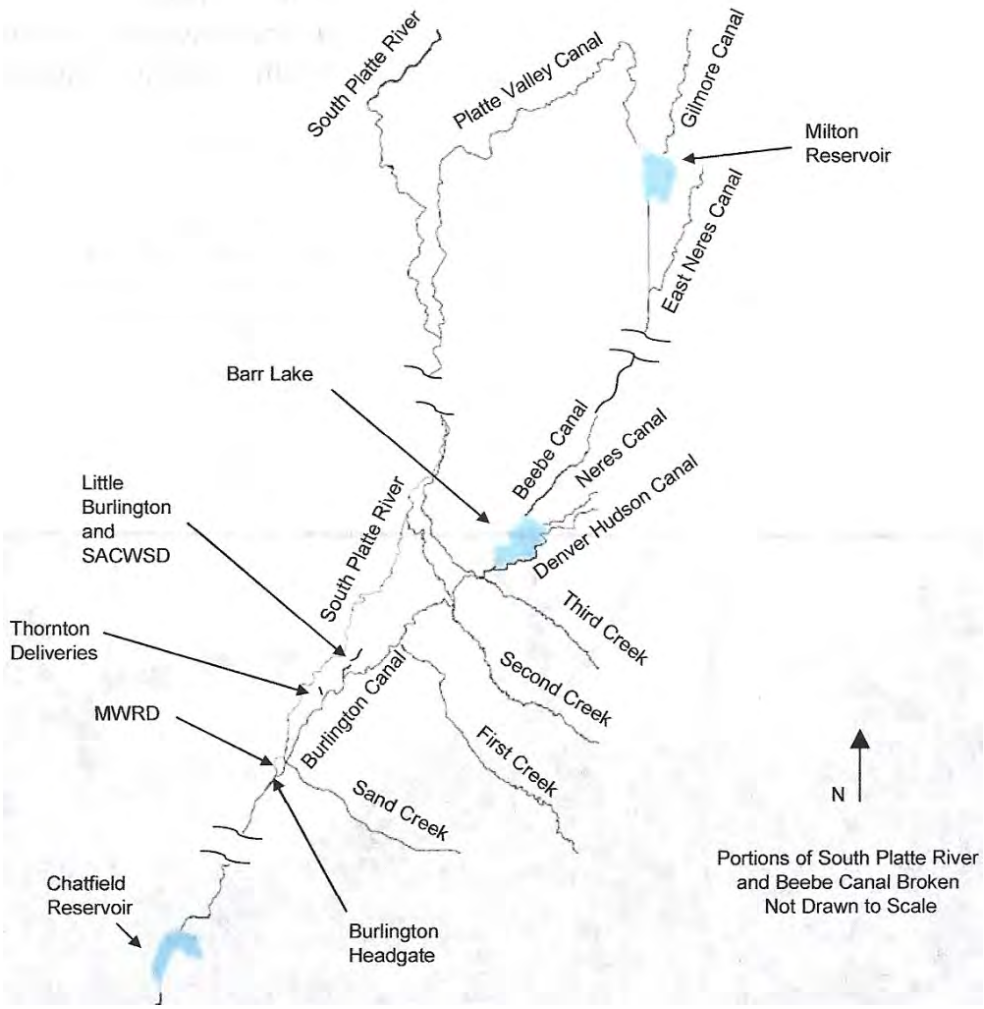
The remedial investigation/feasibility study project managed by CDPHE-HMWMD (Tetra Tech-RMC, 2004a; 2004b) addressed the final remediation work to be completed for Operable Unit 4 for the watershed as a Superfund site. There have been several iterations of QUAL2E model applications for the watershed. Other reports focus on issues associated with water quality and ecology of Standley Lake (Tetra Tech, Inc., 1994; Horn and others, 1996; Hydros Consulting, Inc., 2012). A source water protection plan for water users of Standley Lake was conducted by Buirgy (2010). Historical impacts of Rocky Flats on Woman Creek, which previously flowed into Standley Lake, are of interest (Advanced Sciences, Inc., 1992; Steele and others, 1993a; 1993b). A watershed restoration environmental assessment was conducted by the USDA (2013) for selected sites in the upper Clear Creek watershed. The mountain tributary aquifer sustainability study (CDM, 2010) was noted previously and applies to this watershed as

well. Other recent, relevant water quality presentations include Pierce and others (2010) and Steele and others (2012).

3.8 Barr Lake/Milton Reservoir

The Barr Lake-Milton Reservoir Watershed Association (BMWA) is a "consensus driven group dedicated to improving water quality through collaborative efforts" (Patten, 2009). A water quality assessment for Barr Lake was completed by AMEC Earth and Environmental (2008). A watershed plan for the entire Barr-Milton subarea has been completed (BMWA, 2008). This subarea is undergoing change, due to increased interest in a recharge/pumping project in the Beebe Draw area downgradient from Barr Lake by the United Water & Sanitation District on behalf of southeast Denver metropolitan area water providers. For water quality protection with an earlier water rights application involving this subarea, the settlement document is of interest (CO District Court, 2011). An amendment to this for a follow-on water rights case is pending.

Figure 8 - Barr Lake/Milton Reservoir Subarea (AMEC Earth & Environmental, 2008)

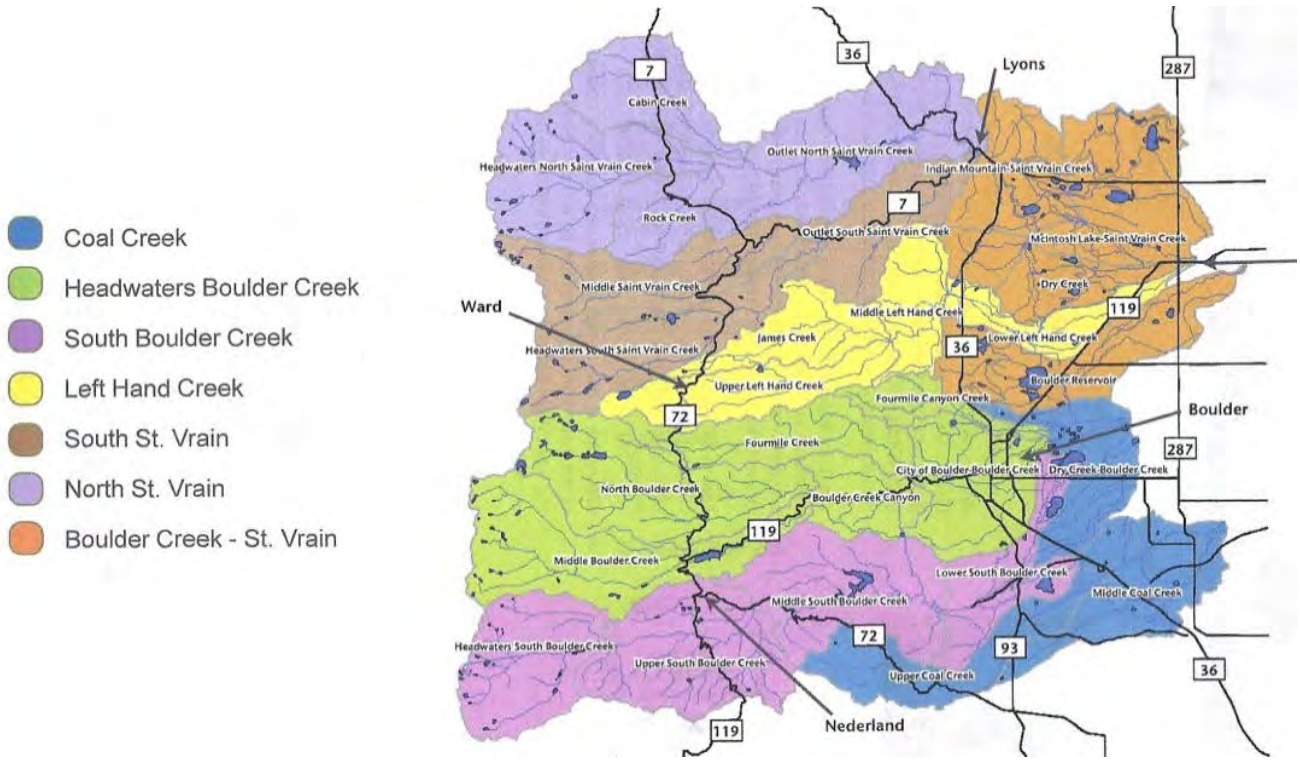


Water development in this subarea demonstrates the challenge of integrated management of surface water/groundwater resources for various beneficial uses and users. The benefits of the water quality monitoring efforts through SPCURE transfer to current and possible future impacts on water development in this subarea. Maintaining recreational and wildlife aspects of these impoundments also is a critical factor, benefitting the entire mid-South Platte River basin area.

3.9 St. Vrain Creek Watershed

The St. Vrain Creek watershed also encompasses several smaller mountain streams (north-to-south): Left Hand Creek, Boulder Creek, and Coal Creek. St. Vrain Creek then flows northeast into the Big Thompson River. An USEPA website provides a water quality assessment on a stream segment basis (www.iaspub.epa.gov/tmdl_waters10/...). One of the more critical subwatersheds is for Boulder Creek; a water quality assessment was made by the USGS in a state-of-the-watershed report (Murphy, 2006). JW Associates also include the St. Vrain Creek watershed in his series of watershed/wildfire assessments (www.jw-associates.org/ saintvrain.html). The Colorado State Forest Service (CSFS, 2013) forest health status report included this as well as other mountain watersheds in the eastern part of the South Platte Basin. Mountain Pine Beetle and Spruce Beetle progression maps are provided and can be compared with previous years' (1996-2013) areal depictions of affected forest areas.

Figure 9 - Saint Vrain Watershed Catchments (Source: JW Associates)



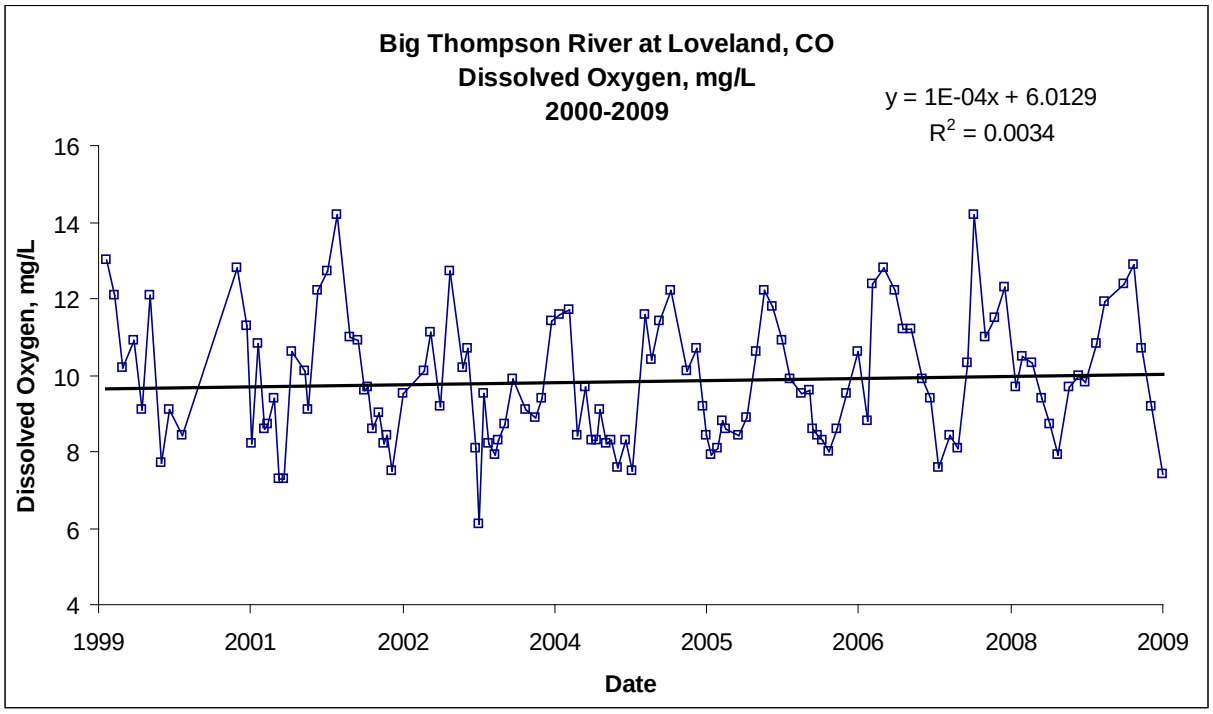
3.10 Big Thompson River Watershed

The Big Thompson Watershed Forum (BTWF) is the organization overseeing water quality and watershed health investigations for this watershed. A watershed management plan was completed by Buirgy (2007). JW Associates and JG Management System Inc. (2010) conducted a watershed assessment, focusing upon prioritization of watershed based hazards to water supplies. In 2013, the BTWF sponsored a nutrient pilot project involving the Sylvan Dale Guest Ranch (www.btwatershed.org).

Walsh and others (1978) assessed water quality recreational benefits, using Rocky Mountain National Park as a case study and based upon interviews with Park visitors. This study indicated a statistical relationship between benefits from water quality and patterns of participation in outdoor recreation activities, attitudes, and other socioeconomic variables.

CSU has collaborated with the BTWF on compiling and analyzing water quality data for this watershed (Haby and Loftis, 2007).

Figure 10 - Seasonal Variations in Dissolved-Oxygen Concentrations, Big Thompson River at Loveland, CO (Source: J.D. Stednick, Colorado State University, written communication, July 30, 2010)



3.11 Cache la Poudre River Watershed

The NRCS (2009) completed a “rapid assessment” of this watershed, focusing upon irrigated agriculture. Conservation system improvements included issues of nutrient and pest management. Impaired water quality stream segments were identified for E. coli and selenium, as well as low dissolved oxygen concentrations in Horsetooth Reservoir

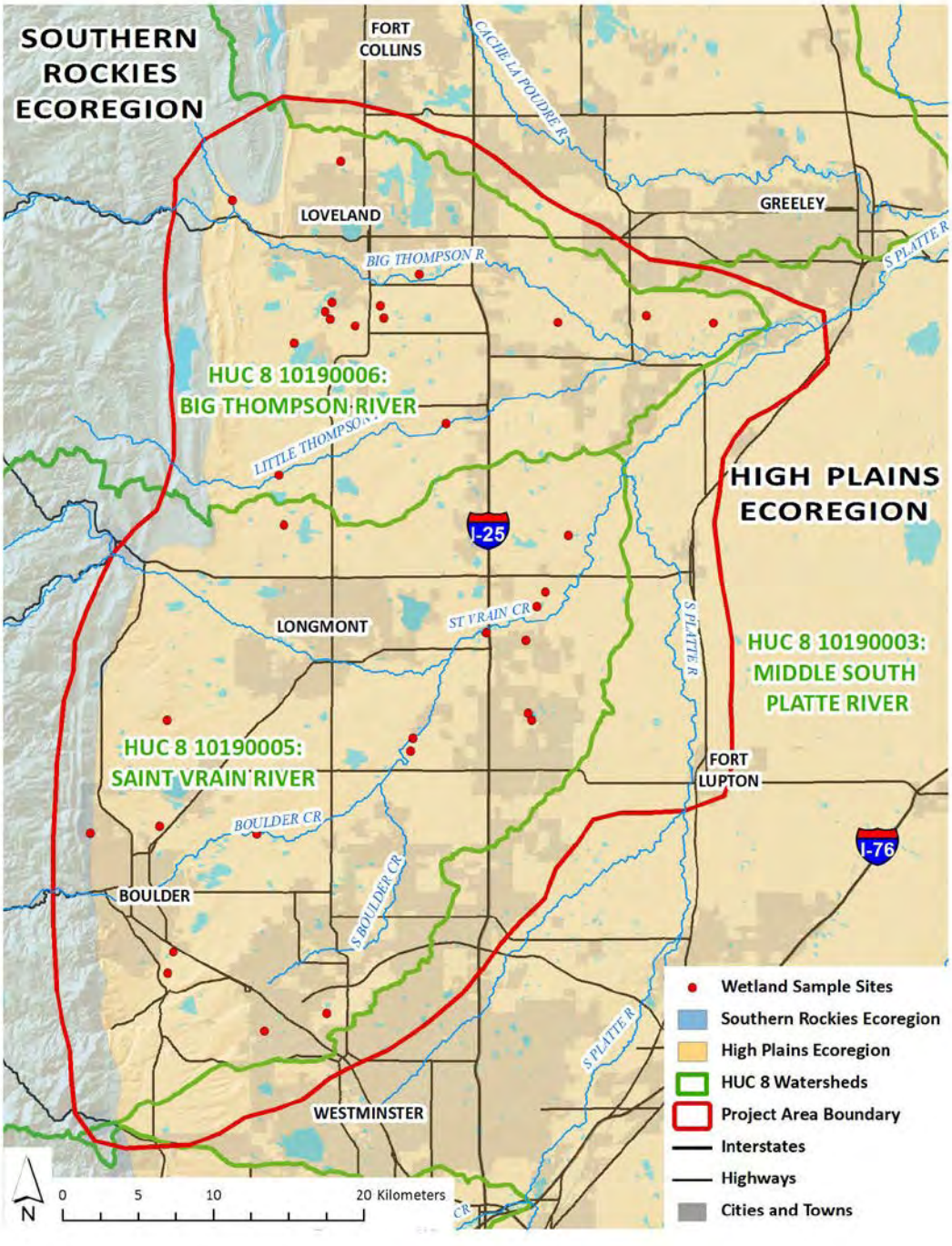
(NRCS, 2009, p. 12). Additional water quality descriptions are included in CDPHE (2012) and WQCD (2013).

