

Auxiliary Materials

Appendices A, B and C to:

Streetlights and Tradeoffs: Better Understanding Water Uses and Values in the Middle Rio Grande Valley

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Table of Contents

Appendix A: Unadjusted and Effective ET: Process, Trends and Maps.....	3
Appendix B: Estimates of Economic Values, Prices, Administrative Charges & Rates for Water in MRGB and Comparable Western U.S.....	22
Appendix C: Technical Background Support for Section III.2.e.: What Do We Pay for 1.5 AF of Consumptive Water Use?– <i>Preliminary</i> Investigation and Comparisons Across Various Sources.....	58
References.....	65

Appendix A:

Unadjusted and Effective ET: Process, Trends and Maps

Evapotranspiration (ET) data were obtained from the OpenET platform via a custom Google Earth Engine (GEE) script developed for this study. OpenET uses satellite data to estimate how much water is lost to evapotranspiration (ET) across the western United States. The process involves combining six established surface energy balance models: SSEBop, PT-JPL, SIMS, geeSEBAL, DisALEXI, and eeMETRIC (Melton et al., 2022). Output products are generated at a native $30\text{ m} \times 30\text{ m}$ spatial resolution and are suitable for both pixel-level raster analysis and field-scale zonal averaging.

All OpenET constituent model outputs are accessible within the GEE environment, including the ensemble product, which aggregates the six individual model estimates into a single combined output (Melton et al., 2022). The ensemble has demonstrated substantially higher agreement with ground-based flux tower measurements in semi-arid and arid settings relative to any single constituent model, establishing it as the appropriate choice for investigations of ET in the desert Southwest (Volk et al., 2024).

Using the GEE script, annual (adjusted) ET values for each pixel from 2000 through 2024 were extracted at the native 30-meter Landsat resolution. GEE zonal statistics tools were then applied to combine these pixel-level values into a mean ET for each of our selected geographies in the Middle Rio Grande Valley (MRGV)

An analogous zonal averaging procedure was applied to extract annual precipitation from the GRIDMET dataset, which supplies daily gridded meteorological fields at high spatial resolution across the contiguous United States. GRIDMET precipitation grids were resampled and spatially aggregated using the identical geographic boundaries employed for the ET extraction, ensuring direct comparability between the two datasets.

After the data were extracted and aggregated, a baseline effective evapotranspiration was calculated as the difference between annual (adjusted) ET and total precipitation for each selected geography. This baseline assumes that all precipitation is available for evapotranspiration. However, total precipitation overstates the water available to plants because some rainfall is lost to surface runoff and deep percolation before it can reach the root zone. To account for this, total precipitation was adjusted using the U.S. Bureau of Reclamation (USBR) effective rainfall method. This method, drawn from the Modified Blaney-Criddle (MBC) framework, expresses effective rainfall (R_e) as a piecewise linear function of total monthly rainfall (R).

Table A1: USBR Effective Rainfall

Monthly Rainfall (R) (inches)	Effective Rainfall (R_e) (inches)
$R \leq 1$	$R_e = 0.95R$
$1 < R \leq 2$	$R_e = 0.95 + 0.90 (R-1)$
$2 < R \leq 3$	$R_e = 1.85 + 0.82 (R-2)$
$3 < R \leq 4$	$R_e = 2.67 + 0.65 (R-3)$
$4 < R \leq 5$	$R_e = 3.32 + 0.45 (R-4)$
$5 < R \leq 6$	$R_e = 3.77 + 0.25 (R-5)$
$R > 6$	$R_e = 4.02 + 0.05 (R-6)$

This correction limits precipitation inputs to the fraction available for evapotranspiration. Monthly effective rainfall values were calculated within the GEE environment and aggregated to pixel-level annual totals, which were subsequently averaged zonally across the same geographic units used for ET extraction.

The final effective evapotranspiration estimate was then calculated as:

$$effective\ ET = ET\ (unadjusted) - Re$$

where Re is the USBR-corrected effective precipitation. All processing steps (data access and zonal averaging) were carried out within the Google Earth Engine cloud computing environment. The resulting zonal-mean ET and precipitation outputs were exported as CSV tables and GeoTIFF raster layers for visualization and statistical analysis in ArcGIS Pro and STATA.

Figure A1: Annual Unadjusted and Effective ET for ABCWUA Service Area, 2000-2024.

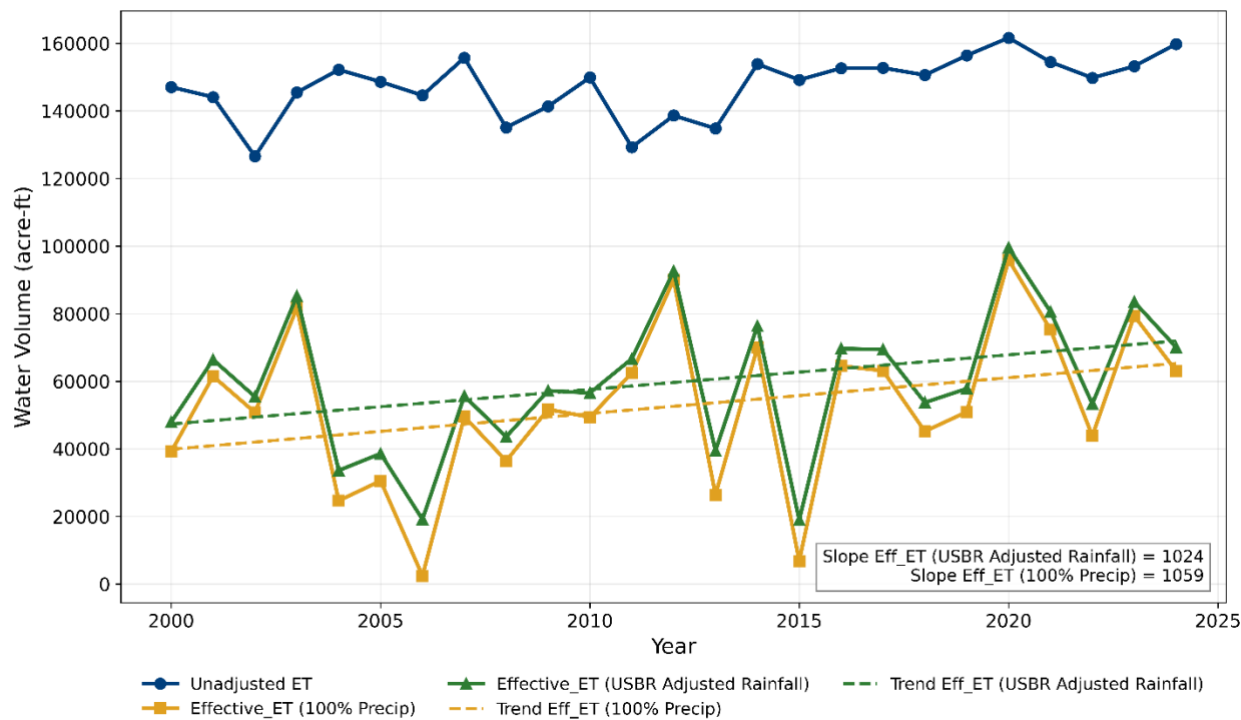


Figure A2: Annual Unadjusted and Effective ET for Levee Zones within ABCWUA, 2000-2024.



Figure A3: Annual Unadjusted and Effective ET for the village of Corrales, 2000-2024

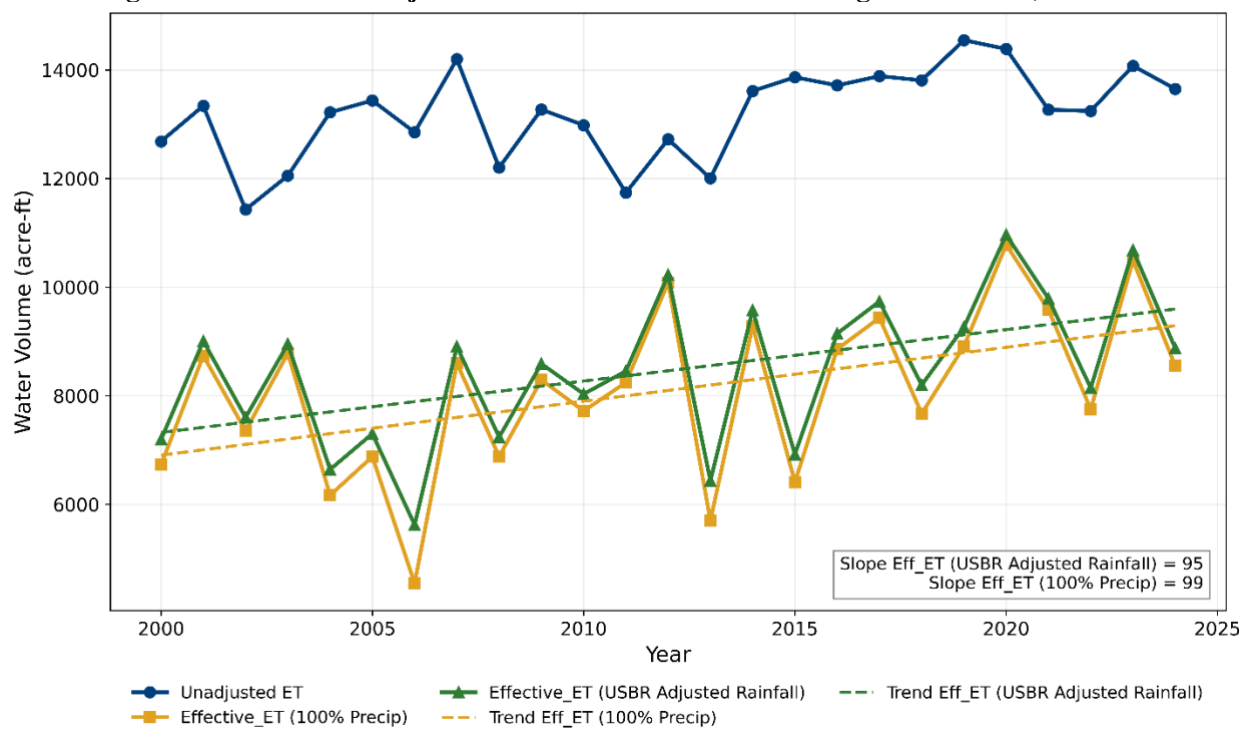


Figure A4: Annual Unadjusted and Effective ET for Levee Zones for MRGV, 2000-2024

