

THE VALUE OF WATER IN THE COLORADO RIVER BASIN:
A SNAPSHOT OF A FLUID LANDSCAPE

PREPARED FOR THE
COLORADO RIVER GOVERNANCE INITIATIVE

BY

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TABLE OF CONTENTS

Introduction	2
Agriculture	5
Wyoming	9
Colorado	12
Utah	14
New Mexico	16
Arizona	17
Nevada	19
California	20
Municipal & Industrial	21
Other uses	24
Energy	24
Recreation	26
Non-Use	27
Conclusions	28
Key “Take-Home” Messages	29

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INTRODUCTION

The Colorado River travels 1,400 miles from the peaks of the Rocky Mountains to the Gulf of California.² The river and its tributaries form a basin that covers 244,000 square miles and includes portions of seven U.S. states.³ Waters of the Colorado River service metropolitan areas like Phoenix, Los Angeles, and Denver, as well as federal and tribal lands.⁴

The purpose of this report is to provide a broad understanding of the economic distribution of water in the Colorado River basin and to provide references for further study of the subject. The report is beneficial for those looking for a basic understanding of economic valuation of water and how water is valued for different uses and in different regions of the basin. It also serves as a guide for further explorations into economic valuations in the basin and as a platform for helping decision-makers formulate legal and economic systems to maximize the use of this valuable resource for the public. As Dean Trelease said, “water law should provide for maximum benefits from the use of the resource.”⁵ This report is the technical foundation for implementing systems for this purpose.

The scope of this report is land within the Colorado River basin, focusing on water diverted from surface tributaries and mainstem of the Colorado River, and water extracted from groundwater sources within the basin. Types of water demands include

² Lawrence J. MacDonnell, *Colorado River Basin*, in *WATERS AND WATER RIGHTS* 6 (R. Beck, ed., vol. 7, 2005).

³ *Id.*

⁴ See U.S. BUREAU OF RECLAMATION, U.S. DEPARTMENT OF THE INTERIOR, COLORADO RIVER BASIN WATER SUPPLY AND DEMAND STUDY, STUDY REPORT SR-5 (2012) [hereinafter *Basin Study*], available at http://www.usbr.gov/lc/region/programs/crbstudy/finalreport/Study%20Report/CRBS_Study_Report_FIN AL.pdf. Twenty-two tribes rely on basin water. *Id.* at SR-2. Seven National Wildlife Refuges, four National Recreation Areas, and eleven National Parks also rely on basin water. *Id.* at SR-3.

⁵ Frank J. Trelease, *Policies for Water Law: Property Rights, Economic Forces, and Public Regulation*, 5 NAT. RESOURCES J. 1, 2 (May 1965).

agriculture, municipal and industrial (M&I), energy, recreation, and non-use. The report does not look at the value of water for quality, for navigability, or for secondary uses.⁶ Operators' average willingness to pay for Colorado River water is the focus of this report.⁷ This methodology is an estimate of the price of water for different uses and in different regions when considering possible transfers.⁸ Along these lines, the report presents information on potential market participants instead of end users⁹ or the public at large.¹⁰ The report does not attempt to assign values to acreages of land and instead values water in dollars per acre-feet (\$/af).¹¹

Data for this report are from a variety of sources. The report contains no new data. All the utilized data are from sources like the United States Department of Agriculture (USDA),¹² United States Bureau of Reclamation (Bureau),¹³ and individual state

⁶ For a resource discussing second tier and quality valuations, see Charles W. Howe and W. Ashley Ahrens, *Water resources of the Upper Colorado River Basin: problems and policy alternatives*, in 5 WATER AND ARID LANDS OF THE WESTERN UNITED STATES 169, 190–93, 197–208 (Mohamed T.El-Ashry & Diana C. Gibbons eds., 1988) [hereinafter Howe & Ahrens]; see also Jenny Thorvaldson & James Pritchett, *Economic Impacts of Reduced Irrigated Agriculture in Eastern Colorado: A Summary of Three Studies*, available at http://water.usgs.gov/wri/05grants/progress.completion_reports/CO/2005CO115B.pdf (second tier methodology for Eastern Colorado). These valuations might be good when determining values from the state or public point of view for the purposes of policy decisions. This report focuses on the valuations to determine responses to different transfer systems.

⁷ See BARRY C. FIELD, *NATURAL RESOURCE ECONOMICS* 42 (2d ed. 2008) (explaining the concept of willingness to pay). For an overview of different valuation methods, see DAVID BATKER ET AL., *NATURE'S VALUE IN THE COLORADO RIVER BASIN* 25 tbl.10 (2014) [hereinafter BATKER], <http://www.eartheconomics.org/FileLibrary/file/Reports/Earth%20Economics%20Colorado%20River%20Basin%20ESV%20FINAL.pdf>.

⁸ For a great resource explaining the different types of methodologies for valuing water, see ROBERT A. YOUNG, *DETERMINING THE ECONOMIC VALUE OF WATER: CONCEPTS AND METHODS* (2005).

⁹ A comparison of end users with potable water is a different comparison than comparing ag users of raw water to municipal operators using raw water. For example of pricing options municipalities use, see THOMAS V. CECH, *PRINCIPLES OF WATER RESOURCES* 185–201 (3rd ed. 2010).

¹⁰ Policy makers may wish to utilize this category to ensure the maximum benefit to society.

¹¹ See BATKER, *supra* note 7.

¹² U.S. DEP'T OF AGRICULTURE, *CENSUS OF AGRICULTURE*, <http://www.agcensus.usda.gov/Publications/Ag> (Census publications available at five year increments going back from 2012 broken down by state and county). For land use methods by acres and farms divided by hydrologic zone up to 2007, see 2007 CENSUS BY WATERSHED, http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/Watersheds/index.asp. See also 2008 FARM AND RANCH IRRIGATION SURVEY, http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/Farm_and_Ranch_Irrigation_Survey/i

reports.¹⁴ Other than the lack of new, independent data, there are other general limitations for this project. Each source has a different bundling scheme. Unbundling groundwater and surface water is difficult,¹⁵ as is unbundling major exportation projects like the San Juan-Chama project and Colorado-Big Thompson (CBT).¹⁶ Also, tribal water use is included or excluded in other uses, depending on the report.¹⁷ In Arizona, municipal and agricultural demands include tribal uses and are broken down by reservation under the

ndex.php (source of irrigation expenses, acreage, and withdrawals in five year increments going back from 2008).

¹³ U.S. BUREAU OF RECLAMATION, U.S. DEPARTMENT OF THE INTERIOR, COLORADO RIVER SYSTEM CONSUMPTIVE USES AND LOSSES REPORTS, <http://www.usbr.gov/uc/library/envdocs/reports/crs/crsul.html> (Bureau (2001–2005 is the most current final report. 2006–2010, and 2011–2015 contain provisional data.); LOWER COLORADO RIVER ACCOUNTING SYSTEM REPORTS (LCRAS), DECREE ACCOUNTING, FORECASTED WATER USE REPORT 2012, AND ACTUAL WATER USE REPORT 2012, <http://www.usbr.gov/lc/region/g4000/wtracct.html> (annual reports all available through the webpage); COLORADO RIVER BASIN WATER SUPPLY AND DEMAND STUDY, APPENDICES C2–C8, C10, <http://www.usbr.gov/lc/region/programs/crbstudy/finalreport/techrptC.html>.

¹⁴ ARIZONA DEP'T OF WATER RESOURCES, ARIZONA WATER ATLAS (2010), <http://www.azwater.gov/AzDWR/StatewidePlanning/wateratlas/default.htm> (Arizona); COLORADO DIVISION OF WATER RESOURCES, CUMULATIVE YEARLY STATISTICS OF THE COLORADO DIVISION OF WATER RESOURCES, http://water.state.co.us/DWRIPub/DWR%20Annual%20Reports/CYS_rpt_2009.pdf (Colorado); COLORADO WATER CONSERVATION BOARD, STATEWIDE WATER SUPPLY INITIATIVE, COLORADO'S WATER SUPPLY FUTURE (2010) [hereinafter SWSI 2010], <http://cwcb.state.co.us/water-management/water-supply-planning/Documents/SWSI2010/SWSI2010.pdf> (Colorado); SNWA, WATER PLAN FOR NEVADA WATER, <http://water.nv.gov/programs/planning/stateplan/part2/> (Nevada); NEW MEXICO OFFICE OF THE STATE ENGINEER, REGIONAL WATER PLANS, http://www.ose.state.nm.us/isc_regional_plans.html (New Mexico); UTAH DIVISION OF WATER RESOURCES, <http://www.water.utah.gov/> (Utah); GREEN RIVER BASIN WATER PLANNING PROCESS (States West Water Resources Corporation, 2001), http://www.swccd.us/images/R_GreenR_Basin_rpt_04.pdf (Wyoming); GREEN RIVER BASIN PLAN (2010), <http://waterplan.state.wy.us/plan/green/2010/finalrept/finalrept-GRB.pdf> (Wyoming).

¹⁵ See, e.g., U.S. BUREAU OF RECLAMATION, U.S. DEPARTMENT OF THE INTERIOR, COLORADO RIVER BASIN CONSUMPTIVE USES AND LOSSES REPORT 2001–2005 13 (rev. 2012) [hereinafter USES AND LOSSES 2001–2005], available at <http://www.usbr.gov/uc/library/envdocs/reports/crs/pdfs/cul2001-05.pdf>.

¹⁶ See MICHAEL COHEN ET AL., WATER TO SUPPLY THE LAND 14 (Pacific Institute 2013) [hereinafter SUPPLY THE LAND], <http://pacinst.org/wp-content/uploads/sites/21/2013/05/pacinst-crb-ag.pdf> (discussing how exported water through projects like CBT, San Juan Chama supply water for many different uses).