This watershed plays a major role in the Colorado-Big Thompson trans-basin diversion project and the more recent proposed Windy Gap Firming project (USBOR, 2011). Another proposed project currently undergoing review is the Northern Integrated Supply Project (NIPS) (USEPA, undated). All of these water development projects have water quality and watershed health implications. A baseline water quality monitoring program started in 1991 under the auspices of the Northern Colorado Water Conservancy District. The program component, as an example, for "flowing sites" (streams, rivers, and canals) is described in a summary fact sheet by NCWCD (2010). Basic data and numerous water quality data analysis reports are available from NCWCD. With the domestic/municipal water use of NCWCD's system, emerging contaminants also are being analyzed (NCWCD, 2013). A "rapid assessment" was made by the NRCS (2009). The Cache la Poudre watershed has also been doing water quality mitigation after the fire.

A couple of CSU studies are relevant to this watershed relative to nutrient characterization:

- Goodwin (2011) – phosphorus transport/eutrophication in the Cache la Poudre watershed
- Son (2013) – nutrient load inputs to the Cache la Poudre watershed

Figure 11 – Big Thompson – St. Vrain Watersheds Showing Wetland Sample Sites (Source: CDPHE-WQCD, 2012, p. 122)



3.12 Northern Plains Basin Tributaries (Lone Tree Creek & Crow Creek)

Wylie and others (1993) studied nitrate conditions in the alluvial aquifer of Lone Tree Creek. Lone Tree Creek is susceptible to flooding. This subarea is part of the Pawnee

National Grasslands (USDA, 2014; ARNF, 2009), protected as part of the Arapaho-Roosevelt National Forest. No other water quality data sources or related issues were found in this cursory assessment effort.

3.13 Southern Plains Basin Tributaries (Box Elder Creek, Kiowa Creek, and Bijou Creek)

The Boxelder Stormwater Authority was created in August 2008. Although its 2006 Master Plan dealt primarily with flooding issues, it included components addressing water pollution control and watershed protection (PBSJ, 2006). Recent concerns of hydraulic fracking in Box Elder Creek (Jaffe, 2014) are indicative of the increasing public awareness of this energy development alternative in many parts of the South Platte Basin.

3.14 Lower South Platte River Basin

The Lower South Platte Water Conservancy District (LSPWC) was founded in 1964 and deals primarily with water resources management of the Basin's interactive surface water/groundwater system within the State of Colorado. A number of CSU-based studies have been conducted for evaluating ambient quantity/quality characteristics as well as model-predicted changes for improved water resources management.

Figure 12 - Irrigation-Diversion Ditch, Lower South Platte River (Source: LSPWCD website)

3.15 Republican River Basin

The part of the Republican River Basin in Colorado is bordered on the east by the State of Kansas. The Republican River Water Conservation District was created in 2004 to promote compliance with the tri-state Republican River Compact, principally involving farmers and ranchers in the Basin. Water use in Colorado involves surface waters of the

Republican River system as well as the west-central part of the critical Ogallala Aquifer (American Ground Water Trust, 2002). No surface water investigations were found through the internet web research. However, the Ogallala Aquifer was studied intensively by the U.S. Geological Survey. Water quality baseline studies were conducted in earlier USGS reports. A recent New York Times article (Bair, 2011) summarized several water quality issues impacting the Ogallala Aquifer:

- 14 percent of all Ogallala irrigation wells tested contained on or more pesticides
- The most common detected herbicide was Atrazine
- Five percent of testes Ogallala irrigation wells indicated nitrate concentrations equal to or in excess of the safe drinking water standard (<10 mg/L NO^3-N) set by the USEPA.

4 Impaired and Threatened Waters

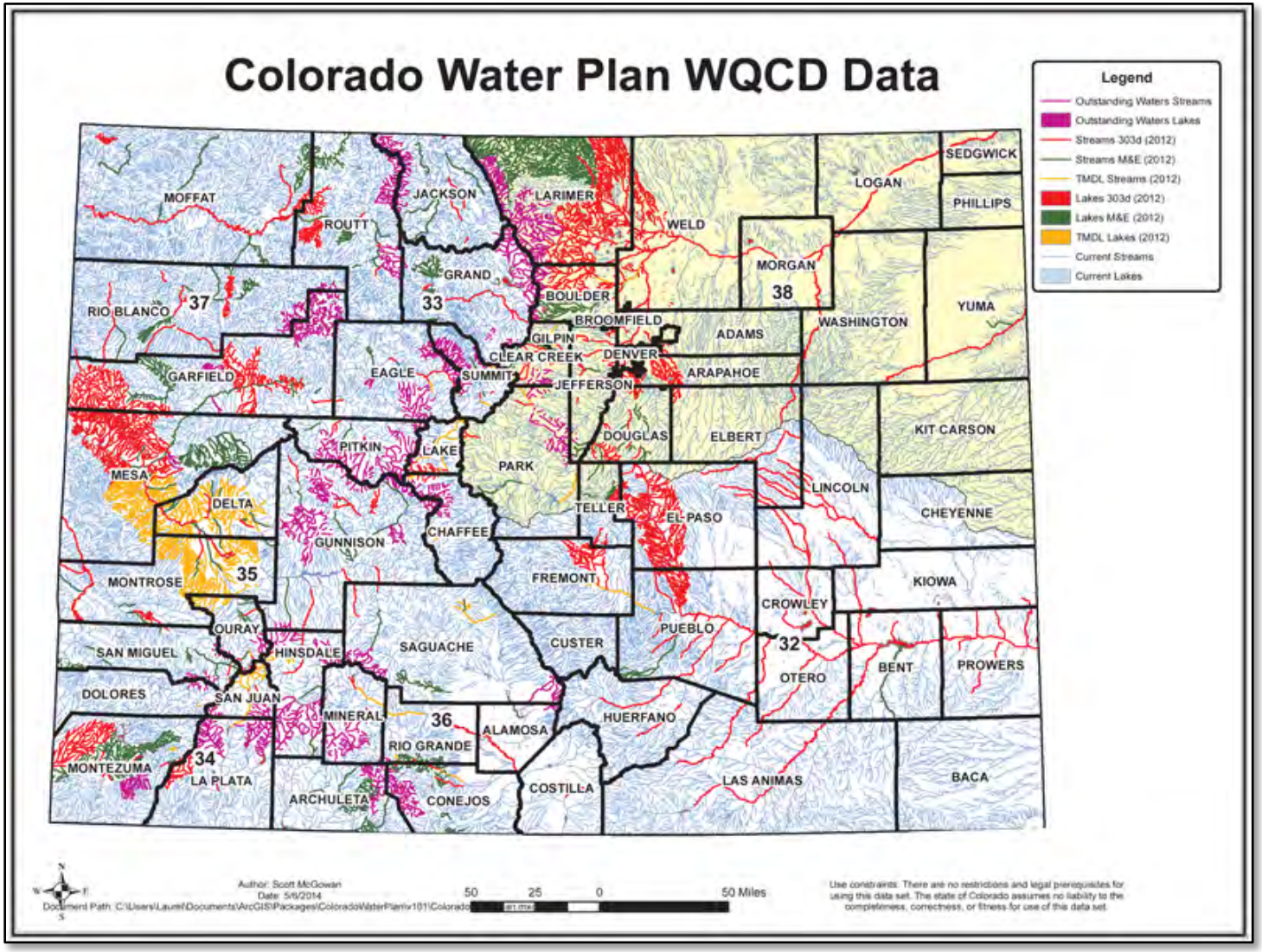
The term "303(d)" indicates those waters on the list of impaired and threatened waters (stream/river segments, lakes) that the Clean Water Act requires all states to submit for EPA approval. States are required to assess the condition of surface waters and submit lists of those that are too polluted to meet water quality standards (called impaired waters). The Act requires that states establish priorities to address these impaired waters by developing water restoration plans (also known as Total Maximum Daily Loads or TMDLs). TMDLs identify pollutant load limits necessary to clean up the water to meet water quality standards and then quantify a pollutant "budget" for different sources of pollutants. The water restoration plans are then implemented via permit requirements and through a variety of other local, state or federal water protection programs.

The Colorado Department of Health and Environment maintains an ongoing monitoring plan to assess the water quality of the State's streams and lakes. The objective of the monitoring plan is to gather, assess and report data regarding the chemical, physical and biological integrity and quality of state surface waters for the Federal Clean Water Act (CWA) 303d list of impaired waters and the 305b report of status of water quality in Colorado as the EPA Integrated Report.[1]

The 303d listed lakes and streams found throughout the Basin are shown in Figure 13, highlighting waterways where water quality may be of concern in the South Platte Basin.

[1] Sources: Colorado Department of Health and Environment (CDPHE), Environmental Protection Agency (EPA)

Figure 13 - South Platte 303d Listed Waterways



Source: CDPHE

5 Summary and Conclusions

A tabulation of various watershed based water quality management entities (a few water conservancy districts are included) was judged to be useful for the users of this document, where only selective references can be given to indicate the diversity and magnitude of useful investigations and reports available for addressing water quality and watershed health:

Table 2 - Summary of Watershed/Regional/Subbasin Organizations, South Platte River Basin

SP Organization	*Website*	*Contact*	*Description/Notes*
Coalition for the Upper South Platte (CUSP)	www.uppersouthplatte.org	Beth Nielsen, Program Assistant	Water quality, forest health, wildlife mitigation, and education; South Park (oil & gas development)
Chatfield (Reservoir) Watershed Authority	www.chatfieldwatershedauthority.org	Larry Moore & Kevin Urie, Co-Chairs	Water quality protection for drinking-water supplies, recreation, fisheries, and other beneficial uses, small WWTPs
South Platte Coalition for Urban River Evaluation (SPCURE)	www.spcure.org	Sarah Reeves, Coordinator	Water quality monitoring, USGS data/model studies, TMDLs, sediment impacts; WWTP discharges
Bear Creek Watershed Authority (BCWA)	www.bearcreekwatershedauthority.org	Russ Clayschulte, Executive Director	Established 1981, monitoring program, includes Turkey Creek, GW-WQ studies, TMDLs, small WWTPs
(Lower) Bear Creek Watershed Planning and Assessment	groundworkscolorado.org	Rachael Hansen, Program Manager	319 Grant (awarded in 2011); website information; watershed plan in process
Cherry Creek Basin Water Quality Authority (CCBWQA)	www.cherrycreekbasin.org	Chuck Reid, Manager	Watershed plan (2012); long term water quality monitoring (annual reports); reservoir controls (TP/chlorophyll-a); WWTPs
Upper Clear Creek Watershed Association (UCCWA); Clear Creek Watershed Foundation (CCWF)	www.clearcreekwatershed.com	Katie Fendel, UCCWA Chair; J. David Holm, CCWF Executive Director	Water quality monitoring, USGS data/model studies, TMDLs, I-70 sediment-control impacts; WWTP discharges; watershed plan update (2013); management agreement (Standley Lake Cities)
St. Vrain River	www.svlhwcd.org	Sean Cronin,	Organized in 1971; levy

SP Organization	Website	Contact	Description/Notes
Watershed Stakeholders		Executive Director	taxes; providing augmentation water to members; water education
Big Thompson Watershed Forum (BTWF); also NCWCD, see below	www.btwatershed.org	Zach Shelley, Program Director	WQ monitoring and assessments; watershed management plan (2007); watershed protection volunteers; CO-BT Project
Big Thompson River Restoration Coalition			Restore river corridor, fisheries and natural areas, and make watershed resilient to future flooding.
Cache la Poudre River Basin - Northern Colorado Water Conservancy District(NCWCD)	www.northernwater.org (also see STP below)	Eric Wilkinson, General Manager	Providing water to northeastern CO via the trans-basin CO-BT P and the Windy Gap projects (above) and the proposed NIPS/Glade Project
Lone Tree Creek/Crow Creek tributaries (Pawnee Natl. Grasslands)	www.fs.fed.us/r2/arnf/	T.J. Williams, USFS	Arapaho-Roosevelt National Forest/Pawnee National Grasslands
Box Elder Creek/Kiowa Creek/Bijou Creek	www.hoaonlineresource.com/boxelder/news.php?category=4		Boxelder Stormwater Authority; stormwater master plan (2006)
Lower South Platte Conservancy District	www.lspwcd.org	Jo Frank, General Manager	Created in 1964; 406,000 acres of agricultural lands; water management and technical services
South Platte River Urban Waters Partnership	www.urbanwaters.gov	Devon Buckels, AICP, Coordinator	Non-regulatory partnership of over 40 organizations focusing on water quality, water protection, and water awareness in the South Platte River watershed.
South Platte Forum	www.southplatteforum.org	Jennifer Brown	Annual conferences since 1989
Republican River Water Conservation District (RRWCD)	www.rrwcd.org	Deb Daniel, General Manager	Created in 2004, self-governed, promotes local involvement in Republican River Compact; Ogallala Aquifer conservation
Colorado Department of Parks and Wildlife (CDPW) - RiverWatch	www.coloradowater.org	Michaela Taylor, Program Manager	Started in 1989; primarily volunteers with training; lab in Ft. Collins (CDPW)
Save the Poudre (STP)–Poudre Waterkeeper	www.savethepoudre.org	Gina Janett	Advocacy group, against proposed NIPS/Glade Project
Centennial Water & Sanitation District	www.centennialwater.org	John Hendrick, General	Water/wastewater provides in Highlands Ranch

SP Organization	Website	Contact	Description/Notes
		Manager	
Evergreen Metro District	www.evergreenmetrodistrict.com	David Lighthart, General Manager	Supplies water and wastewater treatment for the Evergreen community area
Aurora Water	aurorawater.org		Supplies water to its service area
Golden Utilities	www.cityofgolden.net/departments-divisions/water/		Water & wastewater treatment for the Golden service area
Littleton Water & Light	www.littletonwaterandlight.org		
Lakewood Utilities	www.lakewood.org/Utilities/		
Englewood Utilities	www.englewoodgov.org		
Denver Water Department	www.denverwater.org		Supplies water to its service area
Standley Lake Cities	Cities of Westminster, Northglenn, Thornton, and Arvada		Stakeholders in the upper Clear Creek watershed
Greeley	www.greeleygov.com/water		
Longmont	www.ci.longmont.co.us/pwwu/water/		
Fort Collins	www.fcgov.com/utilities/		
Fort Collins-Loveland Water District	www.fclwd.com/		
Boulder	https://bouldercolorado.gov/water		
United Water and Sanitation District	www.unitedwaterdistrict.com	Bob Lembke, President	Client districts: ACWWA and ECCV (SE Denver metro area)
Northern Colorado Water and Sanitation District	www.northernwater.org/		

Municipal water supply utilities and providers require development and submittal of annual water quality reports to be available to the public. Examples are those by Centennial (2013), Aurora Water (2012) and the Denver Water Department (2013).

Long term human-health epidemiological studies are recommended to assess the potential long term adverse impacts of the presence of minute concentrations of chemicals introduced into water supplies – namely, herbicides and insecticides, and pharmaceuticals and personal care products (PPCPs, or emerging contaminants) (Battaglin and others, 2013; Daughton and Ternes, 1999; Sprague and Battaglin, 2005; NCWCD, 2013; Stephenson, 2013). These substances currently are unregulated by the USEPA and CDPHE; however, low detection analytical methods have been developed, and this regulatory situation may change in the near future.

Finally, review of water management strategies proposed in the past (Nichols and others, 1972; CCRI South Platte Team, 1980) might be beneficial with regard to future planning in the South Platte River Basin as well as Statewide planning from the standpoints of

water quality and watershed health. The benefits of dealing with these issues on a watershed/subarea scale are demonstrated by the bibliographic overview provided by this document. Also, we may learn from *post audit* analysis of water development projects that were not authorized (USEPA, 1996). The review of reasons why these past efforts did not move forward can assist in future planning, particularly as similar projects will likely be needed in the future.

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Appendix F – South Metro Water Supply Authority Concept for Discussion

South Platte Basin Implementation Plan

South Platte Basin Roundtable/Metro Basin Roundtable

April 17, 2015

Below is a collaborative conjunctive use multi-purpose project concept based on a potential Flaming Gorge Pipeline project and conjunctive use with the Denver Basin Aquifer System. This is an example that provides something for others to react to, and should be evaluated and built upon through the Basin Roundtables and planning process. Although this "straw-man" is conceptualized around a Flaming Gorge Pipeline project, many of the concepts could extend to other new water supply projects. Section 1 describes the concept and Section 2 provides additional summary information on the Denver Basin Aquifer and the opportunity to use it as a drought reserve.

Section 1: Conjunctive Use Multi-Purpose Project Concept

This description outlines potential elements of a conjunctive use multi-purpose new supply project.1 This conceptual "straw-man" project is prepared to test and demonstrate the ability of a project to meet stakeholders' concerns including environmental, recreational, and water users concerns. It could be centered around a number of potential projects such as the Green Mountain/Blue River Pumpback, Yampa Pumpback, Blue Mesa Pumpback, or Flaming Gorge Pipeline with conjunctive use of the Denver Basin Aquifer and interruptible supply agreements in the South Platte Basin.