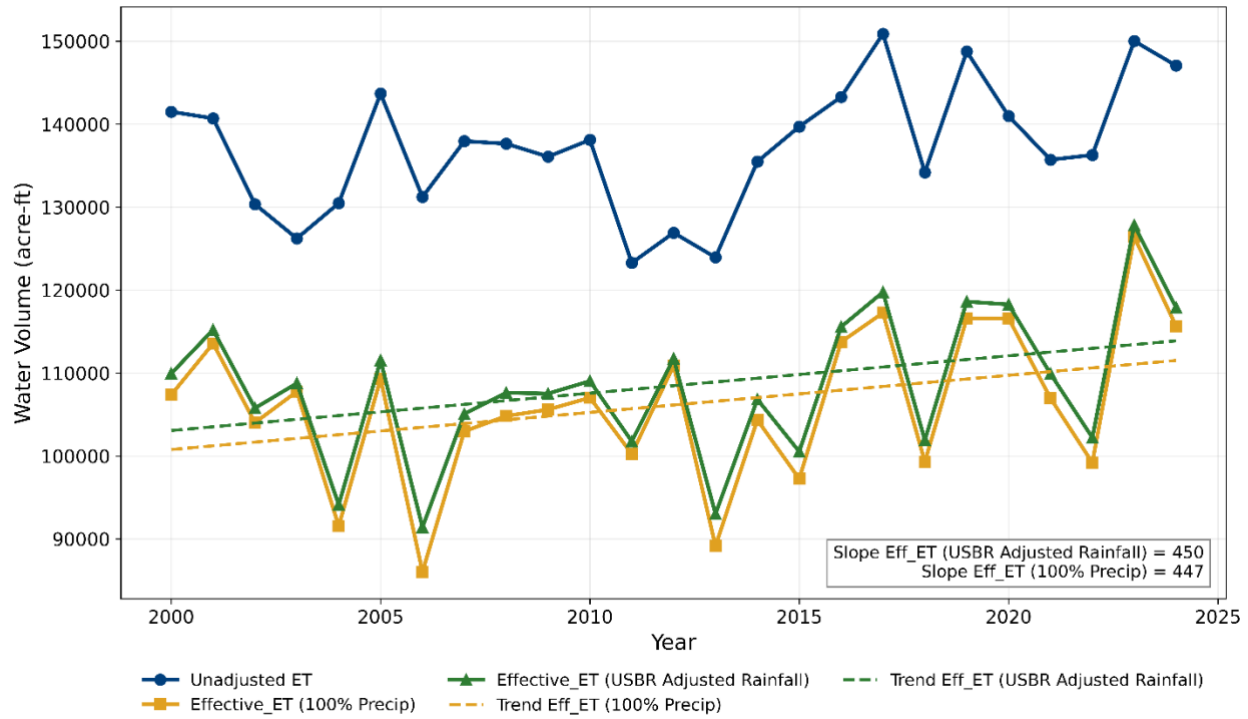


Figure A5: Annual Unadjusted and Effective ET within Outer MRGCD Boundary, 2000-2024

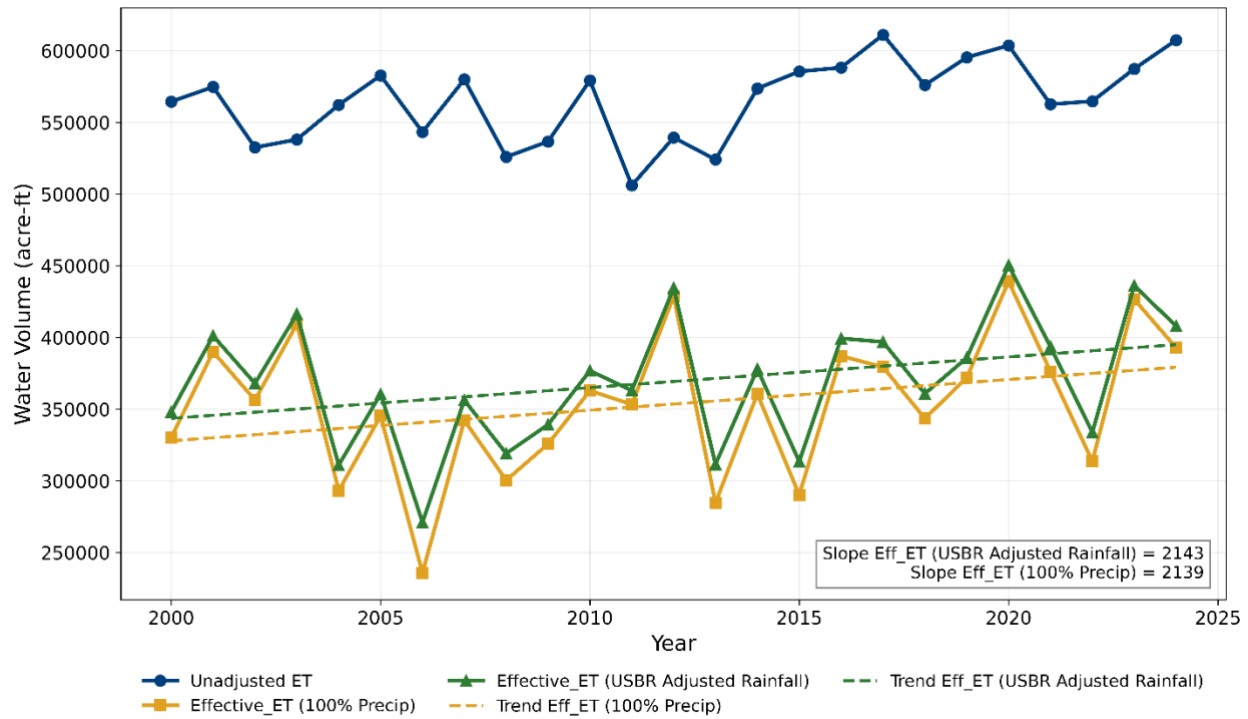


Figure A6: Annual Unadjusted and Effective ET for MRGCD Boundary Excluding Levee Zones, 2000-2024

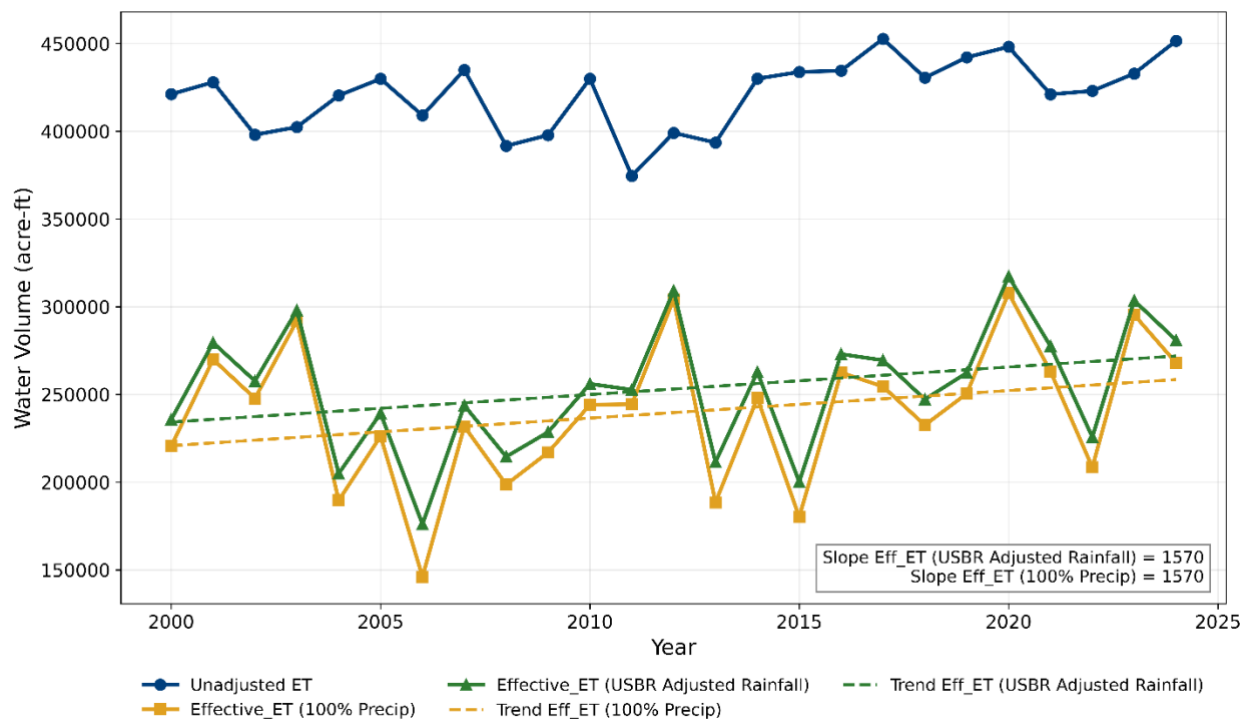


Figure A7: Annual Unadjusted and Effective ET for Full BDANWR Boundary, 2000-2024

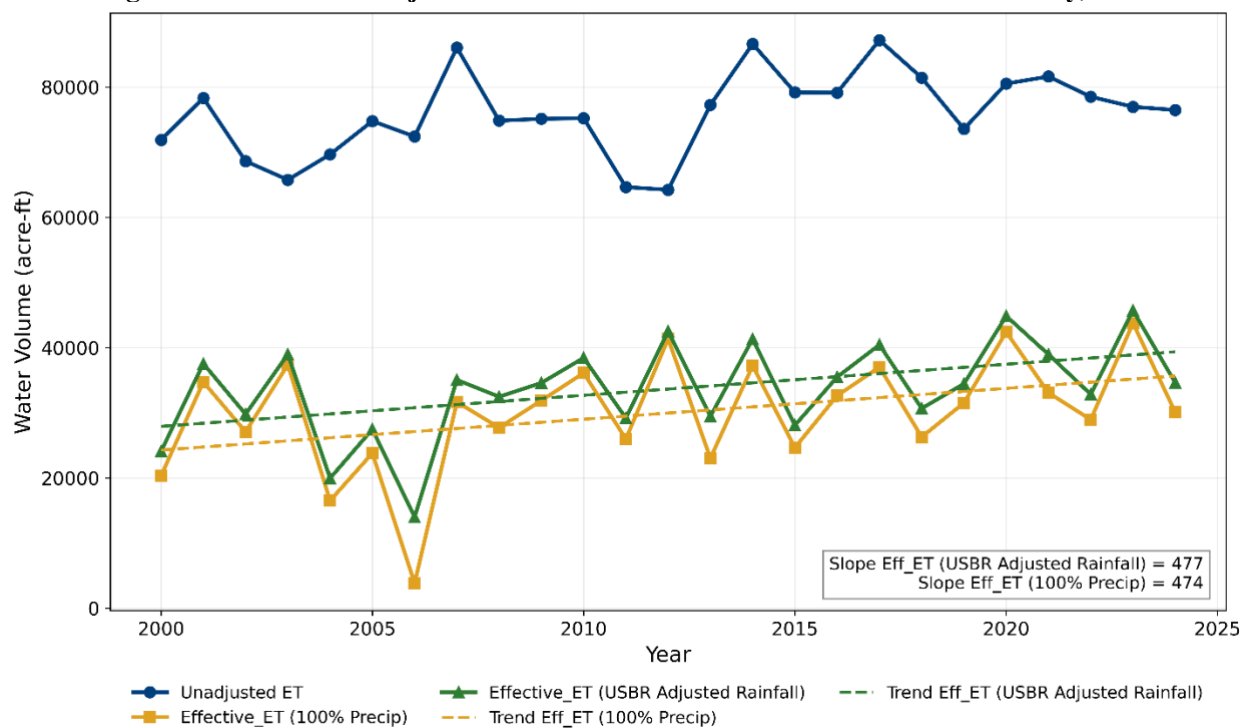


Figure A8: Annual Unadjusted and Effective ET for MRGCD-Intersected Areas in the BDANWR, 2000-2024



Figure A9: Annual Unadjusted and Effective ET for 0.275-EVI-Threshold MRGCD in BDANWR, 2000-2024