¹⁷ See U.S. BUREAU OF RECLAMATION, U.S. DEPARTMENT OF THE INTERIOR, COLORADO RIVER BASIN WATER SUPPLY AND DEMAND STUDY, APPENDIX C2: COLORADO WATER DEMAND SCENARIO QUANTIFICATION C2-17 (2012) [hereinafter APP. C2] (Colorado includes tribal water in the other demands, but other states separate tribal water use).

use analysis.¹⁸ Further, the definitions of municipal, industrial, and energy are inconsistent across the reports,¹⁹ and reports are organized differently.²⁰

Other limitations stem from boundary identification. Some reports are broken down by county, others by hydrologic zone, but both focus on the area where the water is used instead of its source. County lines do not coincide with hydrologic basins.²¹ Sources also vary in terminology, or contain unclear definitions of important terms. For instance, in some reports, “demand” could include consumptive or diverted water use. Sources also vary by timing of the data collection, which makes it difficult to utilize a single year’s data completely or to visualize trends. Finally, the methodology in this report assumes there is a capacity to make transfers from one use and region to another at no transfer cost.²² The focus is on the potential buyer, not the seller’s characteristics like location and available water.

AGRICULTURE

Agricultural demand is the largest type of consumptive use in the Colorado River basin. Farmers and ranchers apply water to 3.5 million acres of land for pastureland and

¹⁸ See, e.g., ARIZONA DEP’T OF WATER RESOURCES, ARIZONA WATER ATLAS VOLUME 2: EASTERN PLATEAU PLANNING AREA 39 (May 2009) [hereinafter ATLAS VOL2].

¹⁹ Compare ATLAS VOL2, *supra* note 18, at 47, with U.S. BUREAU OF RECLAMATION, U.S. DEPARTMENT OF THE INTERIOR, COLORADO RIVER BASIN WATER SUPPLY AND DEMAND STUDY, TECHNICAL REPORT C—WATER DEMAND ASSESSMENT C-33–35 (2012) [hereinafter *Demand Assessment*].

²⁰ Compare ATLAS VOL2, *supra* note 18, with ARIZONA DEP’T OF WATER RESOURCES, ARIZONA WATER ATLAS VOLUME 4: UPPER COLORADO RIVER PLANNING AREA (May 2009) (range of years of which data is collected). Volume 4 also includes AZ v CA decree accounting section. Utah reports represent a variety of years that do not correspond. See Utah Division of Water Resources, *State Water Plans – Planning for the Future*, <http://www.water.utah.gov/Planning/PlanningPage2.html> (listing the regional water plans and dates). New Mexico also uses different consulting companies to perform the regional water plans. Compare SAN JUAN REGIONAL WATER PLAN (San Juan Water Commission, 2003) http://www.ose.state.nm.us/Planning/RWP/region_02.php (Volume IV), with SOUTHWEST NEW MEXICO REGIONAL WATER PLAN (Daniel B. Stephens and Associates (DBSA), 2005).

²¹ See, e.g., SUPPLY THE LAND, *supra* note 16, at 18 fig.20.

²² Though there seems to be a lot of value in the storage system. See BATKER, *supra* note 7, at 32 tbl.17.

for crop production.²³ More than 90% of that land is irrigated with some amount of water from the Colorado River.²⁴ Although a major human use of water, the agriculture production represents a much smaller portion of the region's economy.²⁵

The methodology for agricultural values divides net revenue of farms by the consumptive use of water resulting in an average willingness to pay for the amount of consumptive water used.²⁶ There are other ways to value the resource.²⁷ Some articles value the land at a per acre basis for its ecosystem services.²⁸ Marginal and elasticity analyses are also important, focusing on the value of a change in water use.²⁹ Other studies determine the value of water based on the difference in net revenue between irrigated and non-irrigated farms.³⁰ Trends may also be considered, but this analysis is only a snapshot.³¹

Sources for net revenue come from the United States Department of Agriculture's Census of Agriculture for 2012, 2007, and 2002.³² Complete data mining of this source is

²³ BATKER, *supra* note 7, at 17.

²⁴ *Id.*

²⁵ *Just the Facts*, PUBLIC POLICY INSTITUTE OF CALIFORNIA (July 2014), http://www.ppic.org/main/publication_show.asp?i=1108 (In California, a basin state, irrigated agriculture represents 80% of the human water use, but accounts for only 2% of the GDP.).

²⁶ Bonnie G. Colby, *Estimating the Value of Water in Alternative Uses*, 29 NAT. RESOURCES J. 511, 520 (1986) [hereinafter Colby], available at http://lawlibrary.unm.edu/nrj/29/2/10_colby_estimating.pdf.

²⁷ This analysis focuses on the average willingness to pay for current water uses, another future analysis might look at marginal willingness to pay for more units of water. See Ronald C. Griffin and Chan Chang, *Seasonality in Community Water Demand*, 16 WESTERN JOURNAL OF AGRICULTURAL ECONOMICS (1991) (discussing the difference in marginal and average analyses).

²⁸ See, e.g., BATKER, *supra* note 7.

²⁹ S.M. Olmstead, W.M. Hanemann, & R.N. Stavins, *Water Demand Under Alternative Price Structures*, 54 JOURNAL OF ENVIRONMENTAL ECONOMICS AND MANAGEMENT 181–98 (2007) (elasticity); D. GIBBONS, *THE ECONOMIC VALUE OF WATER* (1986) (elasticity).

³⁰ Robert Benjamin Naeser & Lynne Lewis Bennett, *The Cost of Noncompliance: The Economic Value of Water in the Middle Arkansas River Valley*, 38 NAT. RESOURCES J. 445 (1998), available at http://lawlibrary.unm.edu/nrj/38/3/03_naeser_noncompliance.pdf.

³¹ Ideally, we want to standardize the net revenues and consumptive uses and compare year-to-year data, but the data available does not have consistency from year-to-year.

³² See, e.g., U.S. DEP'T OF AGRICULTURE, CENSUS OF AGRICULTURE, 2012 CENSUS VOLUME 1, CHAPTER 2: COUNTY LEVEL DATA, available at http://www.agcensus.usda.gov/Publications/2012/Full_report/Volume_1,_Chapter_2_County_Level/Wyoming/ (2012 Wyoming tables by county). Table 4 displays the

limited. The crop prices used are what were paid by purchasers, but sales prices fluctuate on a daily basis. It is also difficult to unbundle livestock operations from farming because of the types of expense categories. This is important because ranchers may be in different situations than farmers to purchase water. Some expenses are apparent like livestock leasing, but others like transportation, are not easy to unbundle. Determining the net revenue of *irrigated* lands instead of all operations in the county is also difficult.³³ The source of the data is full of uncertainty, as well.³⁴ Even where the information exists, it is not always disclosed for fear of disclosing individual farming operations, so the information from the source is incomplete. Lastly, the counties closely mirror use of Colorado River water, but because of transbasin diversions, and groundwater hydrology, we do not know exactly the source of the water being applied to the land. The counties in the report best estimate Colorado River water use. Table 1 outlines the net revenues for the portions of each state within the basin.

State	Net Revenue
Arizona	\$584,944,000–652,021,000
California	\$359,443,500–364,562,750
Colorado	\$24,033,000–33,918,000
Nevada	\$2,196,000–4,462,250
New Mexico	(\$4,047,000)-4,065,000
Utah	\$6,787,000–11,890,000
Wyoming	\$11,222,000–30,719,000

Tbl.1 Agricultural Net Revenue by State

net revenue. From this website, 2007 and 2002 data are available, and for the other states in the basin. This report uses data from “Net cash farm income of the operations”. *Id.* at App.B B-15 (“subtracting total farm expenses from total sales, government payments, and other farm-related income”).

³³ There is no expense category for irrigation, no revenue statistics for irrigated operations, and irrigation data are limited to number of farms, acreage, farm size, and type of irrigated land. *See id.*, at tbl.10. Irrigation is further complex because some farms are partially irrigated. Irrigation quantity depends on crop rotations, precipitation, and temperature.

³⁴ Data are collected from farmers through requests every five years. *Id.* at App.A A-4.

For the methodology, this report relies on consumptive use instead of withdrawals.³⁵ The valuation based on consumptive use represents the value of actual water used for irrigation.³⁶ Data sources include state agencies and Bureau of Reclamation reports. Just like net revenue data, consumptive use data have limitations. The statistics include groundwater, and actual unbundling would be difficult because there is uncertainty about the connectivity of some aquifers and surface water. Some groundwater depletion may be drawing from the Colorado River system while some may be independent.³⁷ Further, pumping that affects the river might be recharged at different rates.

Unbundling of pastureland for livestock and livestock use is also difficult, and the consumptive coefficient is a further source of uncertainty. The coefficient depends on irrigation type, crop, soil, and climate, which all contain variability between farms and counties.³⁸ The basis of the consumptive use equations, withdrawal, also varies. Each method for determining consumptive use is slightly different, and it is difficult to determine which methods include Colorado River as the sole source of water. There are transbasin diversions like San Juan-Chama and CBT to consider, as well as tribal water unbundling. Further, the amount of rainfall is important to determine how much water is applied and how much is consumptively used. But this is not addressed in this simplified

³⁵ Some sources for withdrawal include U.S. Geological Survey, Estimated Use of Water in the United States (2005), <http://pubs.usgs.gov/circ/1344/pdf/c1344.pdf> (produced every five years); Arizona Water Atlas, *supra* note 14. With the right parameters like soil type, crop type, climate, and altitude, consumption coefficients are created to determine consumptive use.