This description is intended to focus discussions related to new supply development and provide a framework for analysis and feedback. It is anticipated that the substance of a specific concept will change and additional details will be developed over time. This description can help inform recent IBCC and roundtable discussions and ultimately be included as part of a roundtable-to-roundtable engagement within Section 4.8 Interbasin Projects and Methods of the South Platte and Metro's Basin Implementation Plan (BIP).

As a starting point, the following elements of a multi-purpose project are described:

- Project Description
  - Water Source
  - Risk Management and Variability
  - Headwater Enhancement
- Overall Benefits of the Project
- Challenges/Issues/Costs of the Project
- Potential Area of Origin Compensation
- Statewide Policy Objectives
- Financing and Governance

[1] Several sources were used to compile this memo including: Prior “Basin of Origin” bills (between 1988 and 2000 the Colorado General Assembly looked at 16 out of basin transfer proposals of which some were compensation/mitigation approaches, some focused on additional requirements before diversion, and two required voter authorization); Reports from the Colorado Water Resources Research Institute on area-of-origin compensation; The South Metro Water Supply Study (February, 2004); SWSI Phase II Section 5 (Addressing the Water Supply Gap); Discussions between the Yampa/White Roundtable and South Platte Roundtable on the proposed Yampa Pumpback Project; SWSI 2010 and the December 15, 2010 IBCC Report; and Basin Roundtable Project Exploration Committee (a.k.a Flaming Gorge Task Force) Phase 1 Report.

These elements are outlined in general terms below. Additional details such as yield (average, firm, and dry), water rights, infrastructure, cost estimates, mitigation, funding, etc. will need to be further developed with additional stakeholder input. In addition, a section at the end further describes the Denver Basin Aquifers as an opportunity for a risk and drought reserve. Including the Denver Basin aquifers as an asset to provide supplies when no project yield is available can be an important element in risk management of Colorado's Compact Entitlement.

The specific elements of projects, mutual commitments, and milestones of progress would be the subject of an exploratory investigation and ultimately negotiation among multiple parties. It is anticipated that should a package of projects emerge as feasible and desirable, commitments would be made in tandem. As potential end users made certain commitments, potential opposers would also make commitments helping to ensure that a new west slope supply project will, in fact, be a fundamental part of "filling the gap" package. This approach needs to provide confidence that Colorado River water supply development will be available for the east slope, thereby providing an alternative to agricultural to urban water transfers.

Elements of a Conjunctive Use Multi-Purpose Project

Project Description:

For discussion purposes, this concept is centered around the Flaming Gorge Pipeline Project. It has been initially screened through a sub-committee, and also been investigated by a variety of agencies over several decades. Much information is already available, reducing the need to gather new data. A group has also begun to coordinate with the US Bureau of Reclamation to review hydrologic analyses and model projections of potential yields and operations. This Conjunctive Use Flaming Gorge Pipeline Multi-Purpose Project contains several major components. The components include:

1. **Flaming Gorge Pipeline**: The source of water for the project would be a contract with the Bureau of Reclamation (BOR) for an annual average yield from Flaming Gorge Reservoir of 150,000 + acre feet. The water would be diverted from the Green River through a pumpstation at Flaming Gorge Reservoir. A 400-mile 7-8 foot diameter pipeline would convey this water to the Front Range. The most likely pipeline route would travel along Interstate 80 through Wyoming to Laramie, and then south along the Colorado Front-Range. The pipeline would convey supplies to municipalities in Wyoming and on the Colorado Front-Range in the South Platte and Arkansas Basin.

   The overall capacity of the pipeline should include consideration of several opportunities beyond that required to convey 150,000 acre feet for several reasons:

   a) Cost/benefit review of moving additional water under certain hydrologic conditions;

   b) Potential as a water management tool, capable of bringing water to the Front Range as an alternative diversion method to depletion in the

headwaters of the Colorado River. That might position the project as a riparian restoration project as well as a new supply project, and;

c) In a fashion similar to the transaction between the Southern Nevada Water Authority and the Arizona Water Banking Authority2, Colorado could perhaps develop underground storage of other Upper Basin state's compact entitlement as a component of risk management and oversize the conveyance system for that type of possibility.

2. **Risk Management and Project Variability Strategies:** In 2010, the IBCC agreed that the development of new water supplies from the Colorado River "should be accompanied by a risk management program that ... is integrated with 'triggers' and utilizes other dry cycle sources to fill the gaps when the new supply water is unavailable." Because populations and economies would be dependent upon this new water supply from Flaming Gorge, mechanisms would need to be in place to deal with periodic supply shortages. The IBCC recommended a two-pronged approach: 1) "to put in place an 'early warning' system that shuts down, curtails, or offsets [the new supply project] in advance of a Compact curtailment. The early warning system would be based on hydrologic triggers;" and 2) "the water supply triggers would be coupled with an emergency water bank or other operational scenario that would meet the critical needs of all of Colorado's post-1922 users if a curtailment cannot be avoided."

a) Triggers and Dry-Period Sources

i. ***Triggers***: Hydrologic triggers could include Lake Powell levels, overall storage in the CRSP system, the 10-year rolling average of upper basin deliveries, or some combination. The IBCC notes, "additional work is needed to define which triggers would be used ... and how they would work."

ii. ***Sources to meet shortages***: Regardless of the triggers, the end users of the project would need supplies that can be used conjunctively with the Flaming Gorge supplies. This is not a new concept for many front-range utilities. For example, the South Metro region recently secured a permanent, but variable, renewable water supply through the WISE Project. In years when no delivery occurs, they will continue to rely on Denver Basin well pumping. Similar strategies could be used to deal with the variability of a Flaming Gorge project and associated triggers.

1) ***Denver Basin Aquifer Conjunctive Use and ASR***: Diversion of water from Flaming Gorge could be tied to levels in Lake Powell or other triggers to avoid compact curtailment. This strategy involves diverting a larger amount of water in wet years for front range groundwater users to store water in Denver Basin aquifers through an ASR (aquifer storage and recovery) program to assure sustained productivity. In dry periods when supplies are not available from

[2]http://www.snwa.com/ws/future_banking_arizona.html

Flaming Gorge, municipalities with access to the Denver Basin Aquifer would meet their water needs from local groundwater supplies. Through ASR and changing the use of the Denver Basin Aquifer from a base supply to a drought supply, the aquifers can be managed to assure long-term reliability. Additional information on this concept is included in the section below "Denver Basin Aquifers - Our Best Opportunity for a Risk and Drought Reserve."

2) ***East Slope Temporary Ag. Transfers***: Interruptible supply agreements with east slope agricultural water rights could also provide a back up water supply during dry-cycles. An alternative agricultural transfer project could build on the FLEX Market concept and include the temporary transfer of agricultural water rights similar to substitute water supply plans (CRS 37-92-308) and interruptible supply contracts (CRS 37-92-309). It could also include supporting the development of additional storage and infrastructure in the Arkansas and South Platte river basins to facilitate the temporary transfer of agricultural water rights to Front Range municipalities.

b) **Emergency West Slope Water Bank for pre-1922 Water Rights:** The triggers and dry-sources above would be coupled with an emergency west slope water bank to help ensure the critical needs of all of Colorado's post-1922 users would be met if a curtailment cannot be avoided. As described by the IBCC, "this water bank would utilize the consumptive uses of Colorado's pre-1922 water rights on a willing buyer/lessee–willing seller/lessor basis. The bank could be combined with or include the use of the capacity of existing reservoirs such as Blue Mesa. The concept of such a bank is the effort of a current study by West Slope and Front Range water users."

3. **Headwater Enhancements:** This multi-purpose project could include non-consumptive environmental and recreational benefits to the headwaters of the Colorado River system. This could involve exchanges with current transbasin diverters for additional flows in Colorado headwaters and could utilize specifics from the Grand County Streamflow Management Plan and the Colorado Roundtable's Nonconsumptive Needs Assessment. This concept would need to be explored with current transbasin diverters.

Potential Area of Origin Compensation

Through the IBCC and Basin Roundtable process, west slope representatives have said that they would need several commitments before being supportive of this type of multi-purpose project. These included:

- Continued viability of the west slope's regional economy
- Certainty – ensure an increment of water is available for development in each west slope basin
- Front-Range commitment to conservation and reuse
- Environmental mitigation and enhancement

These elements could be met through a combination of water related benefits for the west slope sub-basins and/or socio-economic compensation.

Water related benefits for west slope sub-basins

Even though the diversion may not occur directly in each basin, different elements could be included to distribute statewide benefits, ensure continued viability of the west slope's economy, and provide certainty.

- Yampa/White
    - Infrastructure for irrigation of additional acres in Moffat County (20,000-30,000 acres of land could be irrigated)
    - Water for future municipal development particularly in Steamboat and Craig. Upper basin interests have previously secured 60,000 a.f. subordinations to protect future uses and they have indicated they would want a similar subordination or component of the project.
- Colorado
    - Exchanges with current transbasin diverters for additional flows in Colorado headwaters (Grand County Streamflow Management Plan; Blue River Flow enhancement)
    - Maintain Dillon Reservoir Levels
    - Wolcott Reservoir for future west slope water demands and additional yield to the Grand Valley
- Gunnison
    - Agricultural firming projects in the upper basin (Tomichi Creek, etc.) to help with current agricultural shortages
    - Water quality improvements in the Uncompahgre River and Lower Gunnison (selenium)
- Southwest
    - Financial assistance and support developing their identified projects and processes

Socio-Economic Compensation (Development Fund)

Generally, the most useful form of compensation would be unrestricted monetary compensation to be used by the west slope to compensate unprotected parties and for whatever other purposes its citizenry prefers. Rather than committing to specific projects, a development fund could be established. The money from this fund would be available to provide assistance for future water needs (see above) or other economic development on the west slope.

The fund could be financed in a number of ways as further described below. These financing mechanisms could also be accompanied by a charge placed on users of the multi-purpose project water (perhaps indexed to the current price of water in the South Platte Basin). The fund could be held by the state (CWCB) or potentially by west slope

conservation districts or counties. Expenditures would be made against the fund for projects proposed by municipalities, conservancy districts, and other public entities on the west slope. Appropriate expenditures could be solely water related3, or appropriate expenditures could include other economic development projects.

An alternative, predicated on the pipeline becoming a riparian restoration management tool, would be application of funds in two ways: First, for compensatory projects in the Colorado River basin, and; Secondly, to fund the increased cost associated with alternative diversions of transbasin sources. The first compensation is an early milestone in the process, bringing environmental benefits to the headwaters on the way to project permitting. The second form of compensation, where water providers with low cost, gravity delivery systems accept alternative deliveries, may also be necessary to have the required support for the project.

The major Front Range water providers have invested enormous capital in transbasin diversion structures. That investment yields lower cost water supply for their customers. The offset to the increased cost of alternative delivery might take the form of cash or delivery of more water than could have been historically diverted. The combination of a hold harmless economic approach, coupled with compensatory water stored underground, might be sufficient to garner enthusiastic support for the project.

Financing

In addition to the configuration of the project, the other major outstanding questions relate to how the project would be financed, managed and implemented. Four models could be further explored:

1. Federal/State partnership similar to the Central Arizona Project
2. State water project such as the California State Water Project
3. State/Local partnership where the state facilitates the project, but end users finance and manage it
4. Local/Local partnership similar to WISE and Chatfield as water examples and E-470 as a transportation example
5. Public/Private partnership similar to transportation projects (Hwy 36)[4]

Under any funding model it is most appropriate for use rates and tap fees to be the primary base of funding. This connects the customers with what they are paying for. However, the conceptual package of projects described above will likely also include broader public benefits that are more dispersed than those that accrue to the specific end users of the transmountain diversion project. Therefore broader public funding

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[3]New storage projects, repair and rehabilitation of existing water storage and delivery facilities, municipal water systems, improvement of irrigation systems, on-farm improvements resulting in greater efficiency, water based recreation facilities, securing in-stream flows, and other water-related projects.

[4] Western Resource Advocates published a report, “Economic and Financial Impacts of the Proposed Flaming Gorge Pipeline” by Honey Creek Resources, Inc. September 6, 2011. The report compares public and private finance approaches. The report does not consider a public-private partnership.

mechanisms should also be explored. Two funding mechanisms, a "water" mill levy and a Container Fee, are briefly described as examples of how some of the broader public components of this multi-purpose concept could be funded. These funding mechanisms are described in order to demonstrate that broader funding mechanisms could be available if a package of projects is generally agreed to. SMWSA is not advocating for nor necessarily supportive of either method; rather, they are described as possibilities in order to spark further discussion.

Finance - "Water" Mill Levy

A two (2) mill property tax on the nine largest front-range counties will generate about $107 million/year. (Adams $9m; Arapahoe $15.2m; Boulder $11m; Denver $20.2m; Douglas $8.6; El Paso $11.6; Jefferson $14.4; Larimer $7.6m; Weld $9m). As a point of comparison most fire districts collect an 8+ mill. An additional two mills might incentivize linking land-use planning and water supply planning in the “Big 9.”

One (1) mill, or about $54 million/year could help provide water and economic development for the west slope. This could be done through a “Development Fund” as described above or it could be divided between the west slope counties.

The other (1) mill or about $54 million/year could help fund construction and operation and maintenance of the multi-purpose project, including headwaters exchanges.

As a point of comparison, the 2009 General Fund Revenue for the following counties - Gunnison $10.388M; Montrose $10.1M; Logan $4.5M; Garfield $28M; Otero $1M (estimate) - approximate what this fund could generate.

Finance – The Container Fee Ballot Initiative of 2010

In 2010, two citizens filed a Ballot Initiative seeking a fee on beverage containers sold in Colorado. Unofficially captioned “Container Fee to Fund Water Preservation and Protection” by legislative staff for tracking purposes, the initiative was heard by the Ballot Title Setting Board at its hearing April 21, 2010. The minutes of that hearing document that the legislative staff determined such a fee would generate approximately $100 Million per year in revenue.

The Title Board’s opinion setting the initiative title for the ballot was appealed to the Colorado Supreme Court. The basis of the appeal was that by naming the Basin Roundtables specifically (the funds were to be allocated in part based on roundtable approval of grants), the initiative was not a single subject. The Supreme Court granted the appeal. Given the timeline of the Colorado Water Plan, consideration could be given to a similar ballot initiative in November, 2015. The funds generated could go immediately to riparian restoration projects with future use for compensatory offsets. In the long run, the funding stream would support project development, permitting and eventually debt service.

Overall Benefits of the Project

- Front-range municipalities get an increment of high quality reusable water.

- New water supply development minimizes loss of irrigate acres in South Platte and Arkansas Basins. Transfers of east slope agricultural would no longer be the dominant strategy for meeting front-range water needs. East slope agriculture could participate in the project and receive additional yields (either directly or through "second use" of fully consumable return flows).
- Acceptable water quality that does not require advanced water treatment and may be used to blend with lower quality South Platte supplies.
- Allows development of new water supplies and utilization of Colorado's compact entitlements while protecting recreation, environmental flows, and future economic development on the west slope.
- Depending upon the location of the diversion it could diversify the state's M&I water supplies. The CRWAS indicates that climate change impacts are less severe in northern basins such as the Green River. Adding a more northerly water supply, and a basin other than the Colorado mainstem, would diversify the state's M&I water supply and could mitigate potential risks from climate change.

Challenge/Issues/Costs of the Project

- Potential endangered fish and depletion issues downstream of the diversion would need to be analyzed.
- May require enlargement or construction of additional storage in the South Platte or Arkansas basins. This storage could be surface water storage or underground storage.
- Additional cost analysis of the various component of the package of projects will be needed. This will include, but not be limited to, the cost of equipping existing wells for ASR, implementing a regional ASR program, and comparing the costs of ASR with above ground storage.
- Complexities of water right administration in the event of a compact call.
- Although the Colorado Compact recognizes the right of one state to move water through another state, there will likely be a need for an agreement with Wyoming, perhaps Utah and perhaps between all four Upper Basin States.

Statewide Policy Objectives

- Safe reliable drinking water supply for all Colorado citizens
- Conservation – the project can include elements to require or encourage different conservation measures
- Reuse – the project can be configured for maximum utilization of fully consumable water either through M&I reuse or "second use" by east slope agriculture
- Maximum utilization of the state's Colorado River Compact entitlements
- Environmental and recreational preservation and enhancements

Section 2: Denver Basin Aquifers - Our best opportunity for a risk and drought reserve

Existing Groundwater Conditions

Denver Basin Aquifers (Laramie-Fox-Hills, Arapahoe, Denver, and Dawson) comprise a huge groundwater storage reserve immediately beneath much of the central Front Range. The aquifers extend from roughly Greeley on the north to Colorado Springs on the south, the Foothills on the west, and the eastern boundaries of Adams, Arapahoe and Douglas counties on the east, comprising around 6700 square miles. The combined aquifers hold over 450 million acre-feet of water, and over 250 million of that may be economically pumped. Wells have been drilled and can produce up to as much as 1000 gallons per minute (gpm).

Historically, the South Metro area has relied almost exclusively on this non-tributary, nonrenewable groundwater supply. Estimates are that approximately 38MAF of recoverable water exists under the South Metro area. However, recent work reinforces previous observation regarding steady rates of aquifer declines. The 2013 Douglas County Rural Water Supply System Feasibility Study included a comparison of USGS groundwater modeling, measurements in active wells, and CDWR investigation of Denver Basin aquifer levels. The USGS modeling predicts a -1 to -5 feet per year average annual groundwater level decline and the CDWR investigation predicts a -5 to -13 feet per year decline. South Metro water providers continue to experience declines in aquifer levels and the cascading reduction in well yields.