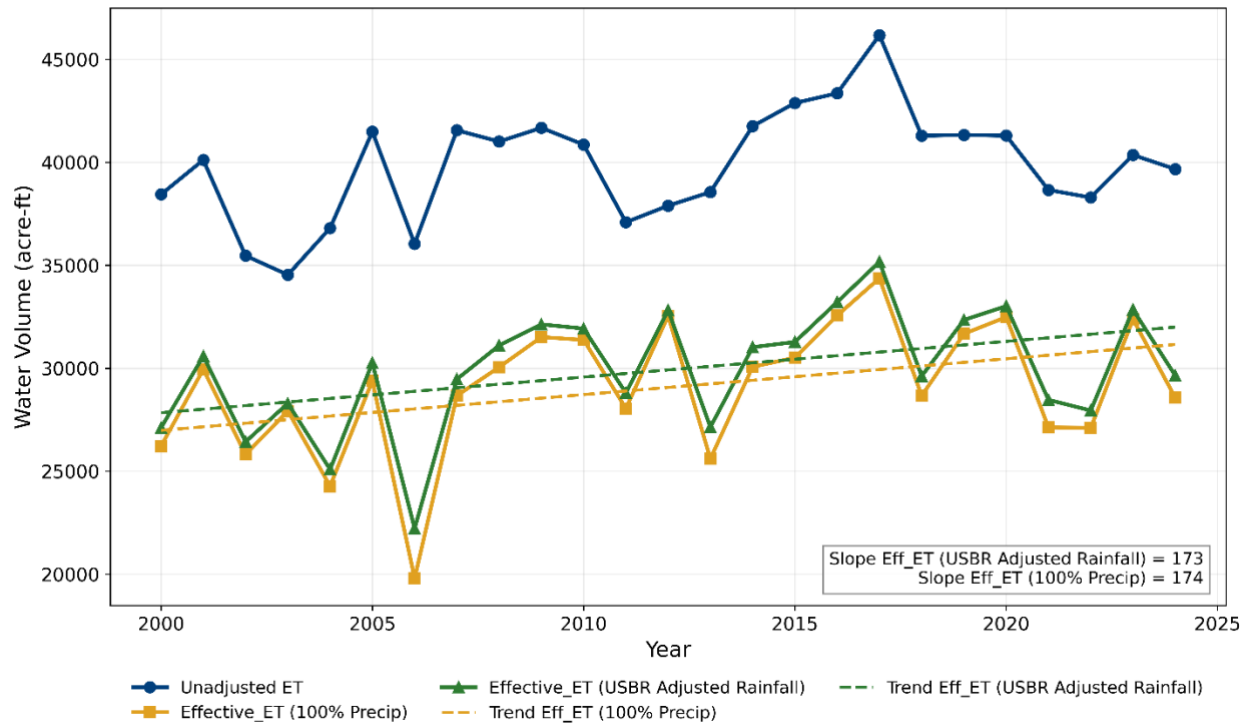


Figure A10: Annual unadjusted and Effective ET for seven community water system boundaries (combined) in Grant area, 2000-2024

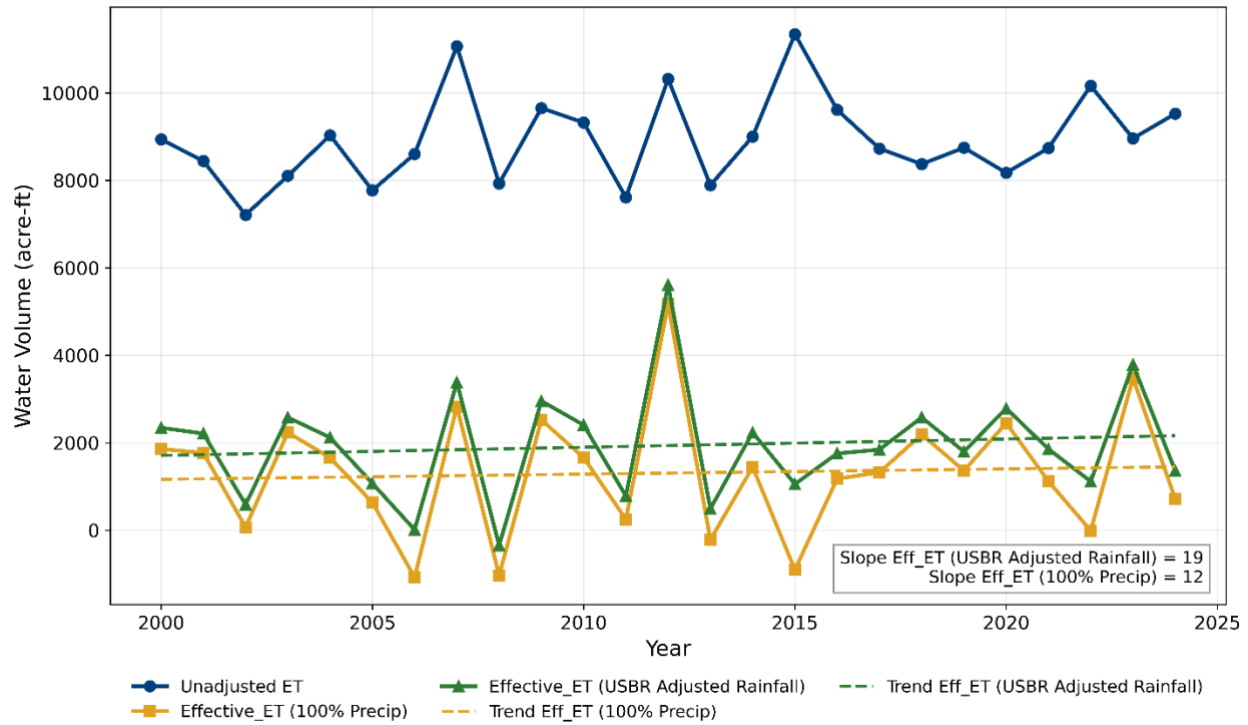
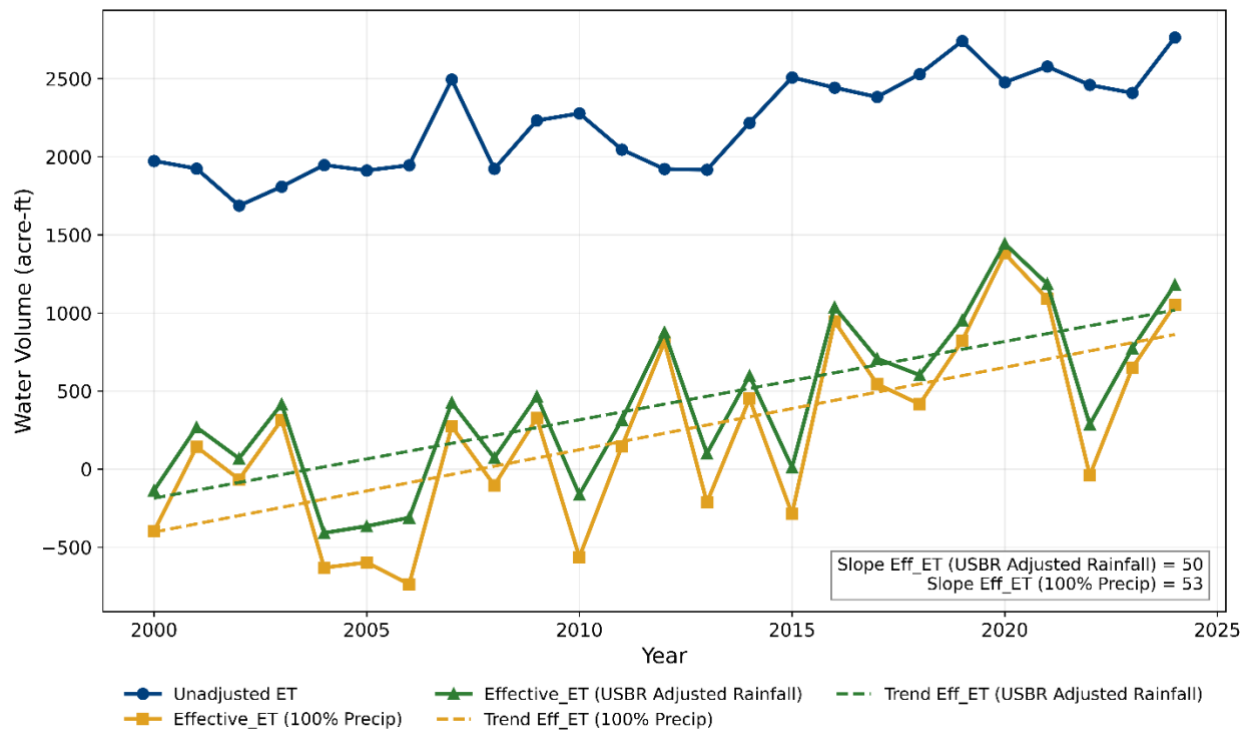
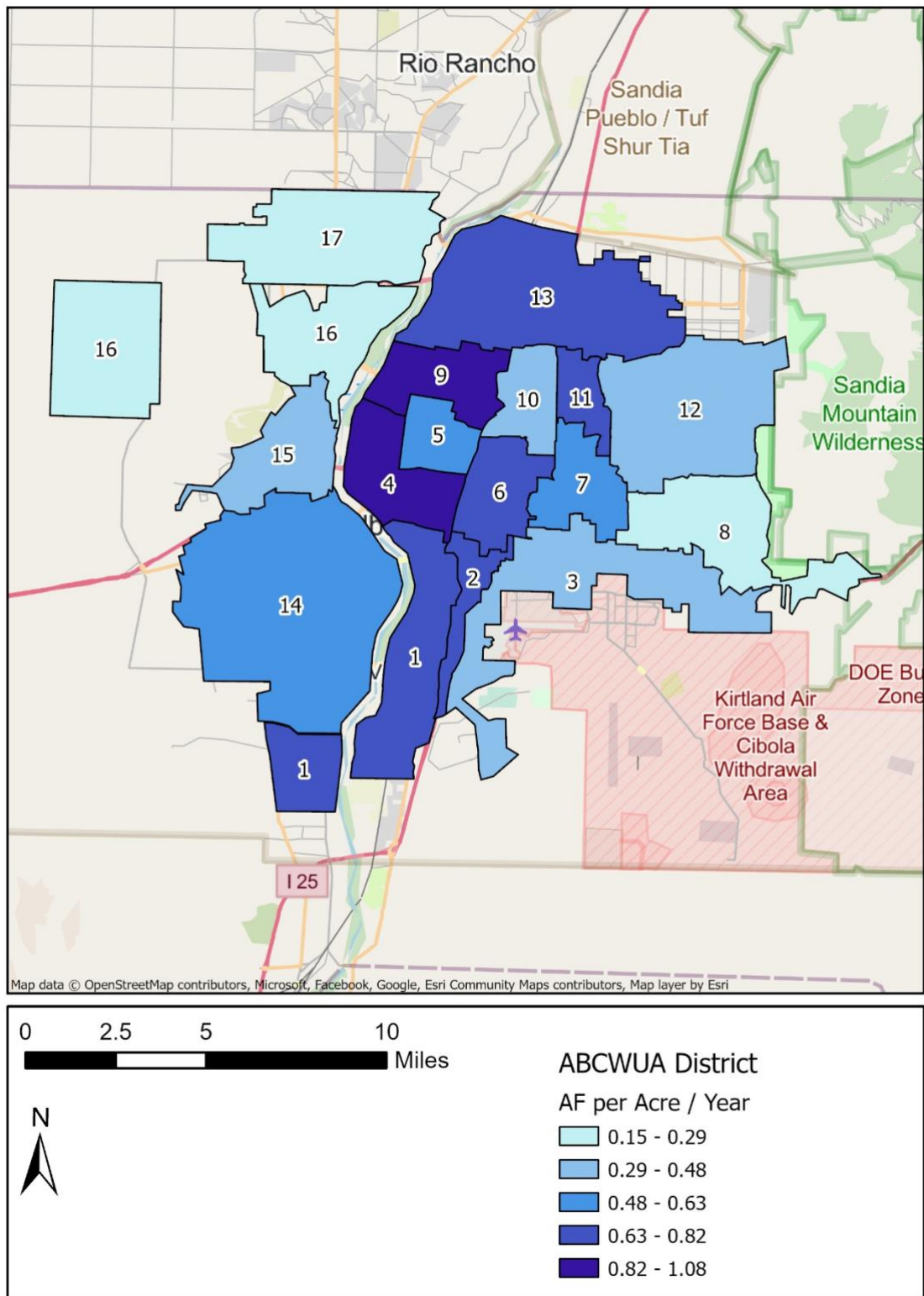


Figure A11: Annual Unadjusted and Effective ET for Sandia Peak Utility Service Area, 2000-2024.