³⁶ See ROBERT A. YOUNG AND JOHN B. LOOMIS, DETERMINING THE ECONOMIC VALUE OF WATER: CONCEPTS AND METHODS 3.1.5 (2d ed. 2014). For an example in the Upper Colorado River basin of a report using consumptive use, see Howe & Ahrens, *supra* note 6, at 185.

³⁷ For a current article on the state of groundwater in the basin, see University of California-Irvine, *Parched West is using up underground water: Study points to grave implications for Western U.S. water supply*, July 24, 2014, <http://www.sciencedaily.com/releases/2014/07/140724172102.htm>.

³⁸ APP. C2, *supra* note 17, at C2-12.

model. The consumptive use numbers for the portions of each state within the basin are outlined in Table 2, and the resulting range of valuations are in Table 3. The following sections discuss each state in more detail.

State	Consumptive Use(af)
Arizona	3,374,900
California	3,121,601–3,666,000
Colorado	1,219,500–1,902,000
Nevada	65,800
New Mexico	111,000–247,000
Utah	457,000–753,000
Wyoming	213,800–421,639

Tbl.2 Agricultural Consumptive Use by State

State	Willingness to Pay (/af)
Arizona	\$173.32–193.20
California	\$98.05–116.79
Colorado	\$12.64–27.81
Nevada	\$33.37–67.82
New Mexico	\$0–36.62
Utah	\$9.01–26.02
Wyoming	\$26.62–143.68
Nationally ³⁹	\$12–4,500

Tbl.3 Agricultural Willingness to Pay by State

Wyoming

Net revenue sources and data come from the USDA Census of Agriculture for 2002, 2007, and 2012. The data is organized at the state and county levels, so an estimate of the portion within the basin included Lincoln, Sublette, Sweetwater, and Uinta counties.⁴⁰

The net revenue for the aggregate of the four counties is \$19,984,000 (2012),

³⁹ U.S. Dep’t of the Interior, *Chapter 6 Water*, in ECONOMIC REPORT (2012) [hereinafter *Water*], available at <http://www.doi.gov/ppa/upload/Chapter-6-FY2012-Econ-Report.pdf>.

⁴⁰ SUPPLY THE LAND, *supra* note 16, at 18 fig.6 (note).

\$30,719,000 (2007), and \$11,222,000 (2002).⁴¹ However, this is only an average for the farms. Despite what seems like a profitable business, many farms lose money. In 2012, 964 of the 1,576 farms in the region lost an average of \$31,587.⁴² None of these farms would be able to pay any amount for their water. In fact, if they have water rights, they may be looking to lease or sell the right to increase their revenue. On the other side, 612 farms in the region made an average of \$82,410 in the same year.⁴³ These farms would be willing to pay much higher prices for water than the average. The average is a good starting point, but the variability in profitability of farms in the region is important to demonstrate how much an individual farmer might pay for irrigation water.

Other important limitations are the inability to unbundle livestock and the sales price variability of crops. In 2012, livestock revenue in the region was 76% of the total revenue, but livestock and feed only constituted 33% of the production costs.⁴⁴

Unbundling livestock from other farm operations is important because ranchers may be in a different financial position to pay for irrigation for their pastureland than growers for their cropland. Addressing sales price variability, the revenue reflects prices received by farmers for their product. These prices vary drastically, and can fluctuate by the day or even hour. Alfalfa and other hay are the largest crops in the region.⁴⁵ Between 2006 and 2010, monthly average prices for alfalfa varied between \$87 and \$130 per baled ton with

⁴¹ U.S. DEP'T OF AGRICULTURE, CENSUS OF AGRICULTURE, 2012 CENSUS VOLUME 1, CHAPTER 2: WYOMING COUNTY LEVEL DATA tbl.4 [hereinafter Wyo. Census 2012]; U.S. DEP'T OF AGRICULTURE, CENSUS OF AGRICULTURE, 2007 CENSUS VOLUME 1, CHAPTER 2: WYOMING COUNTY LEVEL DATA tbl.4 (2007 Census contains numbers for 2002).

⁴² Wyo. Census 2012, *supra* note 41, tbl.4.

⁴³ *Id.*

⁴⁴ Wyo. Census 2012, *supra* note 41, tbls.2,3.

⁴⁵ SUPPLY THE LAND, *supra* note 16, at 19.

no apparent seasonal trends.⁴⁶ Any average monthly price could be a minimum in one year and a maximum in another year. This variability demonstrates the variation possible in revenue numbers when attempting to value net revenue.

Consumptive use for Wyoming's portion of the Colorado River for 2005 through 2011 varies between 213,800 af in 2006 and 322,800 af in 2007 according to the US Bureau of Reclamation Consumptive Uses and Losses Reports.⁴⁷ These numbers only reflect irrigated agriculture. Evaporation and livestock consumption are minimal, but can be found in the reports. Other Bureau reports show an estimate of 398,000 af for 2015 and a maximum recorded consumption between 2001 and 2010 of 356,000 af.⁴⁸ State report statistics reflect different numbers. Green River basin consumptive use is 370,852–421,639 af depending on whether it was a dry or wet year, respectively.⁴⁹ These numbers reflect data for the years 1971 through 2007, and the average for the period is 401,037 af. These numbers are considerably higher than the Uses and Losses Reports, but they only offer a snapshot. For trending analysis, the Bureau's reports can be compared to each other on an annual basis with the same data collection methodology.

⁴⁶ U.S. DEP'T OF AGRICULTURE, NAT'L AGRICULTURAL STATISTICS SERV., WYOMING 2012 AGRICULTURAL STATISTICS 91, *available at* http://www.nass.usda.gov/Statistics_by_State/Wyoming/Publications/Annual_Statistical_Bulletin/bulletin2012.pdf.

⁴⁷ USES AND LOSSES 2001–2005, *supra* note 15, at 19–23 tbls.C-2–6; U.S. BUREAU OF RECLAMATION, U.S. DEPARTMENT OF THE INTERIOR, UPPER COLORADO RIVER BASIN CONSUMPTIVE USES AND LOSSES REPORT 2006–2010 11–15 tbls.UC-2–5 (rev. 2013) [hereinafter USES AND LOSSES 2006–2010], *available at* <http://www.usbr.gov/uc/library/envdocs/reports/crs/pdfs/cul2006-2010prov.pdf>; U.S. BUREAU OF RECLAMATION, U.S. DEPARTMENT OF THE INTERIOR, UPPER COLORADO RIVER BASIN CONSUMPTIVE USES AND LOSSES REPORT 2011–2015 11 tbl.UC-2 (rev. 2013) [hereinafter USES AND LOSSES 2011–2015], *available at* <http://www.usbr.gov/uc/library/envdocs/reports/crs/pdfs/cul2011-15prov.pdf>.

⁴⁸ U.S. BUREAU OF RECLAMATION, U.S. DEPARTMENT OF THE INTERIOR, COLORADO RIVER BASIN WATER SUPPLY AND DEMAND STUDY, APPENDIX C5: WYOMING WATER DEMAND SCENARIO QUANTIFICATION C5-5 TBL.C5-1 (2012); APPENDIX C10: HISTORICAL CONSUMPTIVE USE AND LOSS DETAIL BY STATE C10-9 fig.C10-11 (2012) [hereinafter APP. C10].

⁴⁹ GREEN RIVER BASIN PLAN (2010), *supra* note 14.

Overall, the range in net revenue is \$11,222,000–30,719,000. The consumptive use is 213,800–421,639 af. The resulting average price an agricultural user will pay is \$26.62–143.68 per af. This is higher than the Bureau of Reclamation contracts with agricultural users for \$8 per af in 2010.⁵⁰ Although variable, the comparison to other regions and uses is still important.

Colorado

Data for net revenue is found in the USDA Census of Agriculture for 2012, 2007, and 2002. The counties included in the report are: Archuleta, Delta, Dolores, Eagle, Garfield, Grand, Gunnison, Hinsdale, La Plata, Mesa, Moffat, Montezuma, Montrose, Ouray, Pitkin, Rio Blanco, Routt, San Juan, San Miguel, and Summit.⁵¹ The aggregate net revenue for these counties is \$32,134,000 (2012), \$33,918,000 (2007), and \$24,033,000 (2002).⁵² There is significant variability between farms and counties. In 2012, 7,059 of the 10,791 farms in the region lost an average of \$17,860, while the remaining farms gained an average of \$42,392.⁵³ In Pitkin county the average net loss was \$50,661.⁵⁴ On the county level, total net revenue ranged from a net loss of \$6,596,000 in La Plata to a gain of \$106,962,000 in Montrose.⁵⁵

Further limitations occur because of the inability to unbundle livestock and because of sales price fluctuations. Livestock revenue in 2012 was 60% of total agricultural

⁵⁰ WATER STRATEGIST: ANALYSIS OF WATER MARKETING, FINANCE, LEGISLATION AND LITIGATION (Rodney T. Smith ed., 2010) [hereinafter WATER STRATEGIST].

⁵¹ SUPPLY THE LAND, *supra* note 16, at 21 n.26.

⁵² U.S. DEP'T OF AGRICULTURE, CENSUS OF AGRICULTURE, 2012 CENSUS VOLUME 1, CHAPTER 2: COLORADO COUNTY LEVEL DATA tbl.4 [hereinafter Colo. Census 2012]; U.S. DEP'T OF AGRICULTURE, CENSUS OF AGRICULTURE, 2007 CENSUS VOLUME 1, CHAPTER 2: COLORADO COUNTY LEVEL DATA tbl.4 (2007 Census contains numbers for 2002).