Given the historic, current, and predicted declines in aquifer levels, the volume of Denver Basin Aquifer production will have a future economic limit which is likely to fall short of urban demands. Numerous studies between 2004 and 2013 all suggest that costs associated with continued reliance on non-tributary, nonrenewable groundwater are expected to be comparable or higher than costs for developing a regional renewable water supply system, thereby providing appropriate incentive to import renewable supplies that can be used conjunctively with the Denver Basin Aquifer.

Future Scenarios for Denver Basin Aquifer Groundwater Use

There are two likely scenarios for South Metro entities involving future use of Denver Basin groundwater: the first scenario is the status quo use of non-renewable groundwater supplies at increasing cost due to declining well production capacities. For the reasons discussed above, this scenario is generally unacceptable as it is an expensive and non-sustainable model.

A second – preferable - scenario is a large-scale conjunctive use plan involving development of renewable supplies and implementation of a robust wet-year aquifer recharge program in which reliance on Denver Basin Aquifer groundwater is primarily as a drought supply. While efforts to increase renewable supplies are currently underway, formalization of a significant conjunctive use plan involving a new transbasin diversion is urgently needed.

Such a conjunctive use plan can operate largely through existing and planned infrastructure. Water providers in the southern metro region rely on multiple wells for their water supply, and have constructed infrastructure connecting them with community water distribution systems. There are around 150 municipal supply wells in Douglas County alone. Recently, the WISE project included plans to link these service areas over the majority of the region. This will provide a water link both internally and to sources of renewable water from outside the region. The opportunity to recharge the Denver Basin Aquifers and a large-scale conjunctive use project is here.

Current annual well production in the area exceeds 40,000 afy (acre feet per year), which corresponds to an average rate of 35 mgd. Assuming the majority of wellfields are sized to meet summer demands and typically triple the average rate, there may be over 100 mgd of peaking capacity available in off-peak periods. With proper equipping and treatment capacity, a significant volume of renewable water could be supplied to the Denver Basin in wet periods for use during droughts.

A rough approximation of rates of flow into the aquifers can begin with the assumption that typical provider demands in the summer are sized for triple that year round rate, or 105 mgd in the aggregate. This leaves an average of up to 70 mgd in off-peak months. If off-peak demands are met with imported water making wells available for recharge, this rate could be returned to the aquifers for a total ranging between 25,000 and 45,000 af per year. Specific rates and durations of flows would be examined in detail during the feasibility review process. Generally, the initial projections affirm the potential viability of this concept.

The potential of a conjunctive use approach to integrating local non-tributary groundwater supplies and storage with interruptible surface water supplies from the South Platte and West Slope drainage basins was outlined in the State of Colorado's Metro Water Supply Investigation, Final Report (Colorado Water Conservation Board, 1998). Subsequently, the South Metro Water Supply Study (prepared for the South Metro Water Supply Study Board in February, 2004) carried the concept further through a joint effort between the Douglas County Water Resources Authority, Denver Water, and the Colorado River Conservation District.

Conjunctive Use is characterized as "The coordinated use of surface and groundwater resources and facilities to produce a larger, more reliable and cost effective combined water supply that could be generated from either source alone." (SMWSSB, page 1-12)

Centennial Water and Sanitation District in Douglas County has operated a conjunctive use plan since the early 1980's and an aquifer storage and recovery project with Denver Basin deep wells since 1992. The technology and recharge operation have met no significant impediments after over 20 years of and over 14,000 acre-feet of treated potable water back into the aquifers. South Metro WISE participants are currently evaluating the feasibility of expanding this operation with future WISE deliveries.

To date, many water suppliers along the Front Range who rely on deep bedrock aquifers have not been able to capture wet year supplies. With the addition of WISE Project infrastructure and Parker's Rueter-Hess Reservoir, the South Metro Area will soon have necessary infrastructure for a large-scale conjunctive use program. A large-scale conjunctive use plan could bring renewable surface water into the South Metro Region by utilizing:

- Interruptible raw water deliveries from existing transbasin diversion systems, Flaming Gorge, or another new transbasin project.
- Deliveries only in wet periods of low-risk hydrologic and administrative conditions.
- Distribution to existing deep aquifer wells equipped for recharge.
- Dry period use of reliable, drought-proof deep aquifer production to provide water when surface yields are not available.
- No increase of risk to yields controlled by partner entities.
- Protecting the integrity of the Colorado River Compact under a working cooperative operation.

This concept has been investigated and described for over 15 years (if not longer) by key parties who would potentially be involved and is now worthy of serious consideration by the IBCC and the CWCB through Colorado's Water Plan. This concept is recommended for further investigation and a role as a practical and viable means to manage Colorado's statewide water resources. It should be vigorously pursued in subsequent stages of the Colorado Water Plan.

Appendix G – South Platte Basin Surface Water Availability Analysis

South Platte Basin Implementation Plan

South Platte Basin Roundtable/Metro Basin Roundtable

April 17, 2015

Appendix H - Summary of Public Comments

South Platte Basin Implementation Plan

South Platte Basin Roundtable/Metro Basin Roundtable

April 17, 2015

1 Phase I

1.1 Public Outreach Meeting Comments

The below table summarizes comments from a series of public meetings held in 2014. The meeting dates were February 26, March 3, March 5, March 19, and April 10.

No.	Date Received	Comment	Type (Email, Letter, or Comment Form)
1	2/26/14	Hard to see how 73% of irrigated acres [Decrease of 27% = 831,000 acres yr 2014 to 607,000 acres yr 2050] By 2050 will increase or stabilize or solidity our food supply. If another chance to present this info in Fort Morgan arises we would be able to get more attendance/input. See need for more storage reservoirs Against buy & dry	Comment Form
	Response	*The South Platte BRT will hold a roving BRT meeting in Sterling during the second phase. The South Platte BIP supports the IBCC water planning strategy "Four Legs of the Stool" which includes using Conservation, Reuse, IPPs and New Colorado Supply to meet the future gap. All these elements would not be able to be achieved without additional storage.*	
2	3/5/14	REAL TIME MONITORING & MODELING Solves high ground water problems – when you use interceptor wells when levels rise above optimal levels Lost Creek Basin – 500,000 acre feet & capacity Need some work to formalize agreements to satisfy concerns of farmers – municipal – MUCH less than $20million I BET! AVAILABLE NOW – BEEN TALKED about for decades! HOW MUCH MORE WATER FLOWS OUT-OF-STATE BEFORE WE START TO UTILIZE IT? WHAT BOB LONGENBAUGH SAID	Comment Form
	Response	*The CDWR has implemented a monitoring system under a WSRA grant. The SP BIP recommends that a sustainable funding source for this program be found so that it can continue in the future. Additionally, the SP BRT Groundwater subcommittee is reviewing recommendations from HB 1278 report. The BIP supports the implementation of more storage to further utilize South Platte native flows.*	
3	3/3/14	Non consumptive: Q. Existing Watershed Management Plans identifying critical watershed needs and management actions: Upper Clear Creek Watershed Plan – to be released March 2014 Includes management action & suggested project identification areas. Counties included – Jefferson, Adams, Gilpin, Clear Creek For information and electronic share of plan and maps contact either UCCWA – Upper Clear Creek Watershed Association or Dave Holm, Executive Director Clear Creek Watershed Foundation (3) 567-2699 * I understand various member of UCCWA have attended meetings related to this process over the years. I do not believe the most current information, which includes needs and management actions has been suggested that a formal presentation must be requested to the round tables to request inclusion in plans. I have included contact person/organization above to trigger that action.	Comment Form
	Response	*Various watershed plans were briefly reviewed during the reference review for the SP BIP. The summary of the review is included in Appendix D. Specific projects were included in the SP BIP as agreed upon by the environmental and recreational subcommittee.*	

4	3/3/14	How are microplastics in estuary systems being prevented? Microplastics are plastics deteriorating over time into smaller pieces, small plastics from makeup, litter and industrial spillage as well as other sources. Primary scientific studies are finding this phenomena become prevalent in the Great Lakes as well as estuaries and island beaches. Methods of remediation, including adequate storm water cleansing have been difficult to pass on a global level. I believe this should be examined in Colorado's long term awareness and planning to protect our ecosystems – see 5gyres.org Are public access water fountains being included in recreational planning? This can help minimize pollution while building awareness. Recycling should be available. Can you cut out single use plastic water bottles at your meetings? How is fracking water being recycled?	Comment Form
	Response	*Thank you for you comments. Public access water fountains are a decision for individual water providers. Additional discussion was included regarding fracking water use.*	
5	3/5/2014	P.A.U.L. E.D. Water Protect - Public interest in water Access – Public Bridge Access to streams Use (non-consumptive) Label – Label water value on food, etc like nutritional values in grocery stores E Educate – increase integration of water uses in K-12 curriculum Water	Comment Form
	Response	*Thank you for your comments. We will consider these when developing the Draft BIP.*	
6	3/3/14	The City of Black Hawk has 3 new reservoirs planed for a total of 1660AF plus an expansion of an existing reservoir by 600AF I want to make sure the following reservoirs are listed as an identified projects list Quartz Valley Reservoir – 600AF Missouri Creek Reservoir – 600AF Pickle Gulch Reservoir – 460AF Expand Chase Gulch Reservoir – 600AF	Comment Form
	Response	*Thank you for your input. Additional information (i.e. project sponsor(s), estimated firm yield, construction timeline, anticipated cost) would be needed by CWCB staff to include as a new IPP.*	

7	3/5/14	According to “The Evolution of The South Platte River” by Bart Woodward The “Natural Flows” of the river were overappropriated about 1880. Ditch diversions constructed after that date created The South Platte River as we know it today. In the early years Nebraska encouraged development of diversions along the river, because every diversion created more return flows, that didn’t exist before. Thus creating a live river for a longer tine during the summer. Irrigation wells started being drilled from 1920-1950 & 1960’s. These wells were drilled to supply water when ditch diversions were inadequate during periods of drought. This once again to additional stream flows extending the live river. In 1965 the river was again overappropriated. This overappropriation is what led to the 1969 Water Act. You can see from the attached “South Platte River Facts” That there are from 13 to 15 million acre feet of Ground Water storage available. Since the drought of 2002 more than 500 augmentation plans have been implemented and another 200 are in planning stages. High water tables have been recorded & recognized by results of HB-1278. Utilization of existing irrigation wells Brighton to Kersey would maximize “beneficial use” of ground water reservoir without spending a dime. High water tables would disappear. It is ludicrous to be sitting on a reservoir of 13 to 15 million AF and not use a portion of it. (see list below) **South Platte River Facts** Surface Reservoir Storage 1,000,000 AF Groundwater Storage 10,500,000 AF + Potential More G.W. Storage 3,500,000 AF Annual Diversions from River 4,000,000 AF Number large capacity wells 9,000 Annual volume pumped 1,000,000 AF Annual Flow from mountains 1,200,000 AF 2002 flow from mountains 300,000 AF Transmountain Diversions 600,000 AF Phreatophyte C.U. (consumptive use) 429,000 AF	Comment Form
	Response	*Thank you for your comments. Consideration of increased groundwater use will be incorporated into the Draft SP BIP.*	
8	03/17/14	The water table is too high-our vegetable crops die because of too much water. Corn is stunted. The high water table is pushing salts up and killing the soil. Our septic tank system is straining to keep up. And to this, the wells on our farm have been shut off and people out East are allowed to drill new wells, install pivots and water previously dry land! This problem has been “studied” to death. How many years? How many millions? (SPDSS) Now more studies. Do something – They did 10 years ago without all these studies. Two lawyers using black magic and sky hooks got hundreds of wells shut off and caused all this. No proof, no science. We attended the annual CCWCD meeting held at Greeley, CO March 11, 2014. In the presentation, the water engineers, and Central Water District acknowledges that we have Over Compensated augmentation, resulting in these huge problems for many of us. The remedy is to allow more pumping (Presently) both irrigation wells have been shut off that once irrigated our fields, resulting in no water to irrigate the crops we grow to make a living. The very little surface water (5 shares) does not even reach the farm down the ditch, it seeps away before it can be used. We used the wells to supplement the irrigation.	Comment Form, US Mail
	Response	*The SP BRT Groundwater subcommittee is currently reviewing recommendations from HB 1278 report.*	

9	3/18/14	Farmers care about the environment as much as anyone. The environment is our Life and livelihood. However, the trees and plants in the South Platte River are out of control. The phreatophytes use approximately 350,000 to 400,000 Acre FT. of water per year. Agriculture uses about 80,000 Acre FT. a year, as presented at the annual CCWCD meeting on March 11, 2014. The 2 wells on our farm were totally shut down, which was the irrigation water. We tried to use the 5 shares of surface water ("ditch water"), to supplement the wells. The surface water is so little that it did not reach our farm from the headgate as it seeps away in the ditch before it arrives here. We joined Central in a water substitute plan (WAS). To join was $5,000.00 and annual assessments were $3,000.00 and rising to $5,000.00. Because of very little income from the farm, and the financial hardship imposed upon us, we could not remain in the WAS plan of CCWCD, and dropped out. We are in a special taxing District for WAS. We are located 1 ½ miles east of the So. Platte River in District 2 in the Platteville/Gilcrest area. Our post pumping depletions were paid back (replaced) while we were still members of WAS as confirmed by engineering. Now, we are getting a "second hit" and more damages. We are not able to use the ground water conjunctively causing our agriculture land to be unproductive, and by being burdened with high water levels, with water rising in the fields and in our septic systems. WE NEED RELIEF. It is not fair, but is wrong and immoral to take our hundreds of <u>new</u> wells for irrigating land that have not been previously irrigated, this is because of over water augmentation resulting in a high water table. At the CCWCD meeting, CCWCD and Colo. State speakers said the wells have been overaugmented causing the high water table. PS. Please see enclosed information regarding the well augmentation subdistrict (WAS). (Scanned and entered below) 	Comment Form by mail
	Response	*Thank you for your comment*	

Augmentation Subdistrict

"Fighting about water is nothing new. Living with limited water resources brings out the worst and best in people."

CREATED in 2004, the newest subdistrict in the Central Colorado Water Conservancy District has already been through many battles. The story began in 1969 when the Colorado state legislature passed an act requiring alluvial wells to participate in the priority system. In this system of **"first in time, first in right,"** newer or "junior" water rights cannot be used if there a senior **"call"** or demand on the river.

Since wells typically need to operate during the peak spring and summer months, the legislature also passed a law allowing wells to pump out-of-priority if they had an **augmentation plan.** A state approved augmentation plan delivers alternate water sources to the South Platte River to cover any depletions caused by pumping.

The Groundwater Appropriators of the South Platte **(GASP)** provided a temporary plan for thousands of well owners in northeastern Colorado. In 2004 this group disbanded, leaving all those wells unable to pump. Central's board of directors made the decision to aide as many of these people as possible.

The Well Augmentation Subdistrict (WAS) accepted 440 of these displaced wells into a new plan. The initial fee to join - $5,000 per well - was used to mitigate the costs of purchasing water rights and storage.

WAS covers approximately 40,093 acres, or 63 square miles. There are an estimated 561 taxpayers. There are 210 Class D Contracts and 214 wells in the plan.

Augmentation plans are also required by the state to obtain a **decree** from their water division water court. A decree is the legal document signed by a judge showing the plan has sufficient water sources to cover the depletions created by pumping. During this lengthy process, the Subdistrict was allowed to operate under a temporary **"Substitute Water Supply Plan"** approved by the State Engineer.

In 2003 the Colorado Supreme Court determined that the State Engineer did not have the authority to administer Substitute Water Supply Plans. Objectors to the filed plan for Augmentation were also claiming damages from the pumped wells. These 2 factors, combined with the worst drought in over 300 years in Colorado, meant disaster for members of WAS.

The Subdistrict agreed to discontinue operation until such time as the augmenation plan went to trial in water court. Additionally, half of the wells were deleted from the plant to bolster obtaining a decree.

The case went to trial in the spring of 2007.