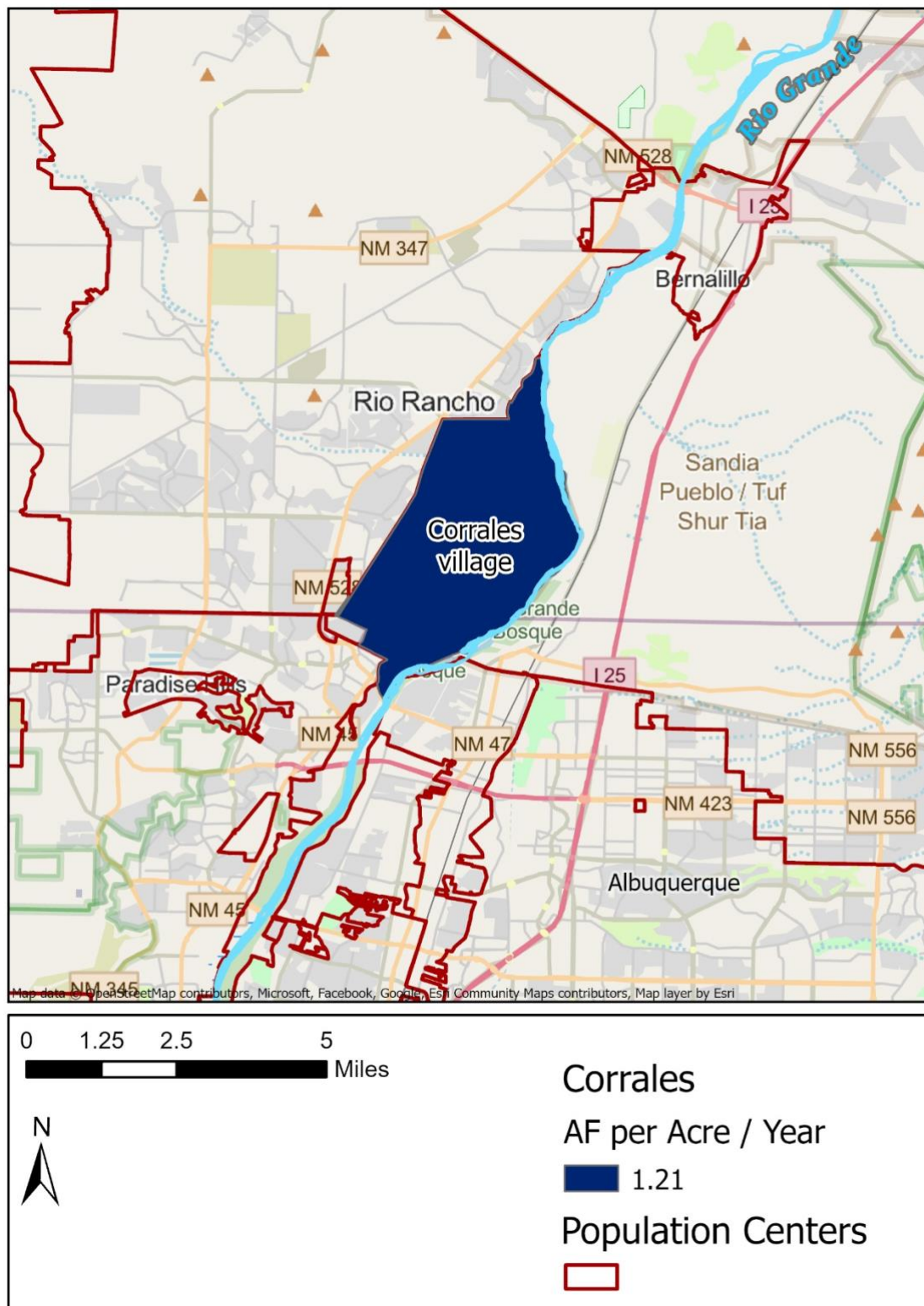




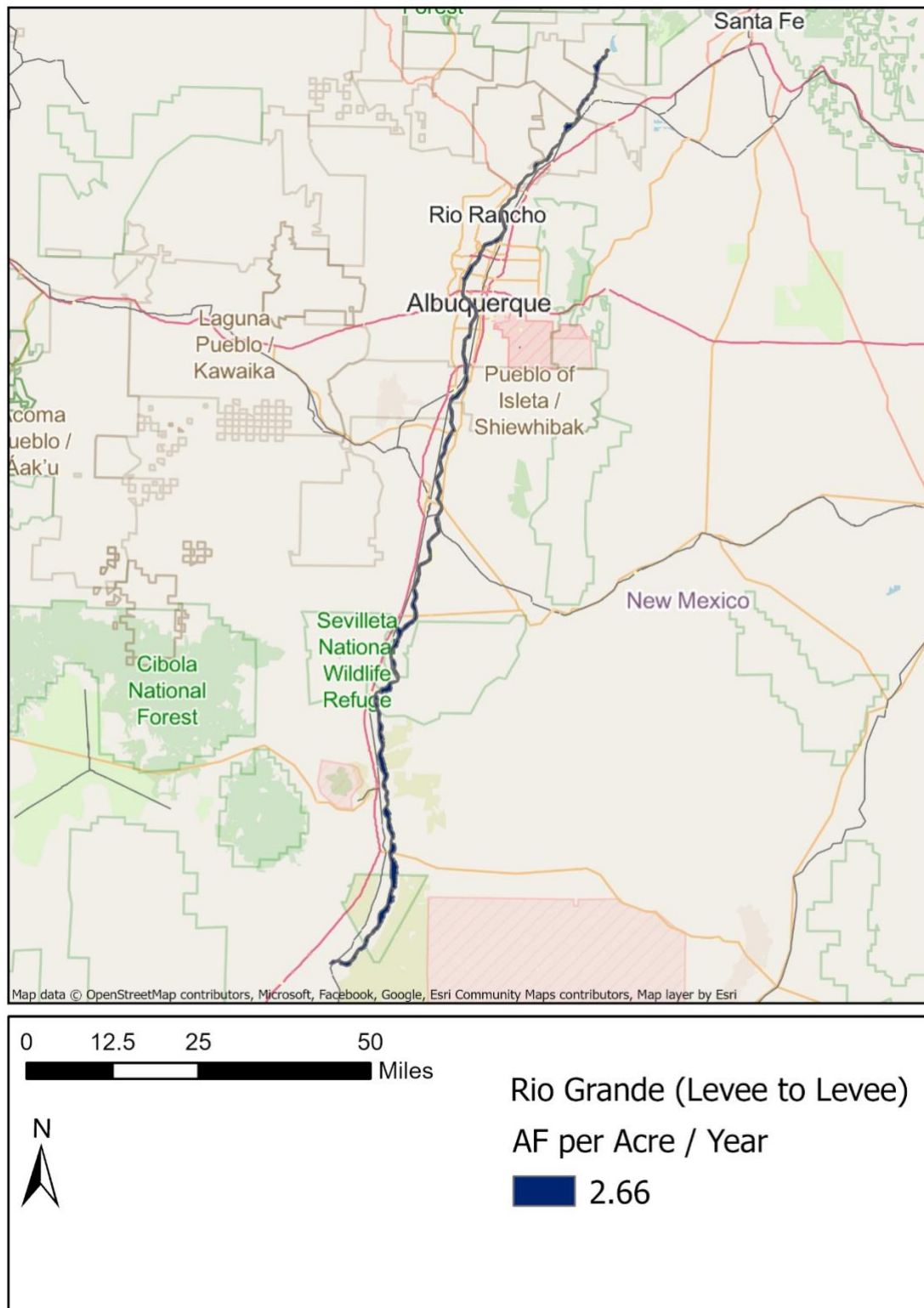
Map A1: Effective ET (USBR Effective Rainfall Adjusted) for ABCWUA Service Area.
 Sources: Data generated using OpenET and ArcGIS Pro. Numbers on the map denote the districts within the service area.