⁵³ Colo. Census 2012, *supra* note 52, tbl.4.

⁵⁴ *Id.*

⁵⁵ *Id.*

revenue, with livestock in Archuleta accounting for 82% of the county's agricultural revenues.⁵⁶ In contrast, feed and livestock costs only account for between 12% and 38% of the production costs at the county level.⁵⁷ Also, there is extreme variability between years for livestock expenses. In Pitkin county, 2002 livestock expenses were \$44,000 while 2007 expenses rose to \$316,000 despite stagnation in the number of farms.⁵⁸ Variability in the market price of crops is also an important factor to consider in the analysis. Alfalfa, dry beans, and wheat are the most common crops.⁵⁹ Between 2004 and 2012 baled alfalfa prices were between \$78 and \$255 per ton.⁶⁰ In the same time period dry beans were between \$16.10 and \$54 per ton, and wheat traded between \$2.80 and \$8.82 per bushel.⁶¹

Consumptive use between 2005 and 2012 was 1,219,500–1,682,900 af according to the Bureau of Reclamation Consumptive Uses and Losses Reports.⁶² These numbers only represent agricultural irrigation and are provisional after 2005. A Colorado state report for 2008 shows 1,553,000 af of agricultural consumptive use for the Colorado River subbasins.⁶³ Other Bureau reports for the state display an estimate of 1,875,000 af for 2015 and 1,902,000 af for the maximum between 2001 and 2010.⁶⁴ Appendix C10 of the

⁵⁶ Colo. Census 2012, *supra* note 52, tbl.2.

⁵⁷ Colo. Census 2012, *supra* note 52, tbl.3. Total is not available because of missing data in some counties.

⁵⁸ Colo. Census 2007, *supra* note 52, tbl.3.

⁵⁹ SUPPLY THE LAND, *supra* note 16, at 24 tbl.6.

⁶⁰ U.S. DEP'T OF AGRICULTURE, NAT'L AGRICULTURAL STATISTICS SERV., COLORADO AGRICULTURAL STATISTICS 31 (2013), *available at* http://www.nass.usda.gov/Statistics_by_State/Colorado/Publications/Annual_Statistical_Bulletin/Final%202013.pdf.

⁶¹ *Id.*

⁶² USES AND LOSSES 2001–2005, *supra* note 15, at 19–23 tbls.C-2–6; USES AND LOSSES 2006–2010, *supra* note 47, at 11–15 tbls.UC-2–6; USES AND LOSSES 2011–2015, *supra* note 47, at 11 tbl.UC-2.

⁶³ CO report. (Colorado is 485,000af, Gunnison is 505,000af, Southwest is 382,000af, and the Yampa-White is 181,000af.).

⁶⁴ U.S. BUREAU OF RECLAMATION, U.S. DEPARTMENT OF THE INTERIOR, COLORADO RIVER BASIN WATER SUPPLY AND DEMAND STUDY, APPENDIX C2: COLORADO WATER DEMAND SCENARIO QUANTIFICATION C2-5 TBL.C2-1 (2012); APP. C10, *supra* note 48, at C10-2 fig.C10-2.

Bureau's Colorado River Basin Study discusses the differences in methodologies between the state report and Bureau consumption estimates that lead to this variation in results.⁶⁵

Net revenue is \$24,033,000–33,918,000 and consumptive use is 1,219,500–1,902,000 af. The average willingness to pay for agricultural operations is \$12.64–27.81 for basin areas in Colorado. This value is much lower than the actual transactions that took place through the CBT.⁶⁶ Prices of transfers fluctuated between \$10,000 and \$22,500 per af between January 2000 and January 2010.⁶⁷

Utah

Net revenue data are found in the USDA Census of Agriculture for 2002, 2007, and 2012. Counties in the Colorado River basin are: Carbon, Daggett, Duchesne, Emery, Garfield, Grand, Kane, San Juan, Uintah, Washington, and Wayne.⁶⁸ Net revenue is \$9,518,000 (2012), \$6,787,000 (2007), and \$11,890,000 (2002).⁶⁹ There is variability between counties and farms, as well. In 2012, 3,410 farms lost an average of \$16,468, while 1,891 farms gained an average of \$34,730.⁷⁰ Wayne county farms lost an average

⁶⁵ APP. C10, *supra* note 48, at C10-1.

⁶⁶ COLORADO BIG THOMPSON WATER RIGHTS PRICE TRENDS, http://irewater.com/sites/default/files/files/CBT_Water_Rights_Price_Trends.pdf (Prices compiled from Water Strategist publications 1991–2010. Note: the information is not separated between M&I and agricultural users, so prices may reflect either type of demand as the buyer.).

⁶⁷ *Id.*

⁶⁸ SUPPLY THE LAND, *supra* note 16, at 27 n.40.

⁶⁹ U.S. DEP'T OF AGRICULTURE, CENSUS OF AGRICULTURE, 2012 CENSUS VOLUME 1, CHAPTER 2: UTAH COUNTY LEVEL DATA tbl.4 [hereinafter Utah Census 2012]; U.S. DEP'T OF AGRICULTURE, CENSUS OF AGRICULTURE, 2007 CENSUS VOLUME 1, CHAPTER 2: UTAH COUNTY LEVEL DATA tbl.4 (2007 Census contains numbers for 2002).

⁷⁰ Utah Census 2012, *supra* note 69, tbl.4.

of \$62,207.⁷¹ Overall, counties in 2012 ranged in profitability from losing \$2,906,000 (Washington) to gaining \$9,130,000 (Duchesne).⁷²

Similar issues with uncertainty and variability exist with the livestock component and crop price fluctuations. 2012 livestock revenue was 60% of the total revenue, while feed and livestock expenses accounted for only 33% of total production expenses.⁷³

Alfalfa and other hay are the major crops in the region.⁷⁴ Between 2003 and 2010 baled alfalfa sold for between \$75 and \$180 per ton, and “other hay” fluctuated between \$60 and \$145 per ton.⁷⁵

The state borders both the Upper and Lower Colorado River basin, and the last year of complete Consumptive Uses and Losses Report data for both basins is 2005. Total consumptive use for that year was 660,700 af.⁷⁶ There is no state data for comparison, but a 2015 estimate by the Bureau is 457,000 af, and the maximum consumptive use between 2001 and 2010 was 753,000 af.⁷⁷

Net revenue is \$6,787,000–11,890,000, and consumptive use is 457,000–753,000 af. The average willingness to pay for agricultural water in the region is \$9.01–26.02 using this methodology and data. This is consistent with actual transactions. In one 2010 documented transaction, irrigators bought 285 af at \$14.50 per af.⁷⁸

⁷¹ *Id.*

⁷² *Id.*

⁷³ Utah Census 2012, *supra* note 69, tbls.2,3.

⁷⁴ SUPPLY THE LAND, *supra* note 16, at 29 tbl.8.

⁷⁵ U.S. DEP’T OF AGRICULTURE, NAT’L AGRICULTURAL STATISTICS SERV., UTAH AGRICULTURAL STATISTICS 69 (2011), *available at*

http://www.nass.usda.gov/Statistics_by_State/Utah/Publications/Annual_Statistical_Bulletin/Pdf/ab11/2011%20Utah%20Ag-Statistics%20Bulletin.pdf.

⁷⁶ USES AND LOSSES 2001–2005, *supra* note 15, at 19–23 tbls.C-2–6; USES AND LOSSES 2006–2010, *supra* note 47, at 11–15 tbls.UC-2–6; USES AND LOSSES 2011–2015, *supra* note 47, at 11 tbl.UC-2.

⁷⁷ U.S. BUREAU OF RECLAMATION, U.S. DEPARTMENT OF THE INTERIOR, COLORADO RIVER BASIN WATER SUPPLY AND DEMAND STUDY, APPENDIX C4: UTAH WATER DEMAND SCENARIO QUANTIFICATION C4-5 TBL.C4-1 (2012); APP. C10, *supra* note 48, at C10-7 fig.C10-8.

⁷⁸ WATER STRATEGIST, *supra* note 50.

New Mexico

Net revenue for operations using Colorado River water is in the USDA Census of Agriculture. The counties within the basin include: Catron, Grant, Hidalgo, McKinley, and San Juan.⁷⁹ The aggregate net revenue for the region is \$677,000 (2012), (\$4,047,000) (2007), and \$4,065,000 (2002).⁸⁰ There is not only a high degree of variability between years, but between counties and individual farms. In 2007, when the region lost money in the aggregate, 1,177 of the 5,269 farms made a profit at an average of \$18,790.⁸¹ Specifically, Hidalgo county farms that made money, averaged \$59,290.⁸² Also, counties in 2012 varied greatly in net revenue. Hidalgo county farms net revenue was \$10,407,000 while McKinley farms lost \$9,806,000.⁸³

There is also uncertainty in the inability to completely unbundle livestock operations. Although livestock revenue only accounted for 36% of total revenue in 2012, counties ranged from 10% (San Juan) to almost 90% (Catron) of the revenues within each county.⁸⁴ The livestock and feed expenses were more consistent with revenue shares than other states, accounting for 21% of the production costs.⁸⁵

Portions of New Mexico fall within both the Upper and Lower Colorado River basins. A 2005 estimate for consumptive use of irrigation water is 222,600 af according

⁷⁹ SUPPLY THE LAND, *supra* note 16, at 33 n.44.