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10	4/01/14	At the March 19 SPBIP meeting in Fairplay a Park County Commissioner stated that there was no new supply of water available to the South Platte River Basin. I am writing this letter to disagree and to suggest new water supply sources. I heard three possible sources of new supply mentioned at the March 19 meeting. They were conservation, re-use, and the capture of excess water in new or expanded reservoirs or the pumping of excess water into underground aquifers. These are all good ideas and I would like to support them. I would like to offer five more suggestions for new supplies of water. Cutting trees in the mountain forests to create gaps in the canopy. The gaps could collect snow during the winter and allow it to melt into streams in the spring. Leaving the canopy intact would allow the snow to either not be deposited or to evaporate into the air. Cutting Gaps in the trees would require coordination with the Forest Service and possibly the EPA. Cutting trees along rivers to reduce the amount of water transpired to the atmosphere by the trees. This was suggested be a water engineer (retired?) at the March 3 SPBIP meeting at the Tivoli center. Cutting a significant number of trees along the South Platte would require co-ordination with recreational groups that would want their riverside paths shaded. Recover the water produced by our power plants that burn natural gas. Conceptually this could be accomplished by running the power plant exhaust through a condenser to collect the water produced by burning methane, [$CH_4 + 2O_2 = CO_2 + 2H_2O$]. Condensing water from flue gas is already being done in the Middle East and North Africa. My calculations suggest that for every Mcf of Natural Gas burned .02 acre feet of water can be recovered. In 2010, Colorado burned 150000 Mcf of natural gas for electrical power. That could mean 3000 acre feet of new supply. Recover water produced from oil and natural gas wells when they hit horizons of brine in the drilling process. The brine would have to be desalinated and there might be only enough produced to offset the water required for fracking. Still, buried seawater is a potential source of new supply and should be investigated. Desalination of ocean water is a source of new supply. Colorado could help build a desalination plant in California or Texas, supply natural gas to run the plant and arrange for the water produced to be exchanged for water that Colorado would no longer be required to let flow out of the state. New laws would have to be created to allow exchanges between states, but creating new laws to facilitate problem solving is what governments should do. Whether any of the above ideas would be considered outlandish or not depends on the cost of every acre-foot produced. A good decision point for landish or outlandish might be $2000 per acre-foot, the price San Diego has decided to pay for desalinated water in California. I would consider water transfers from Hudson Bay, the Missouri river or even the Western Slope outlandish because the transfers do not create water they merely move existing water someplace else, possibly creating shortages for the source areas.	Comment form/by mail
	Response	*Thank you for your comment. These suggestions will be considered in the development of the Draft SP BIP.*	
11	4-10-14	One of Largest Water Storage Facilities in World. Hardly any Evaporation Ogallala Aquifer Pick a location or multiple locations Red lion Road, to State Line. Develop a way to inject extra water that flows in high water flow times w/low use Never let 1 extra gallon flow into Nebraska than what is required. Store the water there (in Aquifer) until needed allowing republican River basin to remove half of it and save half of it for later for urban use. Would have to change basin rules to allow export of water but if importing could export it as long as below amount injected. Say 50% Challenges: Management, $$, underground loss to Nebraska. Compact,	Comment Form
	Response	*Thank you for your comment. Both groundwater and surface water resources are important components within the South Platte Basin. These suggestions will be considered in the development of the Draft BIP.*	

1.2 Online Survey Responses

The questions below were part of the Phase II online survey available at www.southplattebasin.com. The Phase I survey was available online from 02/2014 – 12/2014.

Questions		What ideas do you have for meeting existing and future water needs?	Response	Do you have additional input for the South Platte Basin Implementation Plan? If so, please provide:	Response
Responses	09/23/2014	More water storage for wet years.	*The South Platte BIP supports the IBCC water planning strategy "Four Legs of the Stool" which includes uses Conservation, Reuse, IPPs and New Colorado River Basin Supply to meet the future M&I gap. Additional storage is integral to all of these components.*		
	06/25/2014	Stop the unfettered urban sprawl, for which we don't have the resources. Our population had grown dramatically since the last water agreement with surrounding states, but we still only get the Orion of water for a small population. Perhaps revisiting that agreement to gain more water based on our percentage of population over our historical levels would be a better place to start. Why do other staff have green yards, but we want to raid and pave over our farms and further delete or natural resources. We're only cannibalizing our own state.	*An overarching theme of the SP BIP is to identify solutions that are pragmatic, balanced and consistent with Colorado Law and property rights.*	Moving water from the W. Slope and San Luis Valley to meet Metro needs eliminated the source of exasperation that eventually falls here. If we dry that up to waser our yards, we will create an ever greater drought and dust bowl situation than we've seen over the past twelve years. The more we cover the natural ground with more asphalt and homes, the more heat this area released, endorsing and drugging up even the small amount of water we have available here.	*Additional supplies from the Colorado River Basin may be needed to meet future M&I demands in the South Platte Basin. The Roundtables support a balance program to plan and preserve options to develop Colorado River Basin Water in the future.*
	05/13/2014			We reviewed the "WQCD_20140418_CWP Revised Water Quality Section.pdf" document and have the following comments: 1) Page 2, Section 5.4.1.1. This bullet is very confusing with the way it is structured, needs to be rewritten. The ideas switch back and forth from one topic to another with no transition. Doesn't explain how recreational fishing is related to stratification and release from dams. 2) Page 4, Section 5.4.1.2. Third paragraph. Needs to be rewritten for clarity. Starts out with discussion of 401 then jumps to 404 without any transition. Definitions are unclear. Run-on sentences.	*This comment refers to the Draft CWP.*
	05/07/2014	Lots of conservation in the cities, particularly landscaping. Fallow some farms in drought and willing seller sales of agricultural water rights. Don't ruin the mountain streams with crazy ideas about diverting them, we've done enough of that. Protect the environment of Colorado. We're in the west man, there will never be enough water, you'll be talking about the next need the next drought.	*South Platte and Metro Basins are one of the leaders in conservation practices. Alternative Transfer Methods (ATMs) may provide a means for agricultural producers to "share" their water with M&I users. The SP BIP strives to proactively identify and implement methods to protect and enhance environmental and recreational water uses.*		
	04/21/2014				
	4/21/2014				
	04/15/2014				
	04/15/2014	I believe we need more reservoirs for the larger populated areas and for recreation. I also believe landowners should have more flexibility in retaining water on their property for both fire prevention and personal use.	*The South Platte BIP supports the IBCC water planning strategy "Four Legs of the Stool" which includes uses Conservation, Reuse, IPPs and New Colorado Supply to meet the future gap. Additional storage is integral to all of these components.*		
	04/15/2014	Allow food growers to have a high priority, allow the use of water for energy production.	*One of the ten "Plan Elements" in Section 5.5.4 of the SP BIP is to "minimize traditional agricultural buy-and-dry and maximize ATMs to where Practical and Reliable". The South Platte Basin is the leading agricultural producer in the State and the Plan supports maintaining the agricultural economy within the South Platte Basin.*		

	04/08/2014	Since ag is the primary use of water, I would encourage more conservation initiatives for ag, with possible subsidies.	*ATMs may provide a means for agricultural producers to "share" their water with M&I users and potentially reduce the negative socioeconomic effects to agricultural communities.*		
	03/27/2014	Urban and suburban water conservation should be the top priority in our basin. Smart growth and careful land use management is critical!	*The South Platte Basin and Metro basin have already achieve great reductions in their gallon per capita use and are pursuing even more aggressive conservation goals for the future.*		
	03/19/2014	water sharing between ag and utilities - longer term contracts (ATMs) for drought firming, recovery and unforeseen events (fire, floods, construction etc,). This includes helping utilities use the ag water they own w/o a change case (3 in 10) and or leasing of water owned by producers for these purposes.	*The South Platte is further exploring making ATMs a feasible options for agricultural and M&I users.*	The Poudre Basin Water Sharing Working Group funded by CWCB is working on prototype contracts for several water sharing mechanisms. They will improve the basin-wide data base, survey irrigators and utilities and ditch companies about their perceptions of each of 4 possible water sharing mechanisms: decree swaps, 2 kinds of interruptible supply and short-term leases. Contact is Mary Lou Smith at the Colorado Water Institute. We hope to look at potential for shared storage, dredging and water banking after the current work is completed	*Thank you for your comment. Your suggestions will be considered in the development of the Draft SP BIP*
	03/19/2014				
	03/14/2014	Improve open channel delivery systems through new technology	*Thank you for the recommendation. This type of improvement may be considered by individual water users or diverters throughout the basin as a mechanism for improving delivery efficiency.*	Improving the operation of canal systems could make 50% water more available to its intended use. This was proven in Australia	*Thank you for this recommendation. Implementation of canal system improvements may be too expensive for individual systems to implement. Cost sharing mechanisms will need to be explored to make efficiency improvements economical.*

2 Phase II

2.1 Online Survey

The questions below were part of the Phase II online survey available at www.southplattebasin.com. The survey was available online from 01/2015 - present.

Question 1	What water needs are most important to you? Select all that apply.					
Survey Date	Agricultural	Environmental	Industrial	Municipal / Residential	Recreational	Other
02/25/2015						Other
02/10/2015	Agricultural	Environmental	Industrial	Municipal / Residential	Recreational	
02/04/2015	Agricultural					
01/25/2015	Agricultural			Municipal / Residential		
01/18/2015	Agricultural	Environmental	Industrial	Municipal / Residential		
01/14/2015						
Totals	4	2	2	3	1	1

Question 2		Comment	Response
The solutions to our water supply challenges as proposed in the South Platte Basin Implementation Plan are comprehensive.	Strongly agree		
	Agree	What of the once-considered idea of transferring water from the Missouri River in eastern Nebraska/Kansas via pipeline? The Colorado River Basin cannot be the solution for the front range issues, IMO.	*Thank you for your comment. Importing water from other basin outside of Colorado may be considered in the future.*
	Strongly disagree	Nothing new in this document	*Noted.*
	Agree	Need to get the Bur. of Reclamation involved. For Olympus Dam and Lake Estes: use for flood control as well as agriculture goals. During flood water conditions, need to have capacity and rules that allow such water to be diverted to the Flat Iron/Carter Lake complex (note: Carter Lake was at low water levels during the 2013 Flood.	*Thank you for your comment. Expansion of existing infrastructure, such as reservoirs, may be a more economical solution than development of new reservoirs. This type of option will be incorporated into the Final SP BIP.*
	Strongly agree	One major source of water waste is dirt irrigation ditches that leak badly. There are many miles of ditches in that condition in the South Platte basin. The issue must be addressed.	*Thank you for your comment. Development of irrigation ditches in Colorado began in the 1850s. Lining of ditches throughout to SP Basin would be cost prohibitive, however, localized solutions may be explored to improve delivery efficiency.*

	Strongly agree	Much water can be saved if we look at lawn watering usage. I know my water consumption goes up, (I live in town), 300-400% in the summer months. Restrictions on the sizes of grass lawns, in ratio to house size, could be implemented, over time. These lawns are mostly just something pretty to look at and could be replaced by fake grass or xeriscaping, retaining aesthetic value, and saving a lot of water.	*Thank you for your comment. Higher levels of conservation will require broad statewide support and political will beyond the purview of water utilities within the South Platte Basin alone. Greater savings in outdoor water use would require major changes in landscaping that moves beyond just efficiency measures; this would involve lifestyle considerations about our urban environments. These decisions must be made and implemented at the broader community level, as well as at the water planner level.*

Question 3	Comment	Response
Finding solutions to the water supply challenges faced by the South Platte Basin is critical to the future quality of life and economic prosperity of the region.	Strongly agree		
	Strongly agree	See above	*Noted.*
	Strongly agree		
	Strongly agree	Regarding my list in question 1, I could have checked all of them. I only checked two of them so as to rank them higher in priority.	*Noted.*
	Strongly agree		
	Strongly agree	The criminalizing of catching rain water off my roof, to water my vegetable garden, I find oppressive and criminal in itself. If you figure out the roof areas, compared to open ground in Colorado, I think you'd find it very minimal, therefore effecting the recharging of aquifers very little. And if you take into account that people using this rainwater, would not have to pump it out of there wells, or tap city supplies, nobody is gaining anything. The only thing this law really does, is oppress the people, with another useless law.	*Thank you for your comment. The solutions identified in the SP BIP must be consistent with existing Colorado Water Law and property rights. Future legislative changes may provide an opportunity for rainwater harvesting on a statewide basis. The State of Colorado has authorized a pilot study for rain water harvesting.*

Question 4	Comment	Response
Do you agree that the Basin Roundtables are working to create balanced plans that consider all water needs?	Agree		
	Neutral		
	Strongly disagree	The Ag representatives don't say much...	*Noted.*
	Neutral	Saw a notice, but could not attend. So I don't know. Hope they weren't all one-sided, like "Save-the-Poudre.	*Noted.*
	Neutral		

Question 5	Comment
How would you rank your understanding of overall water resource issues in the South Platte Basin?	Strong	
	Intermediate	
	Strong	
	Intermediate	My training was (am now retired) in geology and earth sciences.
	Fair	
	Intermediate	

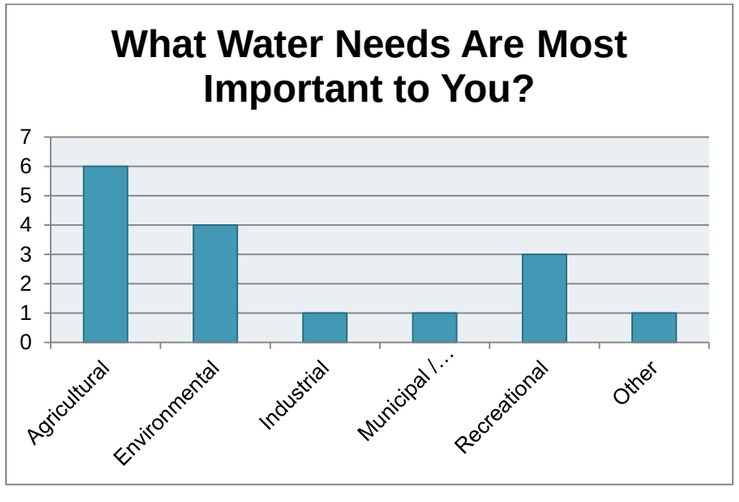
Question 6		Comment
Before visiting this site, rank your understanding of the BIP's purpose and content.	Intermediate	
	Poor	
	Intermediate	
	Intermediate	
	Fair	
	Fair	

Question 8	How did you hear about this survey?					
	Internet	Newspaper	Email	Referral	Word of mouth	Other (please specify)
02/25/2015	Internet					
02/10/2015				Referral		
02/04/2015			Email			
01/25/2015		Newspaper				
01/18/2015		Newspaper				
01/14/2015		Newspaper				
Totals	1	3	1	1	0	0

Question 9	In the future, I would like to learn more about the BIPs via:					
	Website	Public meeting	Emails	Webinars	Written articles	Presentations
02/25/2015			Emails			
02/10/2015	Website				Written articles	
02/04/2015		Public meeting				
01/25/2015			Emails			
01/18/2015	Website	Public meeting				
01/14/2015						
Totals	2	2	2	0	1	0

2.2 Phase II - Roving Basin Roundtable Meeting Surveys

Please answer the following:										
Questions		The scope and goals of the Basin Implementation Plans were adequately explained in this meeting.	The solutions to our water supply challenges provided at tonight's meeting are comprehensive.	Finding solutions to the water supply challenges faced by the South Platte Basin is critical to the future quality of life and economic prosperity.	Based on the information presented tonight, do you agree that the Basin Roundtables are working to create balanced plans that consider all water needs?	How would you rank your understanding of overall water resource issues in the South Platte Basin?	Before tonight's meeting, rank your understanding of the BIP's purpose and content.	Before tonight's meeting, were you aware of the Basin Implementation Plans and Colorado's Water Plan?	How did you hear about this survey?	In the future, I would like to learn more about the BIPs via:
Responses	1/13/2015	Agree	Agree	Strongly Agree	Strongly Agree	Strong	Strong	Strong		
	1/13/2015	Agree	Disagree	Strongly Agree	Neutral	Strong	Strong	Strong		
	1/13/2015	Agree	Agree	Strongly Agree	Agree	Intermediate	Intermediate	Strong	Email	Email/ Website
	1/13/2015	Neutral	Neutral	Strongly Agree	Neutral	Strong	Intermediate	Strong		
	1/13/2015	Strongly Agree	Agree	Strongly Agree	Strongly Agree	Strong	Intermediate	Strong	Word of Mouth	
	2/10/2015	Agree	Neutral	Agree	Agree	Strong	Intermediate	Strong	Email	
	2/10/2015	Agree	Neutral	Agree	Agree	Strong	Intermediate	Strong	Email / Referral	Email/Public Meeting



South Platte Basin Implementation Plan

Metro Basin Roundtable

South Platte Basin Roundtable

April 17,
2015

HDR

West Sage
water consultants

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Acknowledgements

The South Platte Basin Implementation Plan (SP-BIP) could not have been developed over the past eighteen months without the involvement and guidance of many individuals, committees and organizations with deep commitments to comprehensive water management in the South Platte and Republican River Basins. HDR Engineering and the West Sage Team are very grateful for the generous support provided to us. First, thank you to the South Platte and Metro Roundtables for entrusting the important work of developing this plan to us. Second, we especially appreciate the direction of the two committees (Metro's BIP Committee and the South Platte's Rio Chato Committee) who were assigned by the Roundtables to do the "heavy lifting" during the development, writing and editing of the SP-BIP. The dedication and support of the people comprising this joint committee brought many important and diverse viewpoints to the SP-BIP. In particular, we thank those individuals who routinely took time each week to coordinate with our teams to shape the approach, technical information, and tone presented in the SP-BIP. We also owe significant thanks to the Environmental and Recreational Subcommittee, supporting West Sage in the development of the environmental and recreational portions of the SP-BIP. The balance and thoughtful advice of the subcommittee members brought important perspectives into the report and helped to provide a well-rounded document. Please see the membership lists for these groups below

The SP-BIP builds on a great deal of previous work prepared by the State of Colorado. We are very appreciative of the support provided to us by John Stulp, special water policy advisor to Colorado Governor John Hickenlooper, to the staff of the Colorado Water Conservation Board, especially Rebecca Mitchell, Jacob Bornstein, Craig Godbout and Brent Newman and to the State's consulting team on the Statewide Water Supply Investigation, led by CDM-Smith.