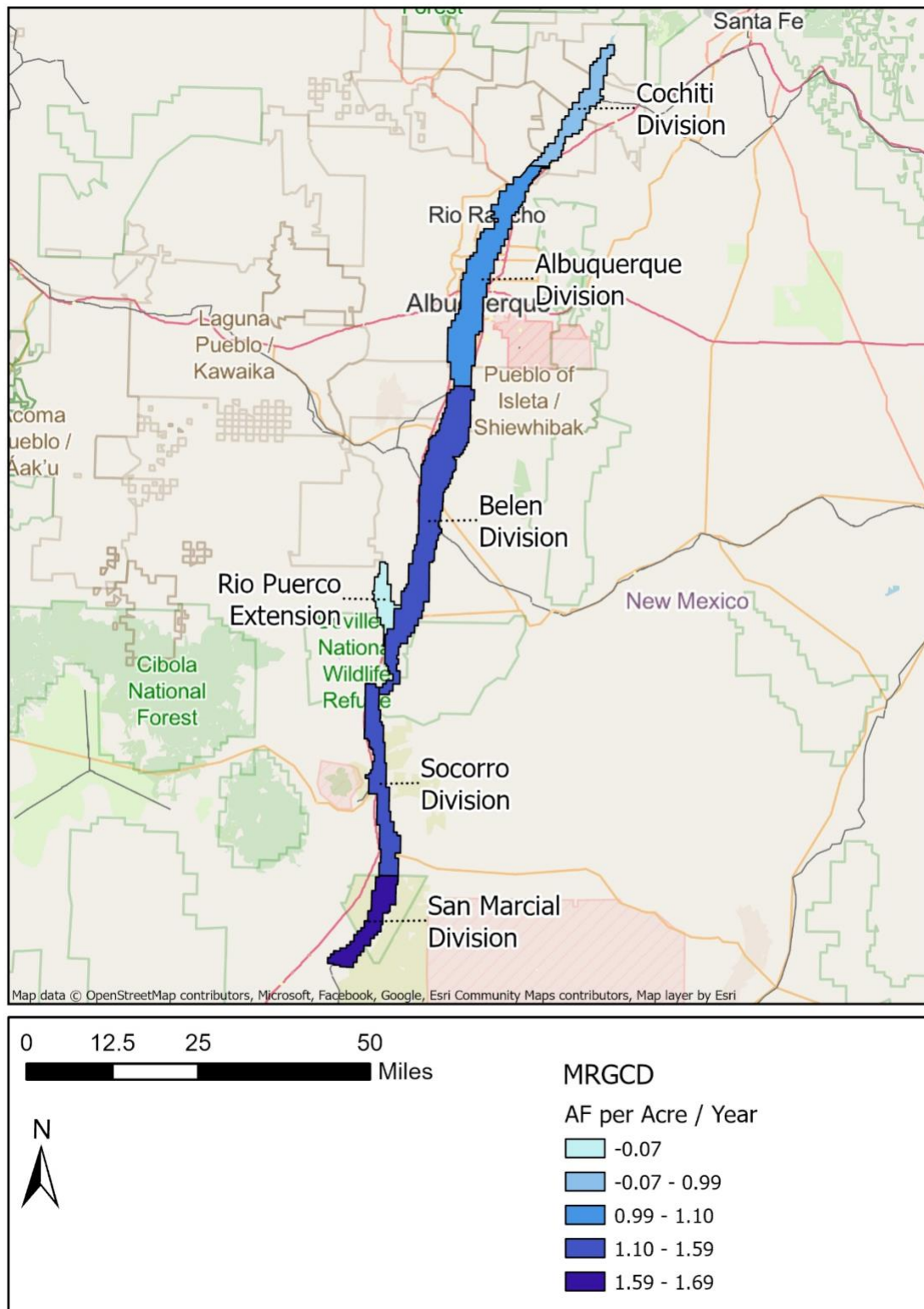
Map A2: Effective ET (USBR Effective Rainfall Adjusted) for Levee Zones within ABCWUA Service Area. Sources: Data generated using OpenET and ArcGIS Pro.



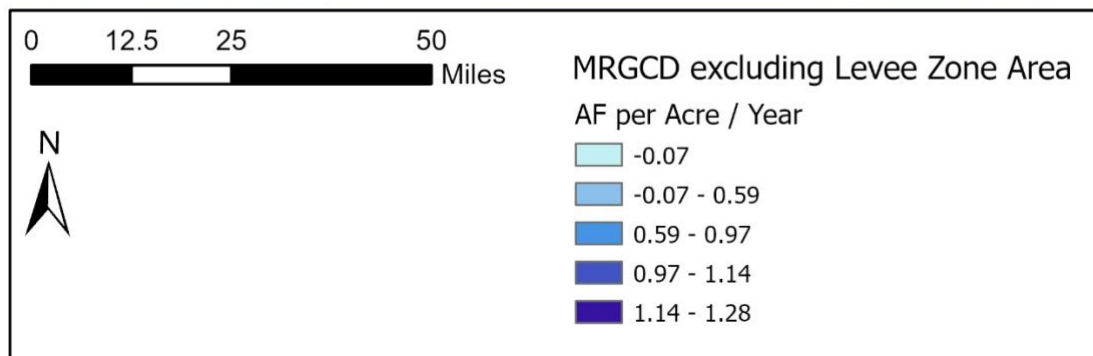
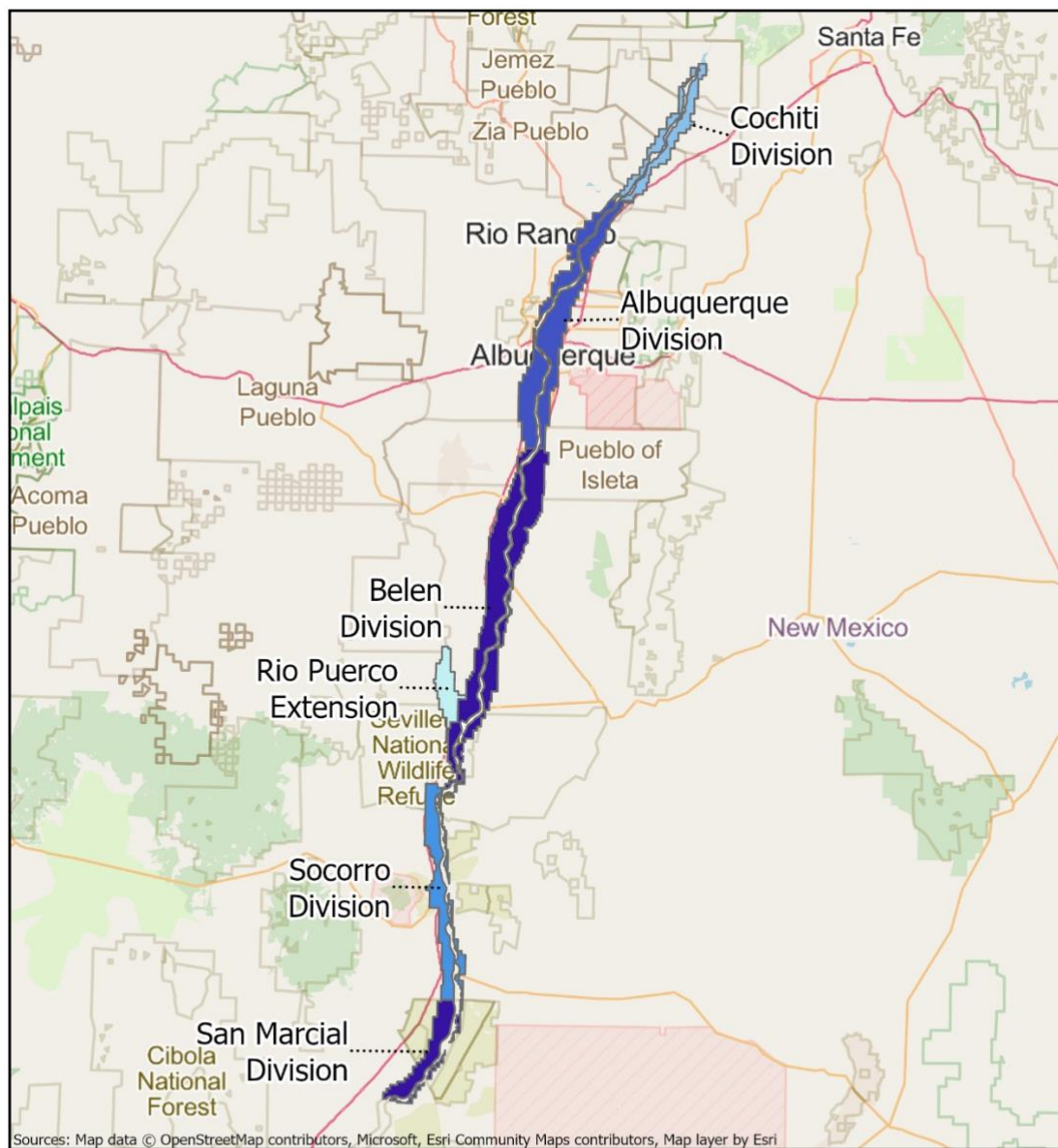
Map A3: Effective ET (USBR Effective Rainfall Adjusted) for the village of Corrales.
 Sources: Data generated using OpenET and ArcGIS Pro.



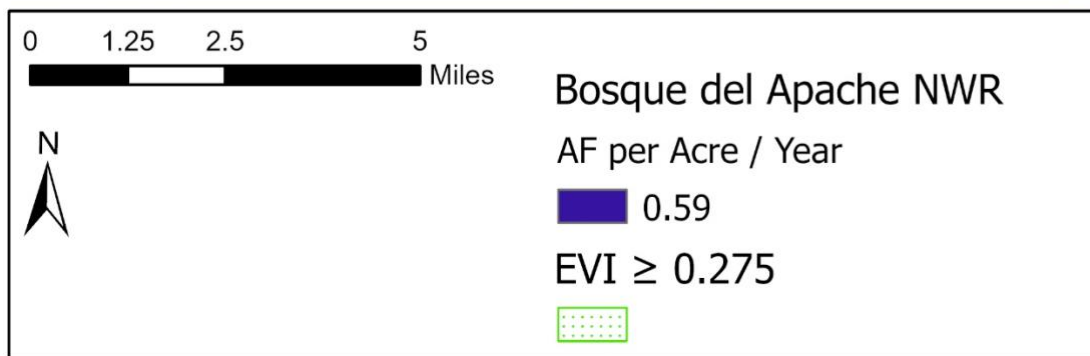
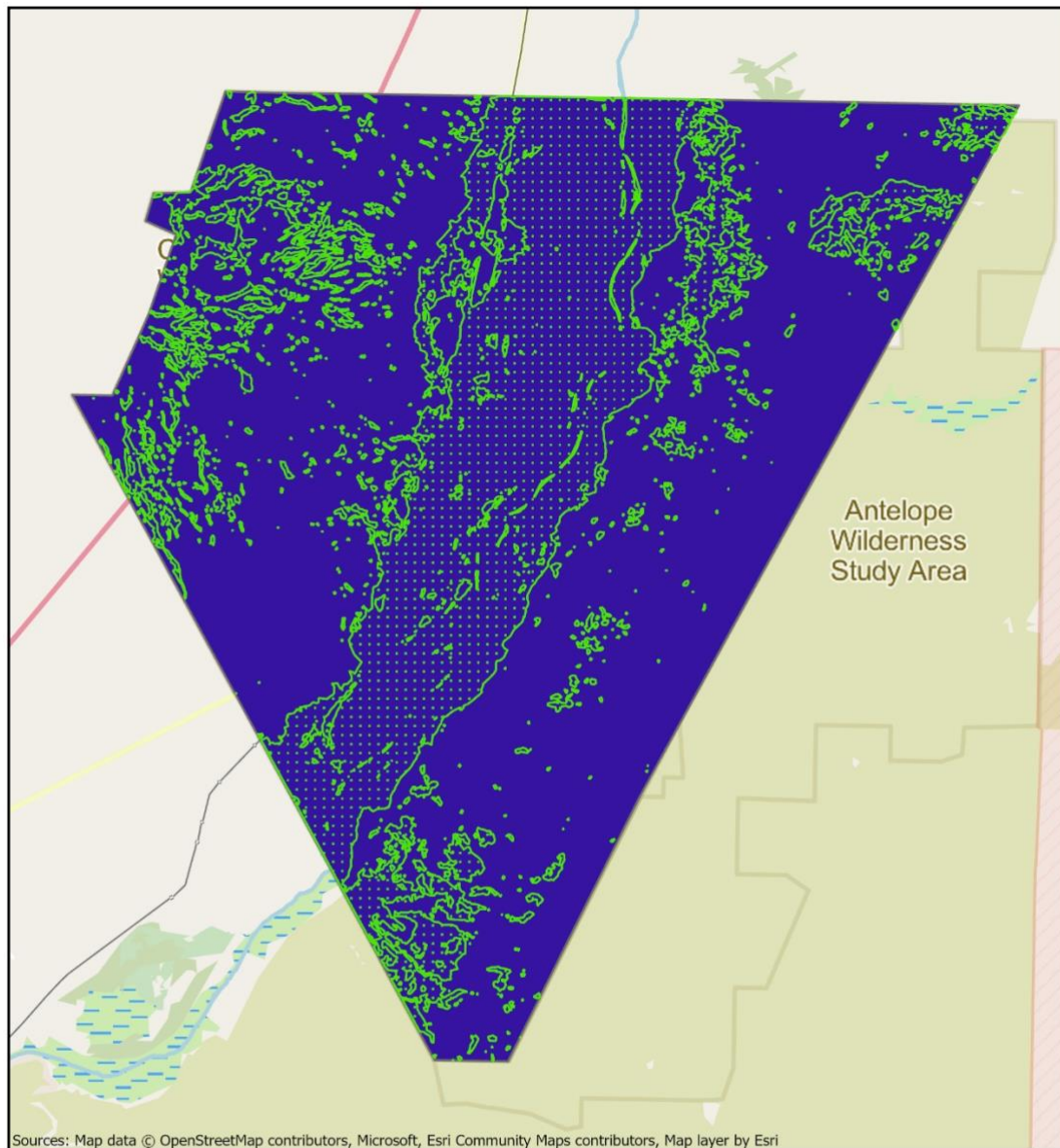
Map A4: Effective ET (USBR Effective Rainfall Adjusted) for Levee Zones for MRGV.
Sources: Data generated using OpenET and ArcGIS Pro.