⁸⁰ U.S. DEP'T OF AGRICULTURE, CENSUS OF AGRICULTURE, 2012 CENSUS VOLUME 1, CHAPTER 2: NEW MEXICO COUNTY LEVEL DATA tbl.4 [hereinafter NM Census 2012]; U.S. DEP'T OF AGRICULTURE, CENSUS OF AGRICULTURE, 2007 CENSUS VOLUME 1, CHAPTER 2: NEW MEXICO COUNTY LEVEL DATA tbl.4 (2007 Census contains numbers for 2002).

⁸¹ NM Census 2012, *supra* note 80, tbl.4.

⁸² *Id.*

⁸³ *Id.* McKinley is an interesting county. The average loss does not seem to change much between 2002, 2007, and 2012, but there is a large jump in the number of farms between 2002 and 2007. This increase in activity remained through 2012, despite an apparent lack of profitability.

⁸⁴ NM Census 2012, *supra* note 80, tbl.2.

⁸⁵ *Id.* tbl.3.

to the Consumptive Uses and Losses Report.⁸⁶ There is no state consumptive use data available.⁸⁷ The maximum consumptive use between 2001 and 2010 was 247,000 af, while the Bureau of Reclamation estimates 2015 use to be 111,000 af.⁸⁸

Net revenue ranges from a loss of \$4,047,000 to a gain of \$4,065,000, and consumptive use estimates are 111,000–247,000 af. The resulting values for average willingness to pay are \$0–36.62 per af.

Arizona

Net revenue data for Arizona are in the USDA Census of Agriculture reports. All of the counties in Arizona fall within the boundaries of the Colorado River basin.⁸⁹ Aggregate net revenue is \$600,394,000 (2012), \$584,944,000 (2007), and \$652,021,000 (2002).⁹⁰ Yuma and Maricopa counties were the most profitable in 2012 with net revenues of \$338,249,000 and \$176,552,000 respectively.⁹¹ Navajo county lost \$2,553,000 through the agricultural operations.⁹² Despite the seemingly profitable operations, 15,664 of the 20,005 farms in 2012 lost an average of \$22,417.⁹³ The

⁸⁶ USES AND LOSSES 2001–2005, *supra* note 15, at 19–23 tbls.C-2–6; USES AND LOSSES 2006–2010, *supra* note 47, at 11–15 tbls.UC-2–6; USES AND LOSSES 2011–2015, *supra* note 47, at 11 tbl.UC-2.

⁸⁷ Withdrawal data can be found in the regional water plans. See New Mexico Office of the State Engineer, *Regional Water Plans*, http://www.ose.state.nm.us/Planning/regional_water_plans.php.

⁸⁸ U.S. BUREAU OF RECLAMATION, U.S. DEPARTMENT OF THE INTERIOR, COLORADO RIVER BASIN WATER SUPPLY AND DEMAND STUDY, APPENDIX C3: NEW MEXICO WATER DEMAND SCENARIO QUANTIFICATION C3-5 TBL.C3-1 (2012); APP. C10, *supra* note 48, at C10-5 fig.C10-5.

⁸⁹ SUPPLY THE LAND, *supra* note 16, at 38 fig.23.

⁹⁰ U.S. DEP'T OF AGRICULTURE, CENSUS OF AGRICULTURE, 2012 CENSUS VOLUME 1, CHAPTER 2: ARIZONA COUNTY LEVEL DATA tbl.4 [hereinafter *Ariz. Census 2012*]; U.S. DEP'T OF AGRICULTURE, CENSUS OF AGRICULTURE, 2007 CENSUS VOLUME 1, CHAPTER 2: ARIZONA COUNTY LEVEL DATA tbl.4 (2007 Census contains numbers for 2002).

⁹¹ *Ariz. Census 2012*, *supra* note 90, tbl.4.

⁹² *Id.*

⁹³ *Id.*

remaining farms averaged \$219,198 in profit.⁹⁴ In Yuma county, 266 farms averaged gains of \$1,401,274.⁹⁵

Livestock plays a varied role in different counties. Livestock revenue for the state accounts for 49% of the total revenue from agriculture.⁹⁶ In comparison, livestock and feed expenses only account for 29% of the production expenses.⁹⁷ In Navajo county, livestock revenue accounted for almost 89% of the total revenue.⁹⁸ Revenue also fluctuates based on the market prices of major crops. Major crops in the state are hay and wheat.⁹⁹ Between 2000 and 2011 hay prices fluctuated between \$89 and \$219 per ton, and wheat was between \$3.45 and \$8.64 per bushel.¹⁰⁰

Consumptive use for irrigation in the state for 2005 was 3,374,900 af.¹⁰¹ State reports only provide withdrawal statistics, not consumptive use numbers.¹⁰² 2015 estimates from the Bureau of Reclamation study range between 1,007,000 and 1,145,000 af.¹⁰³ The maximum consumptive use between 2001 and 2010 was 1,742,000 af.¹⁰⁴ However, neither of these reports include mainstem diversions in the numbers. Net

⁹⁴ *Id.*

⁹⁵ *Id.*

⁹⁶ *Id.* tbl.2.

⁹⁷ *Id.* tbl.3.

⁹⁸ *Id.* tbl.2.

⁹⁹ SUPPLY THE LAND, *supra* note 16, at 41 fig.26 (Total vegetables and cotton are also major crops in the state.).

¹⁰⁰ U.S. DEP'T OF AGRICULTURE, NAT'L AGRICULTURAL STATISTICS SERV., ARIZONA AGRICULTURAL STATISTICS 11-14 (2011), *available at* http://www.nass.usda.gov/Statistics_by_State/Arizona/Publications/Bulletin/11bul/pdfs/2011FullBulletin.pdf.

¹⁰¹ U.S. BUREAU OF RECLAMATION, U.S. DEPARTMENT OF THE INTERIOR, COLORADO RIVER ACCOUNTING AND WATER USE REPORT: ARIZONA, CALIFORNIA, AND NEVADA (2005) [hereinafter 2005 ACCOUNTING]; USES AND LOSSES 2001-2005, *supra* note 15, at 19-23 tbls.C-2-6; USES AND LOSSES 2006-2010, *supra* note 47, at 11-15 tbls.UC-2-6; USES AND LOSSES 2011-2015, *supra* note 47, at 11 tbl.UC-2. *See also* SUPPLY THE LAND, *supra* note 16, at 15 tbl.5. *Arizona v California* allocates 2,800,000 af of Colorado River water to Arizona. 376 U.S. 340, 342 (1964).

¹⁰² *See* ARIZONA WATER ATLAS, *supra* note 14.

¹⁰³ U.S. BUREAU OF RECLAMATION, U.S. DEPARTMENT OF THE INTERIOR, COLORADO RIVER BASIN WATER SUPPLY AND DEMAND STUDY, APPENDIX C6: ARIZONA WATER DEMAND SCENARIO QUANTIFICATION C6-5 TBL.C6-1 (2012).

¹⁰⁴ APP. C10, *supra* note 48, at C10-11 fig.C10-14.

revenue is \$584,944,000–652,021,000, so willingness to pay is \$173.32–193.20 per af.

This range is lower than other literature reporting marginal values for irrigation on cotton fields to be as high as \$236 per af.¹⁰⁵

Nevada

USDA Census of Agriculture is the source of net revenue statistics for Nevada.

Clark, Lincoln, and about 25% of White Pine county lie within the basin.¹⁰⁶ Net revenue for the region is \$2,196,000 (2012), \$4,462,250 (2007), and \$4,454,250 (2002).¹⁰⁷ There appears to be a large drop in profitability in 2012 compared to 2007 and 2002. Further, in 2012, 421 of the 597 farms in the three counties lost an average of \$32,247.¹⁰⁸ White Pine farms that lost money averaged \$49,459 in loss.¹⁰⁹ However, the county was extremely variable because farms that were profitable averaged \$119,702 in net gains.¹¹⁰ Livestock revenue for 2012 was 43% of the total revenue, while feed and livestock production costs accounted for only 20% of the production expenses.¹¹¹

Consumptive use statistics come exclusively from the Bureau of Reclamation reports. Colorado River water in Nevada is almost completely consumed for Municipal and Industrial use. The 2005 Consumptive Uses and Losses Report shows 65,800 af of consumptive use.¹¹² The average willingness to pay is \$33.37–67.82 per af.

¹⁰⁵ Colby, *supra* note 26, at 521.

¹⁰⁶ SUPPLY THE LAND, *supra* note 16, at 43 n.61. Nye county is excluded from the methodology.

¹⁰⁷ U.S. DEP'T OF AGRICULTURE, CENSUS OF AGRICULTURE, 2012 CENSUS VOLUME 1, CHAPTER 2: NEVADA COUNTY LEVEL DATA tbl.4 [hereinafter Nev. Census 2012]; U.S. DEP'T OF AGRICULTURE, CENSUS OF AGRICULTURE, 2007 CENSUS VOLUME 1, CHAPTER 2: NEVADA COUNTY LEVEL DATA tbl.4 (2007 Census contains numbers for 2002).

¹⁰⁸ Nev. Census 2012, *supra* note 107, tbl.4.

¹⁰⁹ *Id.*

¹¹⁰ *Id.*

¹¹¹ *Id.* tbls.2,3.

¹¹² USES AND LOSSES 2001–2005, *supra* note 15, at 23 tbl.C-6.