Metro Roundtable BIP Committee:

Mark Koleber	Metro Roundtable Chair
Eric Hecox	South Metro Water Supply Authority
Marc Waage	Denver Water
John Kaufman	Centennial Water and Sanitation Authority
Joe Stibrich	Aurora Water
Peter Nichols	IBCC Representative
Barbara Biggs	CDM Smith
David Nickum	Trout Unlimited
Julio Iturreria	Arapahoe County
Tom Bellinger	Metropolitan State University of Denver

South Platte Roundtable Rio Chato:

Joe Frank	South Platte Basin Roundtable Chair
Sean Cronin	St. Vrain and Left Hand Water Conservancy District

Mike Applegate	Northern Colorado Water Conservancy District
Rich Belt	Xcel Energy
Jacob Bornstein	CWCB
Sean Conway	Weld County Commissioner
Frank Eckhardt	Eckhardt Farms, Inc
Harold Evans	Evans Group, LLC
Joe Frank	Lower South Platte Water Conservancy District
Jim Hall	City of Greeley
Diane Hoppe	CWCB
Larry Howard	City of Loveland
Julio Iturreria	Arapahoe County
Lynda James	Upper South Platte Water Conservancy District
Andy Jones	Lind Lawrence & Ottenhoff LLP
Greg Kernohan	Duck's Unlimited
Erin Messner	Aurora Water
Rebecca Mitchell	Colorado Water Conservation Board
Douglas Robotham	The Nature Conservancy
John Stencel	Rocky Mountain Farmers Union
Bob Streeter	Environmental and Recreational Subcommittee Chair
Eric Wilkinson	Northern Water Conservancy District

Environmental and Recreational Subcommittee:

Bob Streeter	Subcommittee Chair
Barbara Biggs	Metro Wastewater Reclamation District
Billy Gascoigne	Ducks Unlimited
Casey Davenhill	Colorado Watershed Assembly
Pete Conovitz	Colorado Parks and Wildlife
David Nickum	Trout Unlimited
Daylan Figgs	City of Fort Collins
Douglas Robotham	The Nature Conservancy
Greg Kernohan	Ducks Unlimited
Jeff Shoemaker	The Greenway Foundation
Jeffrey Boring	Larimer County
Jim Hall	City of Greeley
John Sanderson	The Nature Conservancy
Julia Firl	Ducks Unlimited
Ken Kehmeier	Colorado Parks and Wildlife
Larry Howard	City of Loveland
Lynda James	Upper South Platte Water Conservancy District
Meg White	The Nature Conservancy
Nathan Fey | AW	American Whitewater
Sean Cronin	St. Vrain Left Hand Water Conservancy District
Susan Smolnik	City of Fort Collins

Foreword

At the request of Governor John Hickenlooper, the State of Colorado has begun to develop "Colorado's Water Plan". As part of the plan, "Roundtables" across the state are developing Basin Implementation Plans (BIPs) which will be incorporated in Colorado's Water Plan as appendices. Colorado's Water Plan is intended to set a course for water planning on a statewide level in Colorado, utilizing a grassroots approach that incorporates local knowledge from each river basin. It is the hope of the South Platte and the Metro Basin Roundtables that the South Platte Basin Implementation Plan (SP-BIP) will serve as a first step towards decisive action to address Colorado's water needs now and in the future.

The SP-BIP, as a piece of this larger project, has been developed in a collaborative effort by the South Platte and Metro Basin Roundtables (BRTs). As a Joint BRT, they engaged two consulting teams to develop the SP-BIP. HDR Engineering, supported by MWH Americas, Inc., was tasked by the BRTs with developing the portions of the SP-BIP related to consumptive water uses including municipal, industrial, and agricultural uses. The West Sage Water Consultants Team was tasked with developing the information related to environmental and recreational uses. The work of HDR Engineering and West Sage has been integrated in this document to form the SP-BIP. Key members of the consulting teams are listed on the following page.

Public input from all categories of water interests in Colorado is critical to formulate a balanced SP-BIP and a successful CWP. To engage the public in the development of the SP-BIP, the Metro and South Platte BRTs utilized multi-faceted communications and outreach tools to reach diverse stakeholders.

HDR Engineering Team

Matt Cook, P.E.
Project Manager
HDR

Britta Strother
Assistant Project Manager
HDR

Blaine Dwyer, P.E.
Principal-in-Charge
HDR

Stephanie White
Public Involvement Lead
HDR

West Sage Team

Laurel Stadjuhar, P.E.
Project Manager
West Sage Water Consultants

Karla Brown
Assistant Project Manager Outreach and Facilitation
The PR Company

Peter Mayer, P.E.
Assistant Project Manager
Engineering Services
Water Demand Management

Bill Miller, Ph.D.
Senior Advisor,
Environmental Flows, Fisheries and Aquatic Habitat
Miller Ecological Consultants, Inc.

Stephanie Fleckenstein, E.I.T.
Water Resource Engineer
HDR

Kara Scheel, E.I.T.
Water Resource Engineer
HDR

Casey Dick
Water Resource Engineer
HDR

Kathryn Weismiller
Technical Editor/Environmental Specialist
HDR

Enrique Triana, Ph.D. , P.E.
Hydrologic Analysis
MWH Americas, Inc.

Chip Paulson, P.E.
Technical Review
MWH Americas, Inc.

Stephen Goodwin, Ph. D.
Environmental Engineer
MWH Americas, Inc.

Katy Reagan
Wildlife Biologist
Sunbird Biological Consultants

Steve Malers
Senior Advisor, Hydrologic Modeling
Open Water Foundation

Courtney Black, P.E.
Shaden Musleh, P.E
Task Leaders, Hydrologic Modeling, Agriculture
AMEC

Tim Steele, Ph.D.
Senior Advisor, Water Quality
TDS Consulting Inc.

Ray Dunn, P.E.
Agriculture, Modeling, Implementation
Colorado Water & Civil Contractors

Table of Contents

S Executive Summary S-1
S.1 Colorado's Water Resources S-1
S.2 Basin Roundtables S-2
S.3 South Platte Basin Water Supply Challenges S-3
S.3.1 Limited Native Water Supply in the South Platte S-4
S.3.2 Successive Use, Conservation, and Reuse S-4
S.3.3 Groundwater and Aquifer Storage and Recovery S-6
S.3.4 Interstate Water Commitments S-7
S.3.5 Environmental Permitting Processes and Threatened and Endangered Species Recovery S-7
S.3.6 Environmental and Recreational Uses S-8
S.3.7 Water Quality Issues S-8
S.4 Solutions for the South Platte S-9
S.4.1 Making Choices S-9
S.4.2 Strategic Overview S-10
S.5 Implementation S-11
S.5.1 Maximize Implementation of IPPs S-11
S.5.2 Maintain leadership in conservation and reuse and implement additional measures to reduce water consumption rates S-12
S.5.3 Maximize use and effectiveness of native South Platte supplies S-13
S.5.4 Minimize traditional agricultural "buy and dry" and maximize use of Alternative Transfer Methods (ATMs) to extent practical and reliable S-13
S.5.5 Protect and enhance environmental and recreation attributes S-14
S.5.6 Simultaneously advance the consideration and preservation of new Colorado River supply options S-14
S.5.7 Promote Multi-Purpose Storage Projects that Enhance other South Platte Basin Solutions S-15
S.5.8 Manage the risk of increased demands and reduced supplies due to climate change S-15
S.5.9 Facilitate effective South Platte communications and outreach programs that complement the state's overall program S-15
S.5.10 Research new technologies and strategies S-16
S.5.11 Advocate for improvements to federal and state permitting processes S-16
S.6 Summary S-16

List of Figures

Figure S-1. Colorado River Basins S-2
Figure S-2. The South Platte Basin S-3
Figure S-3. Remaining Gap by county (65% IPP Success Rate in the South Platte Basin and 88% IPP Success Rate in the Metro Basin) S-12

Acronyms

AF	Acre-feet
AFY	Acre-feet per year
ASR	Aquifer Storage and Recovery
ATMs	Alternative Transfer Methods
AWWA	American Water Works Association
BIP	Basin Implementation Plan
BMP	Best Management Practices
BRTs	Basin Roundtables
CAWS	Collaborative Approach to Water Supply Permit Evaluation
CBEF	Center for Business and Economic Forecasting
C-BT	Colorado Big Thompson
CCGA	Colorado Corn Growers Association
CDPHE	Colorado Department of Public Health and Environment
CDSS	Colorado Decision Support System
CDWR	Colorado Division of Water resources
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfs	cubic feet per second
CGWC	Colorado Ground Water Commission
Corps	United States Army Corps of Engineers
CRCA	Colorado River Cooperative Agreement
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Resource Program
CRSPA	Colorado River Storage Project Act
CRWAS	Colorado River Water Availability Study
CSA	Combined Service Area
CU	Consumptive Use
CU&L	Consumptive uses and Losses
CWA	Clean Water Act
CWCB	Colorado Water Conservation Board
CWP	Colorado Water Plan

CWRPDA	Colorado Water Resources and Power Development Authority
DBAS	Denver Basin Aquifer System
DCWRA	Douglas County Water Resource Authority
DNR	Colorado Department of Natural Resources
DPR	Direct Potable Reuse
ECCV	East Cherry Creek Valley
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
EQIP	Environmental Quality Incentive Program
ERMOU	Eagle River Memorandum of Understanding
ESA	Endangered Species Act
FRICO	Farmers Reservoir & Irrigation Company
FSA	Farm Service Agency
G&MOs	Goals and Measureable Outcomes
GIS	Geographic Information System
gpcd	gallons per capita per day
GW	Groundwater
GWMD	Ground Water Management Districts
HB	House Bill
IBCC	Interbasin Compact Committee
IPP	Identified Projects and Processes
IPR	Indirect Potable Reuse
ISA	Interruptible Service Agreement
ISF	Instream flow
IWR	Irrigation Water Requirement
LEDPA	Least Environmentally Damaging Practicable Alternative
LIRF	Lawn Irrigation Return Flows
M&I	Municipal and Industrial
MO	Measurable Outcome
MOA	Memorandum of Agreement
MODFLOW	Modular Finite-difference groundwater flow computer program
MPB	Mountain Pine Beetles
NAWQA	National Water Quality Assessment Program

NC	Nonconsumptive
NCNA	Nonconsumptive Needs Assessments
NEPA	National Environmental Policy Act
NGOs	Non-governmental organizations
NISP	Northern Integrated Supply Project
Northern Water	Northern Colorado Water Conservancy District
NPIC	North Poudre Irrigation Company
PACSM	Platte and Colorado Simulation Model
PEPO	Public Education, Participation, and Outreach
POR	Period of Record
PPCD	Pharmaceuticals and Personal Care Products
PRRIP	Platte River Recovery Implementation Program
RICD	Recreational in-channel Diversions
RO	Reverse Osmosis
ROD	Record of Decision
RRWCD	Republican River Water Conservation District
SB	Senate Bill
SDO	State Demographer's Office
SMWSA	South Metro Water Supply Authority
SP - BIP	South Platte Basin Implementation Program
SPDSS	South Platte Decision Support System
SRGAP	Southwest regional Gap Analysis Project
SSI	Self Supplied Industrial
SW	Surface Water
SWP	Surveyed Water Providers
SWSI	Statewide Water Supply Initiative
TDS	Total Dissolved Solids
TMD	Transmountain Diversion
USDA	United States Department of Agriculture
USGS	United States Geological Study
WEF	Water Environment Foundation
WERF	Water Environment Research Foundation
WISE	Water Infrastructure and Supply Efficiency

WQCD	Water Quality Control Division
WSL	Water Supply Limited
WSRA	Water Supply Reserve Account
WSSC	Water Supply Storage Company
ZLD	Zero Liquid Discharge

Executive Summary

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S Executive Summary

S.1 Colorado's Water Resources

Over the last decade Colorado has faced substantial and increasingly complex water-related challenges. The sources of these challenges are as diverse as the state itself. They range from competing water needs including agriculture, oil and gas, tourism, environmental, recreational, industrial, and municipal uses, to differing regional outlooks about water management based on the state's geography and demographics. It was this coalescing of challenges facing Colorado that demanded stronger action. Taken together these and other issues presented a call for executive-level action to align competing interests and outlooks under a unified vision for the future of Colorado water planning. On May 14, 2013 Colorado's Governor, John Hickenlooper, responded to this situation by issuing an Executive Order directing the Colorado Water Conservation Board to commence work on Colorado's Water Plan (CWP). As specified in the Executive Order, the CWP must integrate the following:

- A productive economy that supports vibrant and sustainable cities, viable and productive agriculture, and a robust skiing, recreation, and tourism industry
- Efficient and effective water infrastructure promoting smart land use
- A strong environment that includes healthy watersheds, rivers and streams, and wildlife.

Colorado's Water Plan tackles many water challenges faced by the state including:

- Addressing the projected municipal and industrial water supply gap that previous state reports indicate may reach 500,000 acre feet per year by 2050
- Addressing the largest regional supply gap in the South Platte Basin – the most populous and agriculturally productive Basin in the state
- Addressing how drought conditions worsen this projected supply gap
- Reducing the state's trend toward "buy and dry" transfers of water rights from agriculture to municipal use as demand increases
- Incorporating environmental and recreational values so important to the economy and quality of life in each of the state's river basins
- Addressing long-standing interbasin and intrabasin challenges through cooperative dialogue and action, including the basin roundtables and IBCC
- Recognizing that water quantity and quality issues in the state are integrally linked
- Addressing interstate water obligations for the nine compacts and two equitable apportionment decrees applicable to Colorado

In developing the Plan, the Governor directed the Colorado Water Conservation Board to utilize the existing system of Basin Roundtables established by the *Colorado Water for the 21st Century Act* in 2005. The Basin Roundtables were created to encourage locally-driven, collaborative solutions to the increasingly complex and controversial water questions facing the state.

Additionally, the Governor directed that Colorado's Water Plan should work to align state water projects, studies, funding opportunities, and other efforts. The Governor further directed that the Plan should improve the state's role in facilitating and permitting water projects, utilize the knowledge and resource of relevant state agencies, as well as assemble working groups and ad-hoc panels to address specific issues that come to light in the process.

The first draft of Colorado's Water Plan was developed and submitted to the Governor in December 2014. The work of the Basin Roundtables and the Colorado Water Conservation Board continues to form the foundation of the Plan as it is finalized for submission to the Governor in December 2015.

S.2 Basin Roundtables

As mentioned above, nine Basin Roundtables were established in 2005 to help manage and develop the state's water resources. This occurred in part as a response to the increasingly controversial and contentious water issues facing the state and in part to help proactively manage the changing water demands associated with the state's population.

Figure S-1. Colorado River Basins

The nine basin roundtables, as shown in Figure S-1, represent the major river basins of the state with one important exception: the South Platte Basin, which includes two roundtables, the Metro Roundtable and the South Platte Basin Roundtable. The factors affecting water in the South Platte River Basin, including the diversity of demographics and water uses for the urban portion of the basin versus the very different needs of agricultural users in other portions of the basin were deemed significant enough that the river basin was divided into two separate Basin Roundtables, one representing the Metro region of the South Platte and the other representing the remainder of the basin including the portion of the Republican River Basin in far Eastern Colorado. Given the integrated water needs of the two designated "basins," however, the South Platte Roundtable and Metro Roundtable decided to develop a single Basin Implementation Plan for the South Platte River Basin.

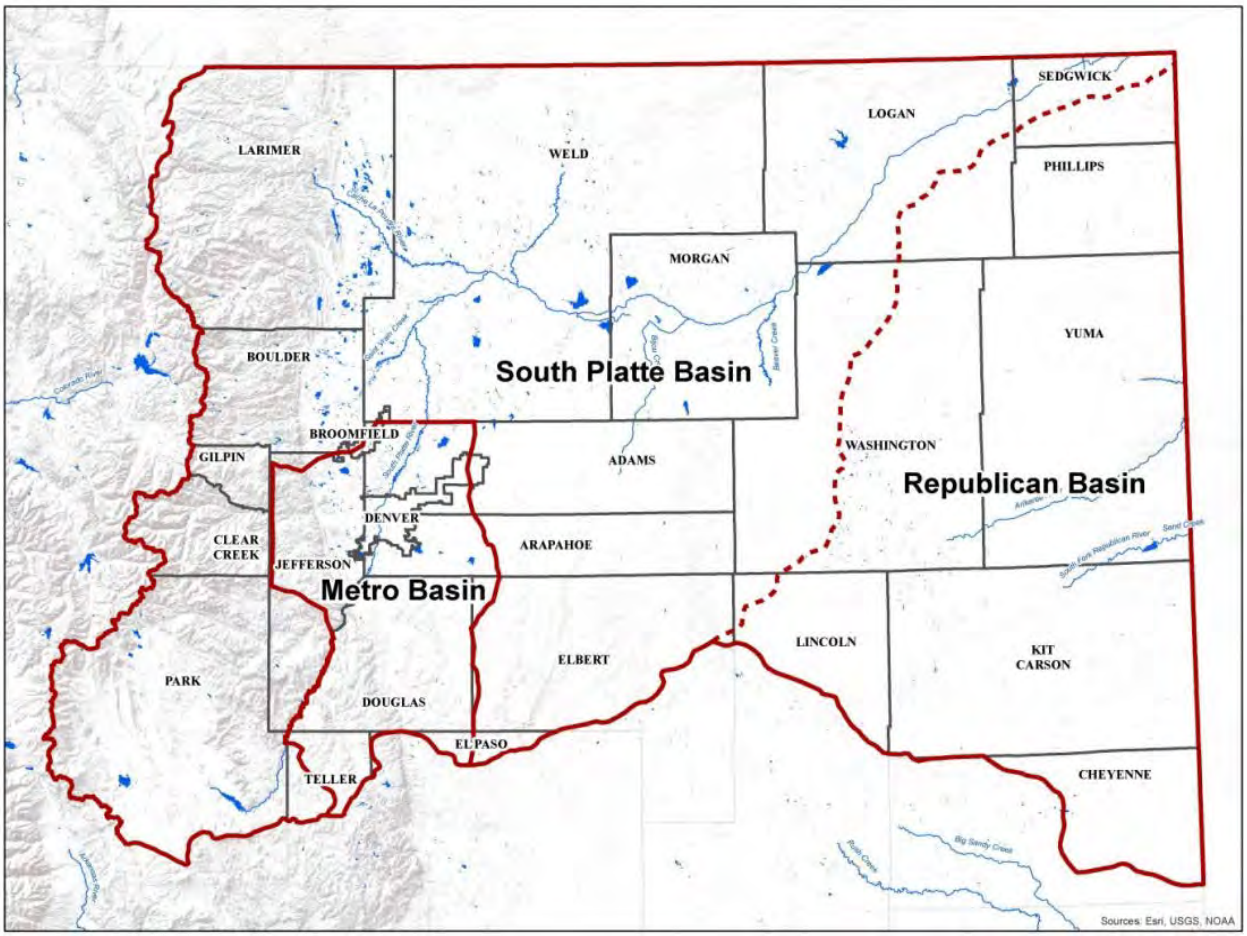

Figure S-2. The South Platte Basin

The South Platte Basin, as shown in Figure S-2, covers a large portion of Northern Colorado including 7 of the state's top 10 agricultural counties as well as major urban centers and diverse environmental and recreational attributes.