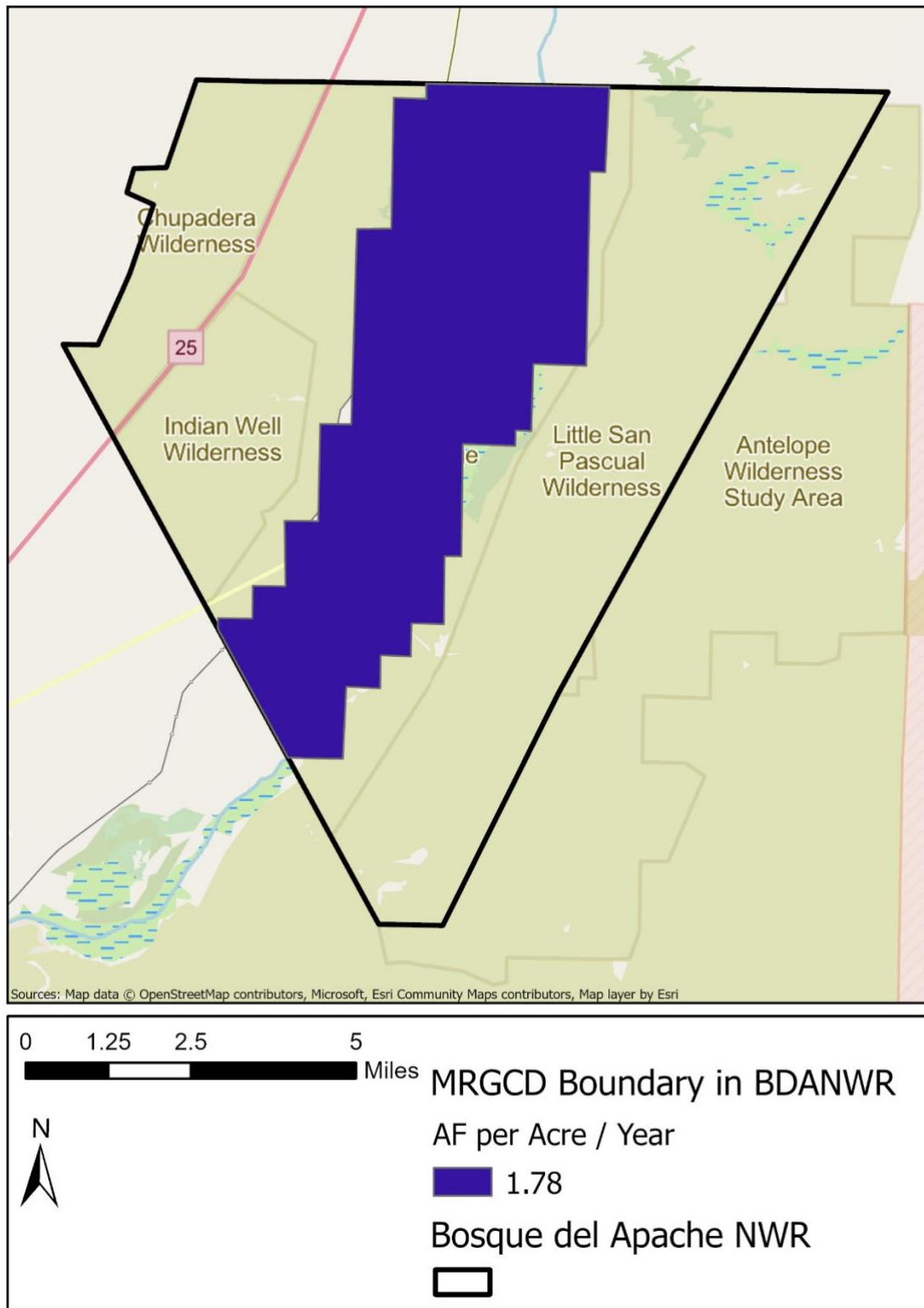
Map A5: Effective ET (USBR Effective Rainfall Adjusted) within Outer MRGCD Boundary.
Sources: Data generated using OpenET and ArcGIS Pro.



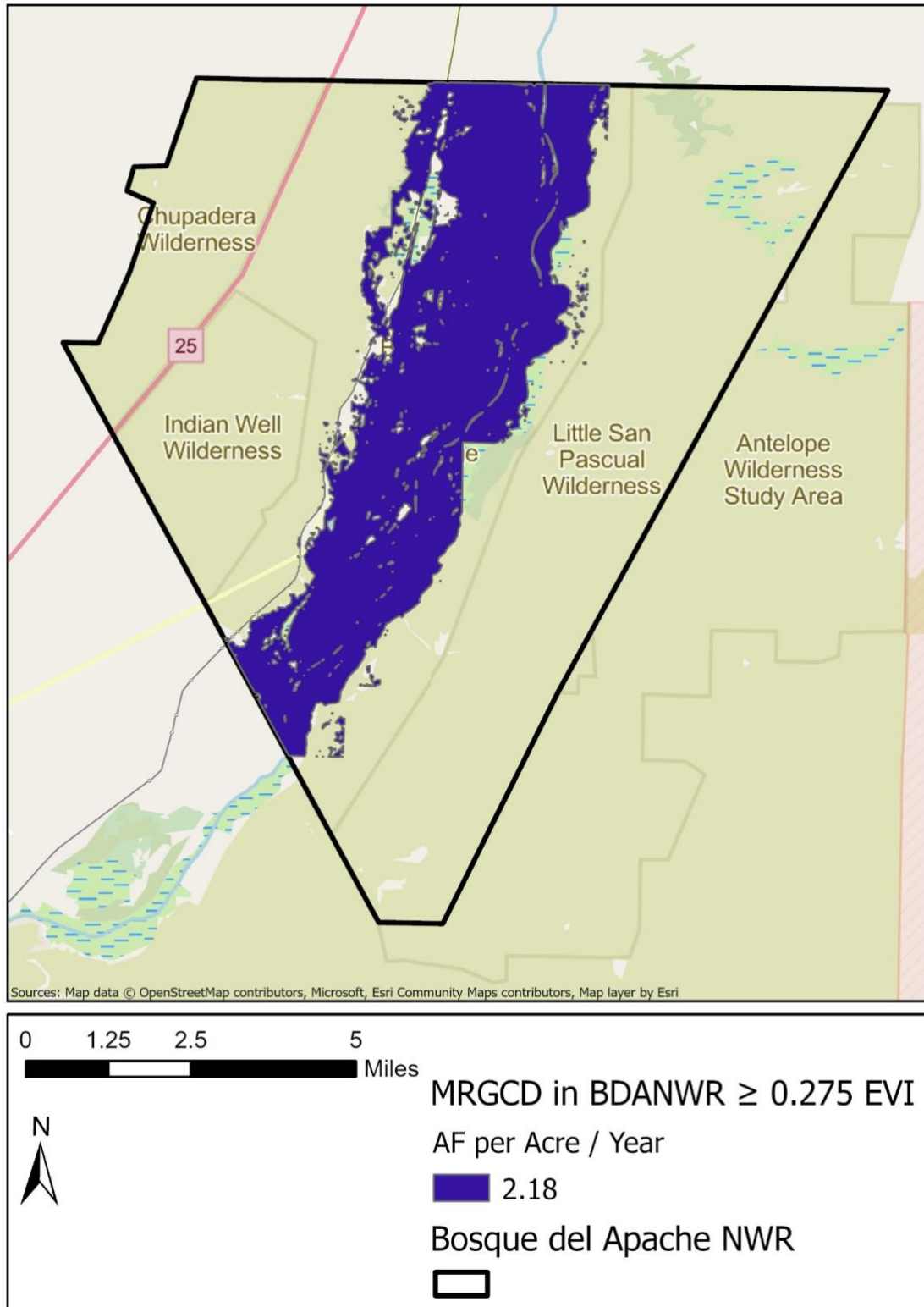
Map A6: Effective ET (USBR Effective Rainfall Adjusted) for MRGCD Boundary Excluding Levee Zones. Sources: Data generated using OpenET and ArcGIS Pro.