California

Net revenue statistics come from the USDA Census of Agriculture reports. Imperial county and about 75% of Riverside county lie within the basin.¹¹³ The net revenues for the area are \$360,302,500 (2012), \$359,443,500 (2007), and \$364,562,750 (2002).¹¹⁴ These aggregates are fairly consistent from year to year, but individual farms can vary dramatically. In Imperial county, the average loss of the 163 farms was \$495,094 in 2012.¹¹⁵ In comparison, 258 farms were profitable that year averaging gains of \$1,327,969.¹¹⁶

Livestock is not as prevalent as other states. Livestock revenue is 29% of the total revenue while feed and livestock expenses combine for 28% of the production expenses.¹¹⁷ Alfalfa is a major crop in the region.¹¹⁸ The average monthly market price for alfalfa was between \$85 and \$250 per ton from 2003 through 2012.¹¹⁹

Consumptive use from the Bureau of Reclamation Consumptive Uses and Losses report was 3,462,900 af in 2005.¹²⁰ Between 2008 and 2013 the Lower Colorado River Accounting Reports show consumptive use for Palo Verde, Imperial, and Coachella agricultural areas to be 3,121,601–3,595,015 af.¹²¹ The Bureau of Reclamation estimates

¹¹³ SUPPLY THE LAND, *supra* note 16, at 12 tbl.3 (note (h)).

¹¹⁴ U.S. DEP'T OF AGRICULTURE, CENSUS OF AGRICULTURE, 2012 CENSUS VOLUME 1, CHAPTER 2: CALIFORNIA COUNTY LEVEL DATA tbl.4 [hereinafter Cal. Census 2012]; U.S. DEP'T OF AGRICULTURE, CENSUS OF AGRICULTURE, 2007 CENSUS VOLUME 1, CHAPTER 2: CALIFORNIA COUNTY LEVEL DATA tbl.4 (2007 Census contains numbers for 2002).

¹¹⁵ Cal. Census 2012, *supra* note 114, tbl.4.

¹¹⁶ *Id.*

¹¹⁷ *Id.* tbls.2,3.

¹¹⁸ SUPPLY THE LAND, *supra* note 16, at 48.

¹¹⁹ U.S. DEP'T OF AGRICULTURE, NAT'L AGRICULTURAL STATISTICS SERV., CALIFORNIA AGRICULTURAL STATISTICS 22 (2012), *available at* http://www.nass.usda.gov/Statistics_by_State/California/Publications/California_Ag_Statistics/Reports/2012cas-all.pdf.

¹²⁰ USES AND LOSSES 2001–2005, *supra* note 15, at 23 tbl.C-6. *Arizona v California* allocates 4,400,000 af of Colorado River water to California. 376 U.S. 340, 342 (1964).

¹²¹ 2005 ACCOUNTING, *supra* note 101.

2015 consumptive use for the area to be 3,230,000 af while the maximum between 2001 and 2010 was 3,666,000 af.¹²²

Overall, net revenue for the region is \$359,443,500–364,562,750, consumptive use is 3,121,601–3,666,000 af, and average net revenue is \$98.05–116.79 per af. This is much lower than \$336 per af recorded in another study.¹²³

MUNICIPAL & INDUSTRIAL

Municipal and industrial use in the basin is important to growing metropolitan areas. 3,900,300 af of Colorado River water is diverted each year for such use.¹²⁴ Arizona and California, alone, account for 77% of the M&I use in the basin.¹²⁵ Typically, M&I water users pay more for water than agricultural users.¹²⁶ At least one study says agricultural values in the region are \$3.04–41.41 per af for agricultural use versus \$504.76–4,823.46 per af for M&I uses.¹²⁷ However, these numbers are based on withdrawals for agricultural use instead of consumptive use, so the price per af is lower in the study than this report. Also, the M&I prices reflect the amount end users are willing to pay for higher quality water instead of what a municipal utility might pay for raw water.¹²⁸ The differences in prices of agriculture can be found in the previous section of this report.

Although end user prices are important, the end user of municipal water pays for the treatment and transportation infrastructure. The market price reflects these costs, causing

¹²² U.S. BUREAU OF RECLAMATION, U.S. DEPARTMENT OF THE INTERIOR, COLORADO RIVER BASIN WATER SUPPLY AND DEMAND STUDY, APPENDIX C7: CALIFORNIA WATER DEMAND SCENARIO QUANTIFICATION C7-5 TBL.C7-1 (2012); APP. C10, *supra* note 48, at C10-15 fig.C10-20.

¹²³ BATKER, *supra* note 7, at 33.

¹²⁴ *Id.* at 31 tbl.14.

¹²⁵ *Id.*

¹²⁶ *Id.* at 31 (often more than 100 times as much).

¹²⁷ *Id.* at 31 tbl.15.

¹²⁸ Even end users vary depending on the use. Colby, *supra* note 26, at 523 (lawn irrigation values of \$184 per af compared to \$326 for indoor uses).

the price to be higher than raw, in situ water.¹²⁹ Examples of municipalities in the basin better reflect what water is worth to a utility that will treat and transport the water to an end user. This report focuses on the Metropolitan Water District of Southern California (MWD), Southern Nevada Water Association (SNWA), Phoenix water utility, and Denver Water.

Using a similar methodology to the agricultural valuation, dividing net revenue for the utility by the amount of water diverted provides an average willingness to pay for that amount of water. Deliveries in 2008 were 904,850 (MWD), 519,200 (SNWA), 305,577 (Phoenix), and 126,161 af (Denver).¹³⁰ While SNWA and Phoenix rely entirely on Colorado River water, Denver and MWD gather water from a variety of sources including the Colorado River.¹³¹

The most recent financial reports for MWD show net revenues of \$105,300,000–373,100,000.¹³² The willingness to pay is \$116.37–412.33 per af based on the 2008 diverted water. Net revenues for SNWA are between a loss of \$3,473,568 and a gain of \$87,378,705.¹³³ SNWA would be willing to pay \$0–168.29 per af for Colorado River water. Phoenix profitability is \$20,479,000–48,811,000.¹³⁴ The willingness to pay for the current water usage is \$67.02–159.73 per af. Finally, Denver Water has financial data

¹²⁹ For data on end user prices, see Brett Walton, *The Price of Water: A Comparison of Water Rates, Usage in 30 U.S. Cities*, CIRCLE OF BLUE (Apr. 26, 2010), <http://www.circleofblue.org/waternews/2010/world/the-price-of-water-a-comparison-of-water-rates-usage-in-30-u-s-cities/>.

¹³⁰ BATKER, *supra* note 7, at 31 tbl.14

¹³¹ *Id.* at 31.

¹³² THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA, COMPREHENSIVE ANNUAL FINANCIAL REPORT FOR THE FISCAL YEARS ENDED JUNE 30, 2013 AND 2012, http://www.mwdh2o.com/mwdh2o/pages/finance/2013%20CAFR_final.pdf.

¹³³ SOUTHERN NEVADA WATER AUTHORITY, BASIC FINANCIAL STATEMENTS (2012–2013), http://www.snwa.com/assets/pdf/about_reports_cafr_basic_financials.pdf.

¹³⁴ CITY OF PHOENIX, ARIZONA COMPREHENSIVE ANNUAL FINANCIAL REPORT 146 (2013), <https://www.phoenix.gov/financesite/Documents/cafr2013r2.pdf>.

available for 2008 to coincide with the withdrawal data. Net revenue was \$71,863,000,¹³⁵ resulting in a willingness to pay of \$569.61 per af for 2008.

It should be noted that the prices could be even higher if operating expenses already account for some of the transactions involving the lease or purchase of water.¹³⁶ This is apparent in the actual transfers that have taken place. In 2010 MWD paid \$250 per af for a long-term lease of 13,500 af.¹³⁷ Also, a development in California paid \$5,850 per af for 1,993 af.¹³⁸ Neither of these were from Colorado River sources, but it shows what operators in the basin state are willing to pay for water, which might be diverted from the Colorado River.

Colorado transfers are also higher than the estimated range. The City of Loveland and North Weld County purchased CBT units for about \$13,600 per af, and the Town of Pierce purchased a unit for \$19,600 per af.¹³⁹ The City of Aurora paid \$10,187.50–13,636.36 per af for 327 af, while the Bureau of Reclamation transferred to private entities for M&I use at a mere \$82.72 per af.¹⁴⁰ Actual Utah M&I transfers were \$2,250 per af, while Wyoming were \$40–75 per af for Bureau of Reclamation leases.¹⁴¹ Arizona valued a transfer at \$125 per af when one company bought another, and the primary assets were storage credits of 126,000 af.¹⁴² Another source values national public supply

¹³⁵ COMPREHENSIVE ANNUAL FINANCIAL REPORT II-7 (Denver 2008), http://www.denverwater.org/docs/assets/E5E35102-BCDF-1B42-D6262C1FD85E64FB/DW_AR20081.pdf.

¹³⁶ *See, e.g., id.* at II-11 (depending on what is included in “source of supply”).

¹³⁷ WATER STRATEGIST, *supra* note 50.

¹³⁸ *Id.*

¹³⁹ *Id.* (one unit is roughly 0.5 af).

¹⁴⁰ *Id.*

¹⁴¹ *Id.*

¹⁴² *Id.*

at up to \$4,500 per af and manufacturing uses at \$14–1,600 per af, based on actual transfer data.¹⁴³

OTHER USES

Other Colorado River demands are even more complex when attempting to value the water for potential market participants. The three remaining uses that might have an impact on the redistribution of the resource are energy, recreation, and non-use.

Energy

Water used for energy purposes falls into three categories: thermoelectric cooling, hydropower, and extraction. Definitions differ between agencies. For instance, the Bureau defines energy as thermoelectric, solar, geothermal, and oil shale demands.¹⁴⁴ Mineral production is a separate category under the Basin Study and includes extraction.¹⁴⁵ In Arizona, mining and power plant demands are included in industrial uses, while municipal use is a separate category.¹⁴⁶

Best alternative valuation might be the optimal valuation method instead of average willingness to pay for energy demands.¹⁴⁷ There is incredible variability in price depending on whether it is base load or peak load power.¹⁴⁸ These variations cause the

¹⁴³ U.S. Department of the Interior, *Chapter 6 Water*, in ECONOMIC REPORT 46 (2012), available at <http://www.doi.gov/ppa/upload/Chapter-6-FY2012-Econ-Report.pdf>.