S.3 South Platte Basin Water Supply Challenges

The South Platte Basin supports a wide range of water needs including municipal, industrial, agricultural as well as important water-dependent ecological and recreational attributes. Coloradoans and tourists regularly enjoy the recreational opportunities provided by the many environmental features of the basin. Based on state Demographers Office population projections, the South Platte and Metro Basins are projected to grow from approximately 3.5 million people in the year 2008 to about 6 million people by the year 2050. Population growth will significantly increase the basin's future municipal and industrial water needs.

There are many water supply challenges and opportunities specific to the South Platte Basin which set the stage for analysis of water demand and implementation of satisfactory solutions. Familiarity with the South Platte's water issues by regulatory agencies, elected officials, the business community, and the general public will bolster Colorado's ability to maintain sustainable water supplies. This will help promote economic growth, public safety, and environmental diversity both within the South Platte

Basin and across the state. A good Colorado solution depends on a good South Platte solution.

Several water supply challenges specific to the South Platte Basin shape the ways that solutions for water availability in the basin are identified, analyzed and implemented. Below, these challenges are described in greater detail.

S.3.1 Limited Native Water Supply in the South Platte

The basin, in a typical year, has little unappropriated water available for new uses. Unappropriated flows in the basin often come in sporadic high peaks during wetter years, making the economics of building a reservoir to capture these supplies questionable because of the large carryover storage requirements. In the lower portion of the basin, where unappropriated flows exist in some years, efforts are underway to develop and use the water through conditional rights and existing projects. Unfortunately, unappropriated flows often occur in such infrequent and high magnitude peaks that they can not be captured and converted to reliable yield. This means that any new population or new economic activity requires a transfer of water away from another use, or the importation of new Colorado River water supplies. In recent years, these transfers have predominantly been from agriculture to municipal use – a process known as “buy and dry” where agricultural water rights are willingly sold to municipalities to supplement their supply, resulting in the loss of irrigated agricultural lands. Although this method can help to address the projected water supply gap, there are negative economic and environmental impacts associated with “buy and dry”.

S.3.2 Successive Use, Conservation, and Reuse

To address the basin’s water needs, water use efficiencies have been improved substantially along the South Platte, including successive use of water. The South Platte River is used and reused many times over to meet multiple needs. On average, South Platte Basin water is used seven times successively before it leaves the state at the Nebraska border. While this amount of successive use by downstream users is commendable, it can constrain the ability of water agencies to exchange water or to convey it back upstream, and can reduce the amount of water for downstream water users.

To establish water rights in Colorado, an emphasis is placed on the way that water is used. A key premise in Colorado water law is the concept of “beneficial use”, and specific water uses must be identified in order to receive a decree. These decrees also indicate whether a water right is limited to a single use or can specify the degree of reuse available. The limits placed on reuse of a water right frequently constrain or prevent water from being reused.

Additionally, because the South Platte relies heavily on return flows, expanded reuse is often simply a reallocation of water from agriculture to municipal uses, thus reducing the water available for agriculture, as well as environmental, and recreational purposes. Though only a limited amount of water is fully reusable under Colorado law, South Platte and Metro water providers are implementing innovative ways to reuse these supplies and are incorporating these projects as key components to meeting their long term needs.

Water providers in the South Platte Basin continue to seek expansion of their existing conservation programs for several reasons. Though these agencies have already implemented significant water conservation measures that are known nationally for their rigor, they plan to pursue even more aggressive conservation levels in the future. Some factors that limit the amount of conservation which can be implemented include the type of industry seeking water savings. Several industries within the basin including livestock operations, food processing, beverage production, oil and gas extraction, as well as mineral development, have significant water requirements which cannot be reduced indefinitely. In addition, indoor conservation measures can reduce the amount of available water for agriculture and environmental and recreational purposes by diminishing return flows the basin relies on. And finally, the wide range of cultures, community settings, and backgrounds within the basin affect lot sizing and landscaping and consequently result in a widely varying per capita water usage that cannot be approached with a “one size fits all” conservation approach.

S.3.3 Groundwater and Aquifer Storage and Recovery

Four types of groundwater are recognized in Colorado water administration: 1) tributary, 2) designated groundwater, 3) nontributary water outside of designated groundwater basins and 4) nontributary and not- nontributary Denver Basin bedrock water of the Dawson, Denver, Arapahoe, and Laramie - Fox Hills aquifers. Aquifer storage in the Denver Basin Aquifer System and conjunctive use of the alluvial aquifer and surface water present opportunities and challenges in addressing the future water needs of the South Platte River Basin.

The Denver Basin Aquifer System is an important, non-tributary, regional asset which is threatened by continuation or expansion of current withdrawal rates. The result is declining water levels and well productivity in large areas of the Aquifer. Conjunctive use of renewable supplies and the Denver Basin Aquifer System could provide promising opportunities for Metro municipalities to better manage water supplies through drought conditions and hydrologic variability. Additionally, new technologies for Aquifer Storage and Recovery (ASR) offer opportunities to use the Denver Basin Aquifer system for future water storage; however they require a reliable renewable resource to supply the recharge and provide strategies to meet EPA water quality requirements for injection water.

Alluvial aquifers (tributary groundwater) along the South Platte have been used historically by water users and continue to present opportunities for increased conjunctive use of surface and ground water supplies. However, numerous wells remain shut down or curtailed since 2006 due to a limited supply of affordable augmentation water in the central South Platte Basin to replace out-of-priority depletions from well pumping on other vested water rights.

In 2012, the Colorado Legislature passed HB-1278, entitled *Concerning the Authorization of a Study of The South Platte River Alluvial Aquifer*, directing the Colorado Water Institute (CWI) at Colorado State University to conduct a study of the South Platte alluvial aquifer. The HB1278 Study was completed in December 2013 and contained

Types of Groundwater in Colorado Administration

Tributary groundwater is underground water that is hydraulically connected to a stream system that influences the rate and/or direction of flow on that stream system.

Designated groundwater (1) is within the geographic boundaries of a designated ground water basin as created by the Ground Water Commission (2) natural course would not be available to or required for the fulfillment of decreed surface water rights. (3) Is in an area that is not adjacent to a continuously flowing natural stream where ground water withdrawals have been the principal source of water for at least 15 years prior to the first hearing on designating that basin.

Nontributary groundwater is "ground water, located outside the boundaries of any designated ground water basin in existence on January 1, 1985, the withdrawal of which will not, within 100 years, deplete the flow of a natural stream, at a rate greater than one tenth of one percent of the annual rate of withdrawal".

Nontributary and not nontributary of DBA is ground water located within those portions of the Dawson, Denver, Arapahoe, and Laramie-Fox Hills aquifers that are outside the boundaries of any designated ground water basin in existence on January 1, 1985, the withdrawal of which will (not nontributary) and will not (nontributary), within one hundred years, deplete the flow a natural stream...at an annual rate of greater than one-tenth of one percent of the annual rate of withdrawal.

several recommendations. The South Platte Basin Roundtable formed a "Technical Committee" to investigate these recommendations and develop specific direction to resolve issues where appropriate. The Technical Committee's current focus is the development of a basin-wide groundwater monitoring network and the mitigation of localized high groundwater conditions in the La Salle/Gilcrest and Sterling areas.

S.3.4 Interstate Water Commitments

South Platte River management is constrained by both interstate compacts and other programmatic and regulatory issues. The South Platte River Compact divides the waters of the South Platte River between Colorado and Nebraska, giving Colorado the right to fully use the water between Oct. 15 and April 1. During the irrigation season, Colorado must curtail water rights in Water District 64 that are junior to June 14th, 1897 if flows at the Colorado-Nebraska state line drop below 120 cubic feet per second. The State Engineer is authorized to administer the compact. In addition, compliance with federal programs for threatened and endangered species recovery also results in interstate water management commitments that are outlined below.

The Republican River Compact between Colorado, Nebraska and Kansas places severe constraints on Colorado residents living and working in this basin. The Republican River Basin is physically distinct from the South Platte Basin such that the Rocky Mountain snowmelt feeding the South Platte River does not benefit the Republican River Basin. Rather, the Ogallala Aquifer, which spans eight Great Plains states, supplies the basin's agricultural economy. According to the 2012 USDA agricultural census, Yuma, Kit Carson, Phillips, and Washington counties are among the top ten agricultural producing counties in the state. In these areas, irrigation with Ogallala Aquifer water contributes to superior crop yields but a declining groundwater table raises concerns about how much longer or to what degree the basin will be able to benefit from this water source.

S.3.5 Environmental Permitting Processes and Threatened and Endangered Species Recovery

Important species protection plans, namely the Platte River Recovery Implementation Plan (PRRIP), place restrictions on developing additional water supplies for the South Platte Basin. This three-state program protects the habitat of four endangered species that utilize the Platte River and riparian areas. The current program places specific constraints on approval of new water depletions and prevents certain types of new water storage facilities in the lower reaches of the South Platte River in Colorado.

In addition to the PPRIP, other regulatory and permitting issues significantly constrain water planning in the South Platte. A key constraint on the South Platte Basin is the ability to permit new reliable sources of future supply. Due to the unpredictable timeframes and requirements associated with federal (Clean Water Act, Endangered Species Act), state, and local permitting requirements, some water supply agencies have been pursuing permits for new water supply projects for ten years or longer without clear resolution. The resulting delays and the extended timelines for permitting water projects, cause a significant financial burden for Colorado residents and result in costly risks for water providers due to the uncertainty of being able to meet their customers' future needs. Given the immense need for water in the basin, permitting processes for major water projects in the state must improve their turnaround times and the

predictability of the process, while maintaining the needed environmental protections and mitigations.

S.3.6 Environmental and Recreational Uses

Preservation and enhancement of the environmental and recreational aspects of the South Platte River is important to Colorado's economy and quality of life. Water is needed to maintain aquatic, riparian and wetlands habitats that are essential for ecological diversity. In addition, flows in streams are essential to many recreational economies, including fishing, waterfowl hunting, skiing, flatwater and whitewater boating, and for general aesthetics near waterways, including greenways, trails and wildlife viewing. The important environmental and recreational values in the South Platte Basin must be considered when planning for Colorado's water future. Many of these attributes currently suffer due to current water diversions and infrastructure operations.

Maintaining or enhancing environmental and recreational attributes can be a constraint on potential future water development, however many opportunities exist to maintain these attributes while concurrently developing water supply projects. Multi-purpose projects or agreements for cooperative operation of existing projects to help benefit these important attributes should be considered when projects are planned to help meet water needs. Additional projects to address these needs should be considered including environmentally friendly diversion structures, restoration of habitat and stream channels, and environmental pools in reservoirs with release timing to benefit the environment.

S.3.7 Water Quality Issues

A major challenge in the South Platte Basin relates to adequacy of the water quality for domestic and municipal water uses. These water users and water supply agencies recognized as early as the late 1800s that higher quality water was found in the mountain tributaries of the South Platte River where they exit the foothills. Since then delivery systems bringing high quality, reliable water from the South Platte River tributaries have been a staple of South Platte Basin water planning. Today, however, these higher quality water sources are approaching full development and municipal water suppliers are attempting to meet new supply demands with lower quality water sources often located within the lower portions of the basin. Major technological innovations are needed for delivery, treatment, and disposal of the waste streams from currently available complex water treatment systems, which results in significant cost to customers, impacts to the environment, and uncertain regulatory permitting processes. Relying exclusively on South Platte River supplies in the face of decreasing water quality will be a major challenge in the South Platte Basin.

Summary of Challenges

Because of the diverse population and economic drivers in the basin, as well as a host of specific challenges on the water available for developing new supply, the South Platte Basin faces an enormous challenge in meeting its future water needs. As the Basin faces the greatest projected regional supply gap, it will need to continue to develop creative, multifaceted approaches to meet a growing demand. The challenges facing the South Platte are representative in many ways of the greater challenges facing Colorado as it looks to plan its water supply to 2050. Though the challenges loom, they are not insurmountable. The South Platte Basin Implementation Plan offers an integrated planning approach that will maximize the use of existing water supplies, develop new opportunities, and leverage technology and policy advancements that help to meet the Basin's diverse water supply needs while striving to maintain or enhance environmental and recreational values throughout the basin.

S.4 Solutions for the South Platte

S.4.1 Making Choices

Finding solutions for the range of issues constraining water planning in the South Platte Basin is as much about determining how to balance the competing demands of Colorado and the South Platte Basin as it is about seeking technological and political solutions. To produce a viable and sustainable model to meet the projected water supply gap requires tradeoffs within the basin and the state concerning how we want to balance the utilization of our natural resources to support diverse economic, cultural, and environmental interests across the state.

Today's current de facto answer to our growing water demands has been the use of agricultural transfers. These transfers offer a mechanism to provide much-needed water to municipal suppliers and the environment through instream flows; however this water comes at the expense of the agricultural sector, which has a long and rich history in Colorado. The dry up of agricultural land in order to support growing municipal demands means that farmers and ranchers who have cultivated land, helped support small communities across the state, and contributed to Colorado's rich cultural heritage are making choices to leave agriculture – and, in the process, affecting surrounding rural economies and our state's historical identity. A key element of the South Platte solution is establishing systems where farmers can decide for themselves how to manage their water rights, while maintaining their right to use or sell vested property rights in the form of water rights, and concurrently offering potential new transactional methods to help lessen the associated impacts on others.

The current solutions for increasing water demands can also have tradeoffs for environmental and recreational values throughout the basin. The South Platte's environmental and recreational attributes are important for the economy and resident's way of life, and these attributes should be proactively considered when planning for the basin's future water needs. Colorado's residents appreciate Colorado's natural resources and want to maintain scenic and ecological values throughout the state, including in the South Platte Basin.

S.4.2 Strategic Overview

Although the two roundtables representing the South Platte Basin support the free market and rights of water owners to sell their property, the roundtables have explored options to counter the "buy and dry" trend. The three major guidelines the basin Roundtables have utilized in determining solutions to meeting the projected municipal and industrial water supply shortfall are:

1. Minimize adverse impacts to agricultural economies
2. Develop new multipurpose projects that either offset transfers from agricultural uses or provide additional water to reduce current agricultural shortages
3. Proactively identify and implement methods to protect and enhance environmental and recreational water uses

In the state's recent water planning program, a common phrase for an integrative approach is known as the "Four Legs of the Stool." This approach recognizes that successful water planning in Colorado needs to utilize four specific tools; Conservation and Reuse, Identified Projects and Processes (IPPs), Agricultural Transfers, and new Colorado River supplies along with a strong supporting component of storage. The South Platte Basin Implementation Plan employs this approach.

The South Platte Basin's goal is to prepare for future water needs in a way that maximizes the state-wide beneficial use of our water resources while minimizing the impacts of additional water use on environmental and recreational resources, and even enhancing these resources when possible. An integrated and managed approach to meeting the supply gap will include implementing a large percentage of the basin's IPPs, a term used to describe the existing strategies and water projects which have been planned but not yet fully implemented. Additionally, the plan calls for enhancing water use efficiencies (conservation and reuse), integrating multi-purpose projects comprised of storage, conveyance via pipelines and other methods, and the integration of existing water infrastructure systems where possible. The plan intends to incorporate environmental and recreational protections and enhancements, utilize some degree of agricultural transfers using alternative methods to traditional "buy and dry," and simultaneously develop new unappropriated Colorado River supplies for the benefit and protection of all of Colorado, both now and in the future.