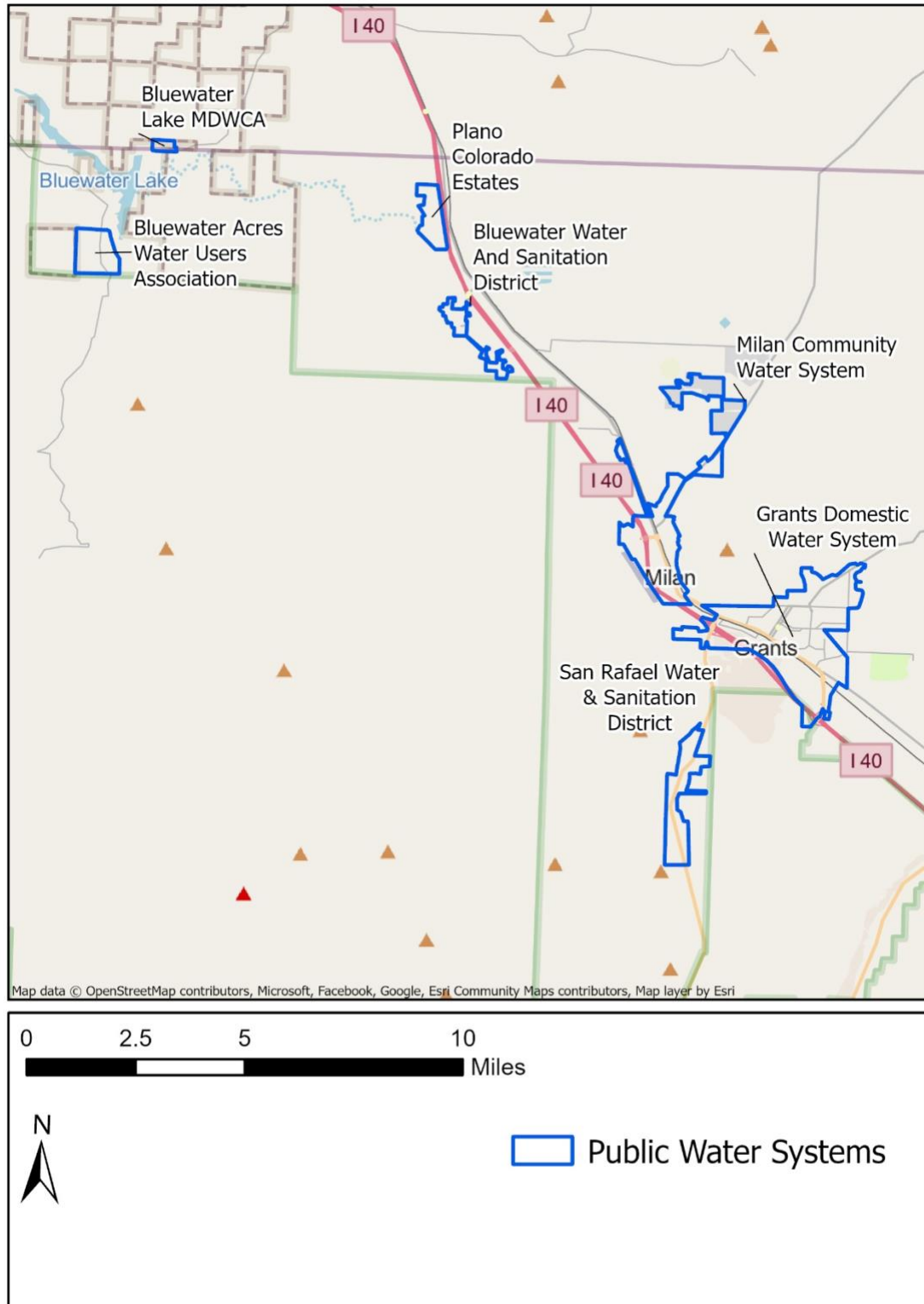
Map A7: Effective ET (USBR Effective Rainfall Adjusted) for Full BDANWR Boundary.
 Sources: Data generated using OpenET and ArcGIS Pro.



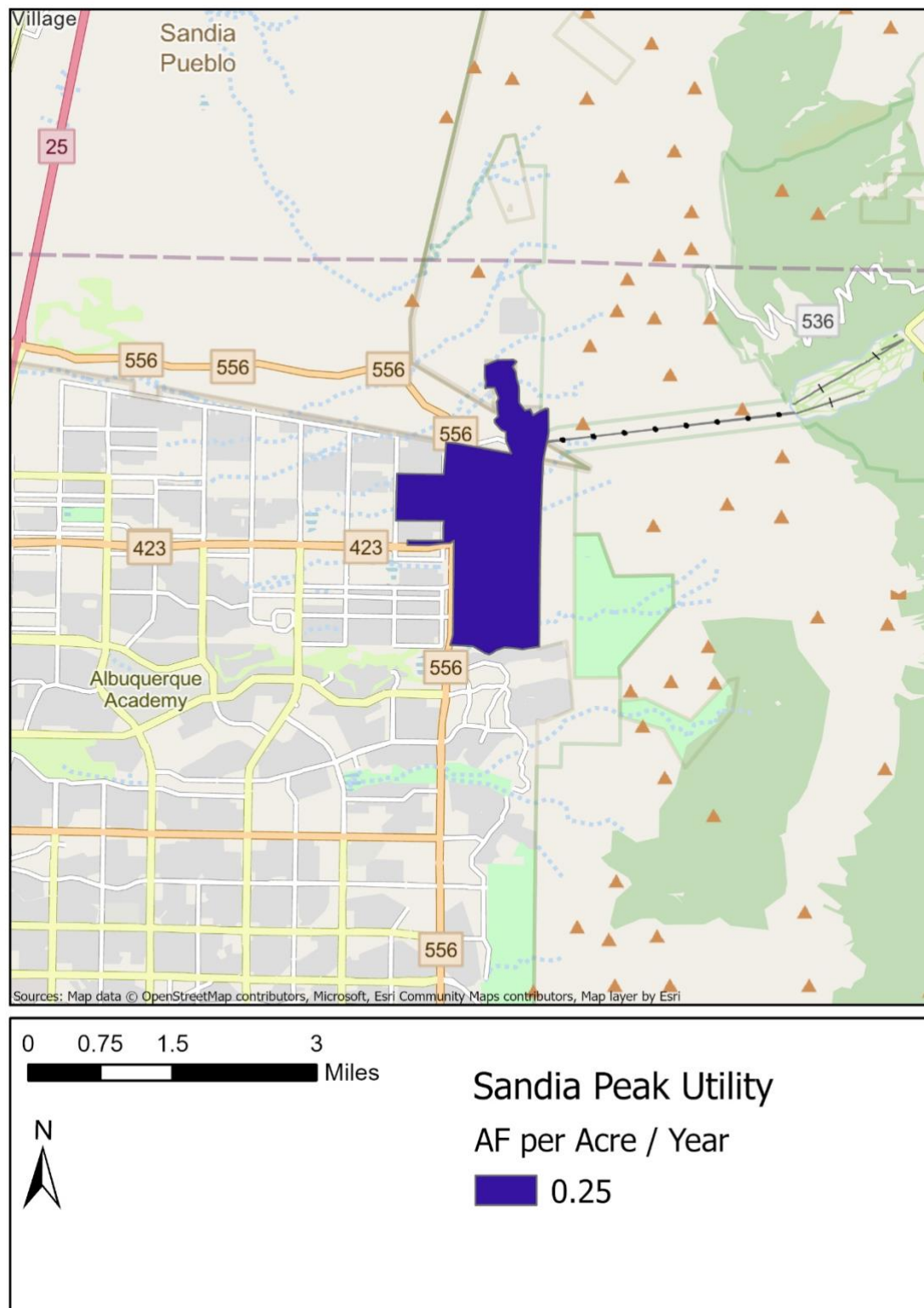
Map A8: Effective ET (USBR Effective Rainfall Adjusted) for MRGCD-Intersected Areas in the BDANWR. Sources: Data generated using OpenET and ArcGIS Pro.



Map A9: Effective ET (USBR effective rainfall adjusted) for 0.275-EVI-Threshold MRGCD in BDANWR. Sources: Data generated using OpenET and ArcGIS Pro.



Map A10: Seven Community Water System Boundaries in Grants Area. Sources: Data generated using ArcGIS Pro.



Map A11: Effective ET (USBR Effective Rainfall Adjusted) for Sandia Peak Utility Service Area. Sources: Data generated using OpenET and ArcGIS Pro.

Appendix B:

Estimates of Economic Values, Prices, Administrative Charges & Rates for Water in MRGB and Comparable Western U.S

This appendix compiles estimates of the economic value, market prices, administrative charges, and retail rates of water in the MRGB in NM and comparable Western U.S. markets. The data is organized and presented in five tables. Table B1 reports the economic value of water across alternative uses, including agricultural, municipal, environmental, hydropower, and others. These studies employ a wide range of valuation methods such as hedonic pricing, travel, contingent valuation, and hydro-economic optimization. Table B2 presents observed market lease and sale prices per AF from water transactions in the MRGB and other western markets. Table B3 summarizes administrative charges, lease payments, and program rates, such as irrigation service charges, environmental and groundwater leasing programs, and federal project wholesale rates, which denotes the cost of delivering or temporarily reallocating water rather than its underlying economic value. Table B4 presents the retail water and sewer rates that community water providers in the MRGB charge residential customers, based on a standardized level of indoor monthly use. All estimates are expressed in 2025 dollars to allow for comparison across studies and years.

Table B1: Value of Water in Alternative Uses¹

Category	Estimate or Calculation in \$2025	Brief Note on Method(s)
Irrigated Agriculture	\$322.49 per AFY	Average agricultural water value in northeast Colorado. At-site value derived from a Hedonic property value method (HPM). Original estimate from Hartman and Anderson (1962); value reported in Colby (1989) (Colby, 1989) ²
Municipal — Outdoor Use	\$498.64 per AFY	Average municipal water value for residential outdoor uses (e.g., lawn irrigation). At-site value representing urban residents' Econometric estimation of municipal water demand functions Original estimate from Young and Gray (1972), as reported in Colby (1989). ²
Municipal — Indoor Use	\$883.46 per AFY	Average municipal water value for residential indoor uses. At-site value representing urban residents' Econometric estimation of municipal water demand functions. Original estimate from Young and Gray (1972), as reported in Colby (1989). ²
Irrigated Agriculture	\$10.84 per AFY	Marginal irrigation water value in Arizona estimated using a Mathematical programming. This estimate represents one of the lowest-valued crops evaluated in the study (grain sorghum). Original estimate from Kelso et al. (1973), reported in Colby (1989). ²
Irrigated Agriculture	\$639.56 per AFY	Marginal irrigation water value in Arizona estimated using a Mathematical programming. This estimate represents one of the highest-valued crops evaluated in the study (cotton). Original estimate from Kelso et al. (1973), reported in Colby (1989) ²
Irrigated Agriculture	\$56.91 per AFY	Marginal irrigation water value in the west side of California's San Joaquin Valley. At-site agricultural value estimated using a Basic residual method and a mathematical programming. Represents the value of water in safflower production. Original estimate from Shumway (1973), as reported in Colby (1989). ²
Irrigated Agriculture	\$154.47 per AFY	Marginal irrigation water value in the west side of California's San Joaquin Valley. At-site agricultural value

		estimated using a Basic residual method and a mathematical programming. Represents the value of water in melon production. Original estimate from Shumway (1973), as reported in Colby (1989). ²
Environmental (Fish & Wildlife Habitat)	\$89.43 per AFY	Average value of instream flow for fish hatchery operations in California's Trinity River. At-source environmental value for fish and wildlife habitat. Original estimate from Bush (1976), as reported in Colby (1989). ²
Environmental (Instream Recreation)	\$59.62 per AFY	Marginal value of instream flow for recreational fishing in Colorado's Cache la Poudre River. At-source environmental value representing the benefit of an additional acre-foot of streamflow during low-flow conditions. Estimated using the Travel Cost Method (TCM) (Daubert & Young, 1981). ²
Environmental (Instream Recreation)	\$43.36 per AFY	Marginal value of instream flow for shoreline recreation in Colorado's Cache la Poudre River. At-source environmental value representing the benefit of an additional acre-foot of streamflow during low-flow conditions. Estimated using the Travel Cost Method (TCM) (Daubert & Young, 1981). ²
Environmental (Instream Recreation)	\$59.62 per AFY	Marginal value of instream flow for recreational fishing at nine Colorado mountain stream sites. At-source environmental value representing the benefit of an additional acre-foot of flow beyond recreation-optimal conditions. Original estimate from Walsh et al. (1980a), as reported in Colby (1989). ²
Environmental (Instream Recreation)	\$13.55 per AFY	Marginal value of instream flow for kayaking at nine Colorado mountain stream sites. At-source environmental value representing the benefit of an additional acre-foot of flow beyond recreation-optimal conditions. Original estimate from Walsh et al. (1980a), as reported in Colby (1989). ²
Environmental (Instream Recreation)	\$10.84 per AFY	Marginal value of instream flow for rafting at nine Colorado mountain stream sites. At-source environmental value representing the benefit of an additional acre-foot of flow beyond recreation-optimal conditions. Original