¹⁴⁴ *Demand Assessment*, *supra* note 19, at C-33.

¹⁴⁵ *Id.* at C-35.

¹⁴⁶ ATLAS VOL2, *supra* note 18, at 47 (also includes golf courses, paper mills, and feedlots).

¹⁴⁷ Colby, *supra* note 26; J.F. Booker & R.A. Young, *Economic Impacts of Alternative Water Allocations in the Colorado River Basin*, in COLORADO WATER RESOURCES RESEARCH INSTITUTE COMPLETION REPORT No. 161 (CSU 1991), available at http://digitool.library.colostate.edu//exlibris/dtl/d3_1/apache_media/L2V4bGlicmlzL2R0bC9kM18xL2FwYWNoZV9tZWRpYS8xMjMlNw==.pdf.

¹⁴⁸ Colby, *supra* note 26.

average willingness to pay to be misleading. Also, when comparing consumptive uses, energy and mining are smaller portions of the pie compared to agriculture and M&I.¹⁴⁹

Water used for cooling thermoelectric power plants is more complicated than the agricultural and M&I uses. In agriculture, the important value to the farmer is not diversions, but what is actually consumed by his crops. With thermoelectric power, consumption is relatively low, but the presence of large quantities of water is “critical to plant operation.”¹⁵⁰ Even withdrawal statistics are difficult to find. Some states in the basin breakdown diversions by power plant.¹⁵¹ Other states only report at the subbasin level.¹⁵² For plants with withdrawal statistics, consumptive use numbers can be determined depending on the type of power plant.¹⁵³ According to one report, the national average willingness to pay is \$12–87 per af based on withdrawals.¹⁵⁴

Hydropower water use is also difficult to value. The amount of water in the reservoir is important to determine the power output.¹⁵⁵ Consumptive use numbers could be based on evaporation from the reservoir, but it is difficult to unbundle the evaporation assigned to hydropower from other diversions from the reservoir.¹⁵⁶ According to one report, using cost savings methodology, hydropower operators are willing to pay \$33 per af above

¹⁴⁹ See *Demand Assessment*, *supra* note 19, at C-27 fig.C-10.

¹⁵⁰ U.S. DEP’T OF ENERGY, ENERGY DEMANDS ON WATER RESOURCES 18 (2006) [hereinafter ENERGY DEMANDS], <http://www.sandia.gov/energy-water/docs/121-RptToCongress-EWwEIAcomments-FINAL.pdf>. Thermoelectric power is 39% of the freshwater diversions for the United States in 2000. *Id.* at 18 fig.II-1.

¹⁵¹ SEE GREEN RIVER BASIN PLAN, *supra* note 14 (WY); ARIZONA WATER ATLAS, *supra* note 14 (AZ).

¹⁵² See, e.g., SWSI 2010, *supra* note 14.

¹⁵³ See U.S. DEP’T OF THE INTERIOR, USGS, METHODS FOR ESTIMATING WATER CONSUMPTION FOR THERMOELECTRIC POWER PLANTS IN THE UNITED STATES (2013), *available at* <http://pubs.usgs.gov/sir/2013/5188/pdf/sir2013-5188.pdf> (breaking down the consumptive coefficients of different types of power plants).

¹⁵⁴ *Water*, *supra* note 39, at 46.

¹⁵⁵ See Howe & Ahrens, *supra* note 6, at 196.

¹⁵⁶ ENERGY DEMANDS, *supra* note 150, at 19–20.

coal-fired steam plants and \$81 above gas-turbine electric plants.¹⁵⁷ Marginal value methodology may be more accurate because of the relationship between the height of the reservoir and the electricity production.¹⁵⁸ One report using actual transfer data, found the national average willingness to pay is \$1–157 per af.¹⁵⁹

Values of water for extraction are found through actual transfers and an average willingness to pay analysis based on withdrawals. Withdrawal volumes are located in sources like Arizona Water Atlases and the Bureau of Reclamation reports.¹⁶⁰ But these sources only provide an overview of use from a state, or regional level.¹⁶¹ Overall, mining only represents a small portion of consumptive use in each state and in the Colorado River basin.¹⁶² Regardless of the proportion of use, the willingness to pay for extractive water could be \$40–500 per af.¹⁶³

Recreation

Recreational values are increasingly important in the Colorado River basin. Western states are shifting from the traditional economic base of extractive industries to economies based on recreation and tourism.¹⁶⁴ Recreational values represent non-

¹⁵⁷ Colby, *supra* note 26, at 526 (based on an acre-foot of flow for hydropower).

¹⁵⁸ James F. Booker & Bonnie G. Colby, *Competing Water Uses in the Southwestern United States: Valuing Drought Damages*, 31 WATER RESOURCES BULLETIN 877, 885 tbl.4 (Oct. 1995) [hereinafter Booker & Colby], available at https://wrrc.arizona.edu/sites/wrrc.arizona.edu/files/severe_sustained_drought_w_0.pdf (listing the dams on the Colorado River and marginal benefits).

¹⁵⁹ *Water*, *supra* note 39, at 46.

¹⁶⁰ See ARIZONA WATER ATLAS, *supra* note 14; *Demand Assessment*, *supra* note 19, at C-27 fig.C-10. See also GREEN RIVER BASIN PLAN, *supra* note 14 (breaking down the demand by type of extraction: Soda Ash Production).

¹⁶¹ Colorado is reported on a basin basis. See SWSI 2010, *supra* note 14.

¹⁶² *Demand Assessment*, *supra* note 19, at C-27 fig.C-10.

¹⁶³ *Water*, *supra* note 39, at 46.

¹⁶⁴ Tony Prato & Dan Fagre, *The Crown of the Continent: Striving for Ecosystem Sustainability*, in SUSTAINING ROCKY MOUNTAIN LANDSCAPES 3, 4 (Tony Prato & Dan Fagre eds., 2007). One study values

consumptive uses of the natural landscape.¹⁶⁵ Types of uses include boating, fishing, and reservoir uses.¹⁶⁶ According to a 1992 study, recreational benefits from dams and reservoirs in the basin are \$3.70–112.40 per af storage.¹⁶⁷ Marginal values may be more important than average values for activities like whitewater rafting and fishing. Such activities require a minimum flow, but may be less profitable if the flow volume is too high.¹⁶⁸ Because most valuations are based on person/day, it is also difficult to compare recreational uses to the other demand categories without actual transfer data.

Non-Use

Water has value to potential market participants, even if they never use the resource directly. A person may value water as an option to use in the future, to ensure it exists for future generations to enjoy, or purely for the existence of the resource.¹⁶⁹ Such non-use demands are difficult to value because they are not visible in market prices.¹⁷⁰ Because of the nature of these demands, estimates are not valued in \$ per af, but rather \$ per non-user. One report shows \$40-80 per year per non-user household for Alaska, Colorado,

the annual recreational benefits for the basin at almost \$1.7 billion. BATKER, *supra* note 7, at 51 tbl.25 (activities limited to rafting, boating, fishing, and swimming).

¹⁶⁵ See, e.g., APP. C2, *supra* note 17, at C2-17. For a great resource of the types of recreational values in the basin and the values/person/day, see PAMELA KAVAL, ECOSYSTEM SERVICE VALUATION OF THE COLORADO RIVER BASIN: A LITERATURE REVIEW AND ASSESSMENT OF THE TOTAL ECONOMIC VALUE OF THE COLORADO RIVER BASIN (2011) [hereinafter KAVAL].

¹⁶⁶ Booker & Colby, *supra* note 158, at 883 (discussing types of reservoir benefits: visiting National Recreation Areas, boating, fishing, and swimming in the reservoir).

¹⁶⁷ *Id.* at 885 tbl.4.

¹⁶⁸ See *id.*, at 884; Colby, *supra* note 26, at 518; Howe & Ahrens, *supra* note 6, at 196 tbl.5.16 (discussing how marginal value for whitewater is constant above a certain minimum flow, while fishing marginal value decreases from positive values to negative values).

¹⁶⁹ KAVAL, *supra* note 165, at 37; Howe & Ahrens, *supra* note 6.

¹⁷⁰ Robert Costanza et al., *The Value of the World's Ecosystem Services and Natural Capital*, 387 *Nature* 253 (1997). See also FIELD, *supra* note 7, at 154–58 (discussing the valuation of nonuse benefits for natural resources).

and Wyoming.¹⁷¹ Another report for Colorado residents values the preservation of wilderness at \$83 per household per year.¹⁷² Although a small sample, actual transfers provide a more accurate idea for what potential market participants might pay. In one California transfer, a conservation group purchased senior rights for wetland mitigation, paying \$7,900 per af for 10,000 af.¹⁷³

CONCLUSIONS

Water is difficult to value.¹⁷⁴ Sources exist that provide some good numbers, but there is huge variability. Marginal valuations might be more important for market participants because each situation is unique. There appears to be a premium for M&I uses compared to agricultural demands, and the Lower Colorado River basin seems to pay more for agricultural water than the Upper Colorado River basin. However, there is variability and uncertainty. Unbundling needs to be done to better understand the landscape, especially with agriculture demands. We need more information and standardization between states and agencies to understand how participants will act. Better reporting of actual transfers will also help to understand if estimates are accurate to current conditions.¹⁷⁵ But transactions under the current system are a small sample. Better monitoring, data mining, and transparency will lead to more transfers because of trust in the system. In turn, more market participants will lead to better monitoring.