Ideally, projects within this strategy would be multi-purpose and address associated recreational and environmental benefits. New Colorado River supply would be developed in a manner that does not exacerbate compact obligations. Front Range storage would come from enlarging existing reservoirs; building off-river storage; and using underground storage to maintain aquifer levels, reduce evaporative losses and minimize riparian impacts. New Colorado River supplies and Front Range storage would be used to coordinate and manage highly variable yields expected from New Colorado River supplies. Additional Colorado River Basin supply would also augment existing municipal and industrial supply while providing environmental and recreational benefits. Front Range agricultural transfers coordinated with use of the Denver Basin Aquifer system would be used primarily for droughts and drought recovery. Alternative transfer methods including land and water conservation easements could be used to help maintain agricultural production and the local economic benefits of agriculture. Continued leadership in conservation and reuse will ensure that all of these resources are used

efficiently, allowing the basin to maximize the benefits and minimize costs of development.

The South Platte Basin's vision is to develop solutions that balance the use of new Colorado River supplies with South Platte agricultural transfers, conservation and reuse, and environmental and recreational programs. Implementing these solutions in a coordinated way can help to reduce the size and effects of the Colorado River supply projects and equitably share project benefits between the east and west slopes. The South Platte Basin proposes the construction of projects that develop diverse sources of supply – from new Colorado River supplies and agricultural transfers – instead of risking Colorado's future on a single source, from either new Colorado River supplies or agricultural transfers.

S.5 Implementation

The graphic above represents the process used to write the South Platte Basin Implementation Plan. Arrows represent each stage of the development of the Plan sequentially. This process helped to drive the evolution of the report, and to establish the strategies and portfolios recommended in Sections 5 and 6.

Implementation of the multipurpose solutions described in the South Platte Basin Plan will be where ideas meet reality. To meet the supply gap and achieve the goals and outcomes identified by both the Governor of Colorado and the Basin Roundtables, the South Platte Basin Implementation Plan has recognized eleven areas of focus, whose successful completion will be integral to meeting the basin's supply gap and ensuring that Colorado's future water needs are met. Current projections anticipate that, in 2050, water demands will exceed water supplies for municipal and industrial uses as well as for irrigated agriculture. This water supply gap, under a medium demand scenario with current hydrologic conditions, anticipates that by 2050 there will be a municipal and industrial water supply gap of 428,000 acre-feet and irrigated agriculture water supply gap of 422,000 acre-feet.

S.5.1 Maximize Implementation of IPPs

Successfully implemented IPPs, both in-basin and transbasin, will be critical to meeting the projected supply gap. The extent of which IPPs are successful will relate directly to the magnitude of the M&I gap. Successful IPPs will decrease the M&I gap while unsuccessful IPPs will widen the gap even further, resulting in larger quantities of water being transferred from agricultural uses or new Colorado River supplies. Figure S-3 shows the IPP yield per county (with a 65 percent IPP success rate for the South Platte Basin and an 88 percent IPP success rate for the Metro Basin) as well as the remaining gap in each county after IPPs are implemented.

Recommendations**: **Facilitate the implementation of IPPs both within and outside of the basin. Continue to support efforts to develop a basin-wide groundwater monitoring network, and to mitigate localized high groundwater.

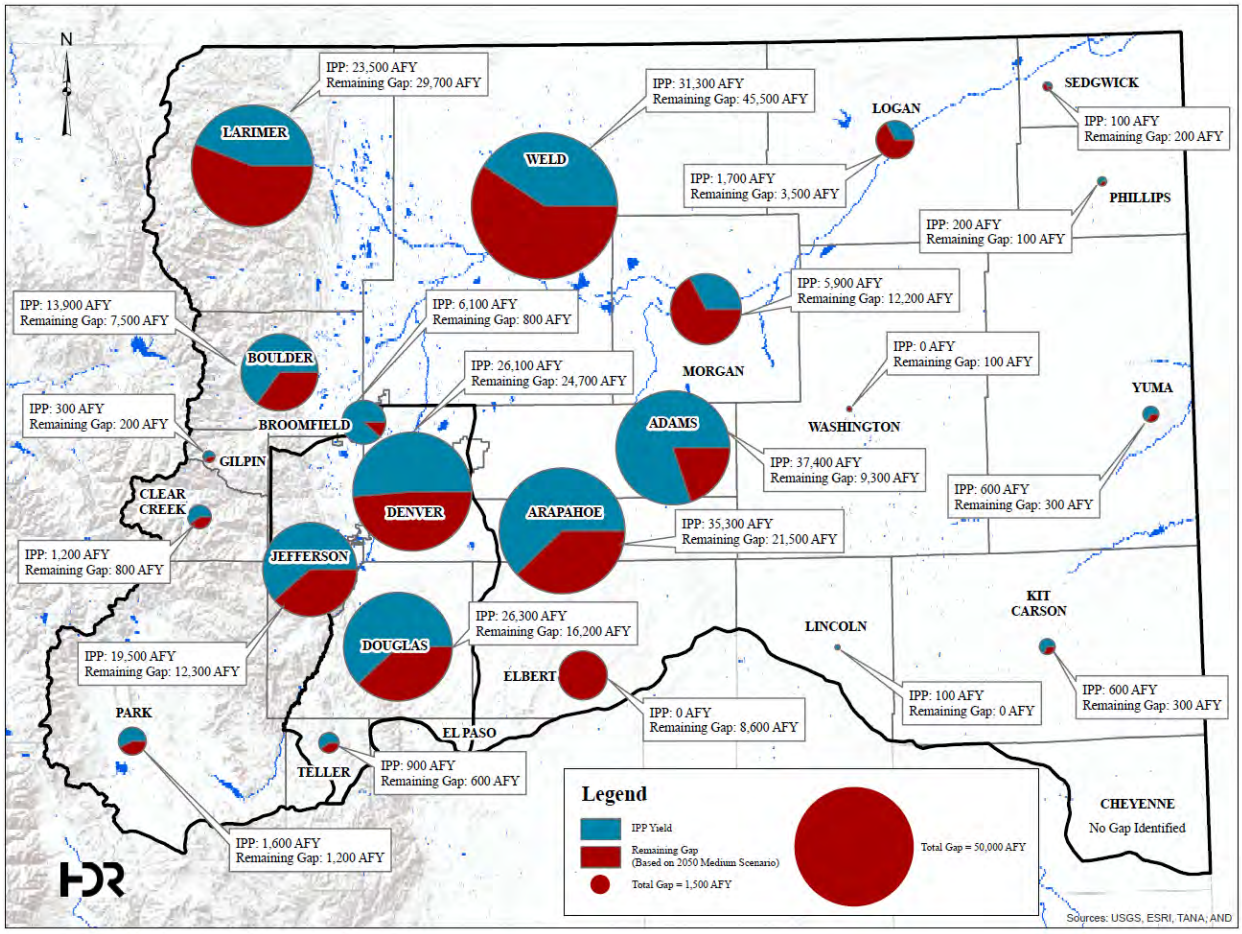

Figure S-3. Remaining Gap by county (65% IPP Success Rate in the South Platte Basin and 88% IPP Success Rate in the Metro Basin)

S.5.2 Maintain leadership in conservation and reuse and implement additional measures to reduce water consumption rates

Already, the basin has reduced water use by approximately 20 percent since 2000 and currently achieves one of the lowest per capita water uses in the state. Even so, both Roundtables anticipate implementation of additional conservation programs tailored to diverse types of water supply systems and conditions existing in the South Platte River Basin. The interplay between conservation programs and municipal and industrial water reuse will continue to be examined.

Currently there are a limited number of sources that can legally be reused in Colorado, but water providers are attempting to reuse every drop to which they are entitled. Water that isn't reused locally is reused within the basin through successive use. Reuse will continue to push the economic, technical, and legal limits in order to maximize South Platte supplies.

Recommendations: Better coordinate water and land use planning to improve water use efficiency. Implement rate design improvements to require more efficient plumbing fixtures, appliances, and landscaping. Implement additional reuse where practicable.

S.5.3 Maximize use and effectiveness of native South Platte supplies

To more effectively utilize native South Platte supplies, the Roundtables suggest the development of multipurpose water storage and conveyance infrastructure, as well as new methods to more effectively utilize tributary and nontributary groundwater. Another critical aspect of utilizing existing supplies will be the exploration of integration of existing South Platte Water Supply Systems on a willing agency basis.

Recommendations: Develop new, in-basin, multipurpose water storage and conveyance mechanisms, explore further integration of South Platte water supply systems to enhance yield and reliability, and develop methods to more effectively use groundwater. Encourage surface water and groundwater availability/hydrologic modeling to provide more detailed and reliable estimates of water availability.

S.5.4 Minimize traditional agricultural "buy and dry" and maximize use of Alternative Transfer Methods (ATMs) to extent practical and reliable

Many water providers count planned agricultural transfers towards their Identified Projects and Processes. These transfers are in the planning stages and will proceed, barring delays in water right transactions, permitting of conveyance infrastructure or other unexpected circumstances. Ensuring that such projects proceed to the extent possible is an important piece of meeting the South Platte supply gap.

Additionally, it is recognized that Colorado's water right transfer process is heavily weighted towards dry-up of irrigated land in order to transfer its historical consumptive use (CU). The solutions described in the South Platte Basin Plan are not aimed at further complicating or restricting this process, but rather developing other alternatives. One alternative method to bolster water supply options is the use of alternative agricultural water transfer methods (ATMs). ATMs are meant to "minimize the impact on the local economy, provide other funding sources to the agricultural user, and optimize both the agricultural and nonagricultural benefits of the remaining lands". (SWSI 2010) Some of these alternative transfer methods include rotational fallowing, interruptible supply agreements (ISAs), water banks, purchase and leasebacks, deficit irrigation, and changing crop types. Through the implementation of ATMs, the agricultural producer can view their water rights as a "crop" and cities may view the producer's fields as "reservoirs" holding water supplies for times of shortage. Much is still to be evaluated about the feasibility of ATMs, but pilot projects in the basin are looking to find solutions to overcome the associated legal, technical, institutional, and financial issues associated with ATMs.

Recommendations: Continue to study water sharing practices and adjust the water court process to encourage water sharing practices while protecting the vested rights of water rights holders. Continue to support measures to maintain

the economy and agricultural production of the Republican River Basin and long-term compliance with the Interstate Water Compact. Finally, continue compliance with the South Platte Compact and the PRRIP.

S.5.5 Protect and enhance environmental and recreation attributes

There are important environmental and recreational attributes within the South Platte Basin that must be proactively considered when addressing water supply needs. Some environmental and recreational attributes in the basin are impaired by the current strategies used to meet water demands, and in these areas habitat and streamflows must be enhanced or maintained to support these attributes. The efforts being undertaken to meet the supply gap may potentially impact these attributes by affecting flows in streams, plant and animal habitat, as well as water quality. Reduced stream flow in focus areas has the potential to expand those areas requiring protection. Additional storage in the basin has the potential to impact streamflows and to disturb wildlife habitat. Opportunities to align environmental and recreational uses with the projects needed to meet the supply gap do exist, however. If cooperative operational agreements can be put into place, there is potential to align environmental and recreational interests with the overarching goals of water suppliers. The strategies discussed regarding additional Colorado River supplies are intended to distribute benefits and impacts on environmental and recreational attributes to both the West and East slopes. Watershed management programs should also continue and be expanded to focus on additional high priority areas. Focused attention is needed to address threats associated with extensive tree mortality in the basin, increased fire hazards and water quality degradation associated with major recent floods.

Recommendations: Fill existing data gaps regarding protection of environmental and recreational attributes in order to better understand the adequacy of existing and future protections. This should be done for all South Platte focus Areas where opportunities arise for new projects. Additionally, provide sustainable and reliable funding for data recording and reporting equipment to assist with environmental and recreational projects.

S.5.6 Simultaneously advance the consideration and preservation of new Colorado River Basin supply options

The Metro and South Platte Roundtables encourage strong consideration and preservation of the ability to use Colorado's entitlement under the Colorado River Compact as we pursue other strategies to meet our water demands. Investigating, preserving, and developing Colorado's entitlement to Colorado River supplies is beneficial to the state's economic, social, political and environmental future. This may involve large state-level water projects, or small level projects, each with comprehensive West Slope water supply and environmental and recreational components. The Roundtables support the Conceptual Framework developed by the IBCC (and as outlined in Colorado's Water Plan) as the means whereby new Colorado River Basin supply options could be investigated and potentially developed.

Recommendations: Promote additional conceptualization analysis of shared development of additional Colorado River Basin supplies. Consider potential criteria for "State Water Projects" including benefits and challenges.

S.5.7 Promote Multi-Purpose Storage Projects that Enhance other South Platte Basin Solutions

Stream flows vary widely in the South Platte Basin, both year-to-year and seasonally. Storing water when it is abundant for use in times of shortage is a vital weather management strategy for a basin with diverse water needs. Storage has historically been important for managing water in the South Platte, and today's water managers understand that storage in the South Platte Basin is a vital means to provide water security for the vast agricultural, municipal and industrial, recreational and environmental needs of the basin. Further, additional storage is essential to implement the six previously described elements of the Basin Implementation Plan.

Recommendations: The Metro and South Platte Basin Roundtables strongly advocate for the development of additional surface and groundwater storage, further research of aquifer storage and recovery (ASR), and investigation into additional off-channel storage and reservoir sites in the basin. Additionally, they encourage the consideration of alternatives to "State Water Projects" such as regional collaboration on and financing of water projects.

S.5.8 Manage the risk of increased demands and reduced supplies due to climate change

The effects of climate change on water resource availability are very difficult to assess and the exact ways it will impact Colorado are unknown. Many South Platte water providers consider it irresponsible not to consider the potential for climate change in making water supply and demand projections.

Recommendations: The South Platte and Metro Roundtables recommend continued analysis of the potential for back-up supply, such as for east slope interruptible supply agreements. They also encourage additional research to disaggregate the basin's M&I supply gap to gather more specific data on the quantity, time, and geography of the gaps within each county.

S.5.9 Facilitate effective South Platte communications and outreach programs that complement the state's overall program

A critical component in advancing the South Platte Basin Implementation Plan and Colorado's Water Plan will be a strategic focus on communication and education with stakeholders including water users, political leaders, and leaders of major businesses and industries throughout the state. Improving public understanding about the goals, needs, and plans of the state and the South Platte Basin will help to improve public acceptance of the need for innovative water rate structures, energetic conservation measures, and more integrated land use and water supply planning.

Recommendations: Design and implement an intensive education, participation and outreach program designed to generate a lasting baseline of public awareness and support.

S.5.10 Research new technologies and strategies

Water quality is an ongoing issue for the South Platte Basin. A major concern is the ability to manage and treat lower quality water effectively, and then dispose of the waste products (brine) in a cost effective and environmentally sound way. One important component of the South Platte Basin Implementation Plan will be for the state to take a proactive role in investigating technologies capable of treating low quality water sources and disposing of waste products.

Recommendations: Continue research and development of new strategies to address both the technical and regulatory constraints associated with treating low quality water and disposing of waste including direct potable reuse (DPR) and indirect potable reuse (IPR), developing an appropriate regulatory framework for these technologies, and promoting and monitoring research on relevant technologies to advance these objectives.

S.5.11 Advocate for improvements to federal and state permitting processes

Cities throughout the South Platte Basin struggle with the time and cost to obtain permits for incremental expansions to their water systems, despite the environmental mitigation and enhancements offered by the projects. To meet near and long term supply gaps while still maintaining regulatory compliance and environmental protections will require improvements to the permitting processes for supply projects. This begins with approvals for planned supply projects including IPPs to meet the nearer term supply gaps as well as other supply projects expected over medium and long range timeframes. It is recognized that not all of the projects currently engaged in federal permitting or planned in the near future may obtain permit approvals with conditions acceptable to the project sponsors. Regardless of permit success rates, an important component of the South Platte Basin Implementation Plan is development of specific and actionable steps to improve the federal and state permitting processes for major water projects both in terms of efficiency and the predictability of the process while still providing the needed environmental protections and mitigations.

Recommendations: Identify methods to improve the approval process by increasing efficiencies in agency coordination, making changes to applicable statutes and regulations, and supporting the formation of a task force to study and implement ways to improve the permitting process for water supply projects.

S.6 Summary

The South Platte Basin faces a cadre of unique challenges in planning for its future water needs. It hosts some of the largest population centers in the state as well as several of the leading economic sectors. As such, the South Platte Basin faces the largest projected regional water shortfall for municipal, industrial and agricultural uses in the future. It also has wide-ranging environmental and recreational attributes important to the basin, the state, and the country. From Rocky Mountain National Park and the most heavily visited state parks, to the important endangered species recovery goals of the Platte River Recovery Implementation Program, the protection of non-consumptive water

needs and enhancement of water-based ecosystems must also be fully considered in planning our future.

The South Platte Basin Implementation Plan offers a strategy to combat our water supply shortfalls by utilizing diverse, integrated supply solutions to chart a course that meets the projected water needs of the South Platte Basin as it continues to develop. This plan acknowledges the unique challenges, opportunities, and tradeoffs in the South Platte Basin, and then leverages these challenges into eleven specific implementation strategies to address them. Because the solutions developed in the Plan are multifaceted, approaching the basin's water challenges with an arsenal of tools to help improve supply, they may help to achieve the goal of bridging the projected supply gap while evenly distributing the impacts of the state's water development across its many regions and diverse economic interests.

When executed with the support of the state, political leaders, business leaders, and the public, the implementation strategies outlined in the Plan have the potential to achieve the ambitious goal of supplying water to the South Platte Basin, and by extension help supply the water needs and sustain the economy of the state of Colorado through 2050.