¹⁷¹ Colby, *supra* note 26, at 520.

¹⁷² KAVAL, *supra* note 165, at 38.

¹⁷³ WATER STRATEGIST, *supra* note 50.

¹⁷⁴ U.S. ENVIRONMENTAL PROTECTION AGENCY, THE IMPORTANCE OF WATER TO THE U.S. ECONOMY (Nov. 2013), <http://water.epa.gov/action/importanceofwater/upload/Importance-of-Water-Synthesis-Report.pdf>

¹⁷⁵ Water Strategist ceased publication in 2010. The company is now a private consulting company.

Key “Take-Home” Messages

After completing research on the valuation of water in the Colorado River Basin, the results reveal five messages that are particularly compelling:

I. Even when analysis focuses on one method of economic valuation of water use, values lack adequate precision and accuracy due both to data deficiencies and to extreme variability.

For irrigation demand valuation, this research focused on a valuation method that took the difference between revenue and expenses for the agricultural water user and divided that number by the amount of water consumed in a year. The idea was to compare this average ability to pay for current use across basin states and counties. The methodology assumes water is free, so any agricultural users with water contracts would actually pay more overall for their current water use.

This seemingly simple methodology was not as accurate as expected because of data deficiencies and extreme variability. Differences between revenue and expenses were determined from the USDA Censuses of Agriculture.¹⁷⁶ Estimating what data should be used was difficult because unbundling actual Colorado River water use was impossible and watershed boundaries did not coincide with county borders. Also, the data from these reports were only published every five years, and data were missing in some areas of the reports.

¹⁷⁶ See U.S. DEP’T OF AGRICULTURE, CENSUS OF AGRICULTURE, <http://www.agcensus.usda.gov/Publications/Ag>.

Further inaccuracies stem from the variability of the data. Even within counties, the average net revenue does not account for the spread of the data; some farms may have lost money and some may have been much more profitable than the average.

Consumptive use of Colorado River water varied depending on whether the report was produced by the Bureau of Reclamation or state agencies.¹⁷⁷ Overall, values based on this methodology ranged from \$0 per acre-foot (af) in New Mexico where the average farms in the appropriate counties lost money, to Arizona where the top end of the range was \$193.20 per af for one year.

II. Comparing different uses is very difficult because methods vary, especially between traditional consumptive uses and instream demands.

Absent a large pool of transactions to draw upon for data, comparing traditional consumptive uses with other values like energy, recreation, and non-use is difficult.

Although methodologies vary, the basic idea for municipal and agricultural users is that

¹⁷⁷ See U.S. BUREAU OF RECLAMATION, U.S. DEPARTMENT OF THE INTERIOR, COLORADO RIVER SYSTEM CONSUMPTIVE USES AND LOSSES REPORTS, <http://www.usbr.gov/uc/library/envdocs/reports/crs/crsul.html> (Bureau (2001–2005 is the most current final report. 2006–2010, and 2011–2015 contain provisional data.); LOWER COLORADO RIVER ACCOUNTING SYSTEM REPORTS (LCRAS), DECREE ACCOUNTING, FORECASTED WATER USE REPORT 2012, AND ACTUAL WATER USE REPORT 2012, <http://www.usbr.gov/lc/region/g4000/wtracct.html> (annual reports all available through the webpage); COLORADO RIVER BASIN WATER SUPPLY AND DEMAND STUDY, APPENDICES C2-C8, C10, <http://www.usbr.gov/lc/region/programs/crbstudy/finalreport/techrptC.html>; ARIZONA DEP'T OF WATER RESOURCES, ARIZONA WATER ATLAS (2010), <http://www.azwater.gov/AzDWR/StatewidePlanning/wateratlas/default.htm> (Arizona); COLORADO DIVISION OF WATER RESOURCES, CUMULATIVE YEARLY STATISTICS OF THE COLORADO DIVISION OF WATER RESOURCES, http://water.state.co.us/DWRIPub/DWR%20Annual%20Reports/CYS_rpt_2009.pdf (Colorado); COLORADO WATER CONSERVATION BOARD, STATEWIDE WATER SUPPLY INITIATIVE, COLORADO'S WATER SUPPLY FUTURE (2010) [hereinafter SWSI 2010], <http://cwcb.state.co.us/water-management/water-supply-planning/Documents/SWSI2010/SWSI2010.pdf> (Colorado); SNWA, WATER PLAN FOR NEVADA WATER, <http://water.nv.gov/programs/planning/stateplan/part2/> (Nevada); NEW MEXICO OFFICE OF THE STATE ENGINEER, REGIONAL WATER PLANS, http://www.ose.state.nm.us/isc_regional_plans.html (New Mexico); UTAH DIVISION OF WATER RESOURCES, <http://www.water.utah.gov/> (Utah); GREEN RIVER BASIN WATER PLANNING PROCESS (States West Water Resources Corporation, 2001), http://www.swccd.us/images/R_GreenR_Basin_rpt_04.pdf (Wyoming); GREEN RIVER BASIN PLAN (2010), <http://waterplan.state.wy.us/plan/green/2010/finalrept/finalrept-GRB.pdf> (Wyoming).

they value water for its consumptive use. On the other hand, it is difficult to determine if this value is comparable to a power plant that uses water for thermoelectric cooling. No matter what method is used for valuing the numerator in dollars, like a best alternative methodology, it is unclear whether the denominator should include consumptive or diverted use. Consumption is much smaller than diversion, and diversion is really the important input to the power plant operator. Similarly, hydroelectric generation values the flow through the turbines and head of the reservoir instead of the amount of evaporation (consumption). Also, comparisons are difficult because of a lack of standardization among units. Recreational water values from reports are commonly expressed in af of storage or per person/day.¹⁷⁸ Further, non-use values are typically expressed in per household/year units.¹⁷⁹

III. There is extreme variation between agricultural operations that make money and lose money, so the averages are not as important for determining potential market participants as individual user data.

Even county data are too broad to determine the potential buyers and sellers in a water market. More data should be collected on individual farm operators. Looking at the distributions of unprofitable and profitable farms in the Censuses of Agriculture, it is clear that averages fall short of conveying the true nature of the potential market for agricultural water in the Colorado River Basin.

¹⁷⁸ See, e.g., James F. Booker & Bonnie G. Colby, *Competing Water Uses in the Southwestern United States: Valuing Drought Damages*, 31 WATER RESOURCES BULLETIN 877, 885 tbl.4 (Oct. 1995).

¹⁷⁹ See, e.g., Bonnie G. Colby, *Estimating the Value of Water in Alternative Uses*, 29 NAT. RESOURCES J. 511, 520 (1986).

In basin counties in Colorado in 2012, 7,059 farms lost money, while 3,732 farms were profitable.¹⁸⁰ Overall net revenue for these farms was over \$32 million.¹⁸¹ Similarly, in Utah counties for the same year, 3,410 of 5,301 farms lost money, while the farms totaled \$9.5 million in net revenue.¹⁸² One of the highest variations on the county level was Yuma County, Arizona, where the average loss for farms that lost money was over \$138,000 in 2012, while the profitable farms averaged net revenues over \$1.4 million for the same year.¹⁸³ Even larger variations exist in Imperial, California where unprofitable farms lost an average of almost \$500,000 in 2012, while profitable farms exceeded \$1.3 million in net revenue.¹⁸⁴

IV. California and Arizona are the titans of agricultural water use among the basin states.

Colorado River Basin counties in California made more than \$360 million in 2012, and Arizona counties exceeded \$600 million in net revenue. Basin counties in the remaining states only made a total of \$64.5 million, with half of that from Colorado. Maricopa, Pinal, and Yuma counties in Arizona and Imperial and Riverside counties in California each exceeded the total net revenues of these remaining basin states. Further, California and Arizona farms are much more diversified than the other states that rely almost exclusively on hay and pastureland.

¹⁸⁰ U.S. DEP'T OF AGRICULTURE, CENSUS OF AGRICULTURE, 2012 CENSUS VOLUME 1, CHAPTER 2: COLORADO COUNTY LEVEL DATA tbl.4.

¹⁸¹ *Id.*

¹⁸² U.S. DEP'T OF AGRICULTURE, CENSUS OF AGRICULTURE, 2012 CENSUS VOLUME 1, CHAPTER 2: UTAH COUNTY LEVEL DATA tbl.4.

¹⁸³ U.S. DEP'T OF AGRICULTURE, CENSUS OF AGRICULTURE, 2012 CENSUS VOLUME 1, CHAPTER 2: ARIZONA COUNTY LEVEL DATA tbl.4.

¹⁸⁴ U.S. DEP'T OF AGRICULTURE, CENSUS OF AGRICULTURE, 2012 CENSUS VOLUME 1, CHAPTER 2: CALIFORNIA COUNTY LEVEL DATA tbl.4.

V. Agricultural and municipal demand values may be closer than prior reports have demonstrated.

Reports on demand valuations for the Colorado River Basin typically focus on side-by-side comparisons between agricultural and municipal demands. At first glance, it appears the municipal values are hundreds of times more than the agricultural values.¹⁸⁵ However, municipal values are based on end users who are paying for treated water that is delivered to their place of use. A better comparison is to determine the value of raw water to the operator or utility that is treating and supplying the water. Accounting for these added values, the economic value of municipal water would decrease and close the gap between the agricultural and municipal prices.

¹⁸⁵ DAVID BATKER ET AL., NATURE'S VALUE IN THE COLORADO RIVER BASIN 31 *tbl.*15 (2014).