		estimate from Walsh et al. (1980a), as reported in Colby (1989). ²
Environmental (Instream Recreation)	\$138.21 per AFY	Marginal value of stored water for recreation in high-mountain Colorado reservoirs. At-source environmental value representing additional recreation benefits from retaining water in reservoirs for two additional weeks during the peak August recreation season. Original estimate from Walsh et al. (1980b), as reported in Colby (1989). ²
Environmental (Fish & Wildlife Habitat)	\$143.63 per AFY	Average value of instream flow for salmon spawning in California's Trinity River. At-source environmental value for fish and wildlife habitat. Original estimate from Bollman (1979), as reported in Colby (1989). ²
Irrigated Agriculture	\$89.43 per AFY	Short-run marginal irrigation water value in Arizona's Salt River area. At-site agricultural value estimated from crop production under irrigated farming conditions. Represents the value of water in grain sorghum production. Original estimate from Martin and Snider (1980), as reported in Colby (1989). ²
Irrigated Agriculture	\$425.47 per AFY	Short-run marginal irrigation water value in Arizona's Salt River area. At-site agricultural value estimated from crop production under irrigated farming conditions. Represents the value of water in lettuce production. Original estimate from Martin and Snider (1980), as reported in Colby (1989). ²
Irrigated Agriculture	\$43.36 per AFY	Marginal irrigation water value in the Four Corners region, including the Navajo Irrigation Project. At-site agricultural value estimated using a Mathematical programming model under a scenario with a 10% reduction in agricultural water availability. Original estimate from Gisser et al. (1979), as reported in Colby (1989). ²
Environmental (Reservoir Recreation)	\$60.98 per AFY	Marginal recreation value for Rio Chama, New Mexico. At-source value estimated using a travel cost recreation demand model. Represents the value of reservoir releases during the summer recreation season under low-flow

		conditions. Original estimate from Ward (1987), as reported in Colby (1989). ²
Environmental (River Recreation)	\$2,565 per AF	Marginal value of instream water for river recreation in New Mexico. Estimated using travel cost methods and hydrologic modeling under alternative streamflow conditions. Original estimates from Ward (1987), as reported in Brown et al. (2025) (Brown et al., 2025). ³
Environmental (River Recreation)	\$3,135 per AF	Marginal value of water for reservoir-based recreation in New Mexico. Estimated using a travel cost model under alternative reservoir water level conditions. Original estimates from Ward (1987), as reported in Brown et al. (2025). ³
Environmental (Instream Recreation)	\$233.06 per AFY	Marginal value of instream flow for recreation on a river in northern Utah. At-source environmental value representing the benefit of additional streamflow during low-flow conditions, with maximum values occurring when flows fall to 20–25% of peak levels. Original estimate from Amirfathi et al. (1985), as reported in Colby (1989). ²
Irrigated Agriculture	\$149.05 per AFY	Average irrigation water value for commercial agriculture in the western United States. At-site agricultural value representing a regional summary of irrigation water values. Original estimate from Young (1984), as reported in Colby (1989). ²
Irrigated Agriculture	\$102.98 per AFY	Short-run marginal irrigation water value in three central Arizona counties. At-site agricultural value representing the contribution of water to alfalfa production. Original estimate from Bush and Martin (1986), as reported in Colby (1989). ²
Irrigated Agriculture	\$360.43 per AFY	Short-run marginal irrigation water value in three central Arizona counties. At-site agricultural value representing the contribution of water to cotton production. Original estimate from Bush and Martin (1986), as reported in Colby (1989). ²
Municipal (Indoor Use)	\$883.46per AFY	Marginal municipal water value in Tucson, Arizona. At-site value estimated from urban water consumption under a scenario with a 10% reduction in water availability.

		Represents winter water demand conditions. Original estimate from Gibbons (1986), as reported in Colby (1989). ²
Municipal (Outdoor Use)	\$498.64 per AFY	Marginal municipal water value in Tucson, Arizona. At-site value estimated from urban water consumption under a scenario with a 10% reduction in water availability. Represents summer water demand conditions. Original estimate from Gibbons (1986), as reported in Colby (1989). ²
Hydropower	\$89.43 per AFY	Short-run value of water for hydropower generation in the Colorado River hydroelectric system. At-source value estimated as the cost savings from generating electricity with hydropower rather than coal-fired steam plants. Original estimate from Gibbons (1986), as reported in Colby (1989). ²
Hydropower	\$219.51 per AFY	Short-run value of water for hydropower generation in the Colorado River hydroelectric system. At-source value estimated as the cost savings from generating electricity with hydropower rather than gas-turbine plants. Original estimate from Gibbons (1986), as reported in Colby (1989). ²
Irrigated Agriculture	\$43.36 per AFY	Marginal irrigation water value in eleven Rocky Mountain agricultural sub-regions. At-site agricultural value estimated using Mathematical Programming under a scenario with a 20% reduction in irrigation water availability. Original estimate from Gollehon et al. (1981), as reported in Colby (1989). ²
Environmental (Instream Flows - Rivers)	\$115 per AF	Average value of instream water for river recreation in Montana. Estimated using contingent valuation methods to measure willingness to pay for instream flows under alternative river flow conditions. Original estimates from Duffield et al. (1992), as reported in Brown et al. (2025). ³
Environmental (Instream Flows - Rivers)	\$60 to \$185 per household per year (5-year payment)	Average household willingness to pay for maintaining minimum instream flows in New Mexico. Estimated using contingent valuation methods under alternative instream flow scenarios. Original estimates from Berrens et al. (1996), as reported in Brown et al. (2025). ³

Environmental (Instream Flows - Rivers)	\$145 to \$158 per household per year	Average household willingness to pay for river protection in New Mexico. Estimated using contingent valuation methods to measure nonuse values associated with maintaining instream flows. Original estimates from Berrens et al. (1998), as reported in Brown et al. (2025). ³
Environmental (Instream Flows - Rivers)	\$47 to \$103 per household per year	Average household willingness to pay for river protection in New Mexico. Estimated using contingent valuation methods to measure nonuse values associated with maintaining instream flows. Original estimates from Berrens et al. (2000), as reported in Brown et al. (2025). ³
Environmental (Recreation - Rivers)	\$27 to \$40 per person per day	Average consumer surplus for river recreation in New Mexico. Estimated using travel cost methods to measure recreation benefits associated with river use. Original estimates from Weber & Berrens (2006), as reported in Brown et al. (2025). ³
Snowpack (Sangre de Cristo Headwaters, New Mexico)	\$32.3 per AF	Marginal (shadow) value of headwater water at the Sangre de Cristo headwaters in northern New Mexico. Estimated using Mathematical Programming in a hydro-economic model linking snowpack, streamflow, and basin water use. Values represent at-source benefits flowing into the Middle Rio Grande Basin. The value reflects the economic contribution of additional snowpack water to downstream agricultural and municipal users in New Mexico (Hurd & Coonrod, 2012). ⁴
Snowpack (Rio Grande at Del Norte, Colorado)	\$125.1 per AF	Marginal (shadow) value of headwater water at the Rio Grande at Del Norte, Colorado. Estimated using Mathematical Programming in a hydro-economic model linking snowpack, streamflow, and basin water use. Values represent at-source benefits at the Colorado headwaters. The value reflects the Rio Grande Compact's delivery requirements to downstream New Mexico users and the high agricultural productivity of Colorado's San Luis Valley, where water is intensively used before reaching New Mexico (Hurd & Coonrod, 2012). ⁴
Groundwater Conservation	Min: \$11.00 per AF Mean: \$172.00 per AF Max: \$334.00 per AF	Marginal user cost of groundwater remaining in situ in the Southern Ogallala Aquifer. Estimated using Mathematical Programming in a dynamic optimal control model of

		groundwater extraction to measure the value of conserving groundwater for future use. Values represent at-source groundwater conservation benefits (Williams et al., 2017). ⁵
Irrigated Agriculture (MRGCD)	\$99.73 per AF	Marginal benefit of irrigation water in the Middle Rio Grande Conservancy District (MRGCD). Estimated using Mathematical Programming in a basin-scale hydro-economic optimization model under current institutional conditions. Values represent at-source agricultural water benefits under the Law of the River baseline with normal water supply conditions (Ward & Pulido-Velazquez, 2009). ⁶
Irrigated Agriculture (EBID)	\$133.19 per AF	Marginal benefit of irrigation water in the Elephant Butte Irrigation District (EBID). Estimated using Mathematical Programming in a basin-scale hydro-economic optimization model under current institutional conditions. Values represent at-source agricultural water benefits under the Law of the River baseline with normal water supply conditions (Ward & Pulido-Velazquez, 2009). ⁶
Environmental (Recreation - Upper Reservoirs)	\$6.92 per AF	Marginal recreational value of water stored in the four upper mainstem reservoirs of the Upper Rio Grande Basin. Estimated using a regional travel cost model relating reservoir storage levels to sport fishing benefits. Values represent at-source environmental water benefits (Ward & Pulido-Velazquez, 2009). ⁶
Municipal (Consumer Surplus)	\$5,733.49 per AF	Marginal benefit of water delivered to residential users in Albuquerque under the Law of the River baseline, where water transfers from agriculture to urban uses are restricted by existing institutional arrangements. Estimated using calibrated household demand functions. Values represent at-site municipal water benefits under normal water supply conditions (Ward & Pulido-Velazquez, 2009). ⁶
Environmental — River Restoration (full restoration, CM)	\$156.60 per household/year	Average household willingness to pay for full ecological restoration of the Middle Rio Grande Bosque, New Mexico. At-source environmental value estimated using a Choice Experiment (CE), a stated-preference method in

		which households chose among restoration scenarios with different attributes and costs, revealing the implicit value of full restoration (Weber & Stewart, 2009). ⁷
Environmental — River Restoration (full restoration, CVM)	\$46.80 per household/year	Average household willingness to pay for the same full restoration scenario (Middle Rio Grande Bosque), estimated instead using Contingent Valuation (CVM), which asks respondents directly for their maximum willingness to pay. At-source environmental value; the gap versus the CE estimate above is consistent with the general pattern in the literature of CE producing higher WTP estimates than CVM (Weber & Stewart, 2009). ⁷
Environmental — Instream Flow Protection	\$129 per household (one-time donation)	Average household willingness to pay to protect freshwater inflows to Texas bay and estuary ecosystems. At-source environmental value estimated using Contingent Valuation (CV). Unlike the other rows here, this reflects a one-time payment rather than a recurring annual payment, so it is not directly comparable on a per-year basis without adjustment (Yoskowitz & Montagna, 2009). ⁸
Environmental (Recreation - Rivers)	\$298 per AF	Marginal value of instream water for river recreation in Colorado. Estimated using travel cost methods to measure recreation benefits under alternative streamflow conditions. Original estimates from Loomis & McTernan (2014), as reported in Brown et al. (2025). ³
Environmental (Recreation/Aesthetics - Rivers)	\$27 to \$40 per person per day	Average willingness to pay for increased river flows in the Southwest. Estimated using a Choice Modeling to measure recreation and aesthetic benefits associated with improved streamflow conditions. Original estimates from Weber et al. (2016), as reported in Brown et al. (2025). ³
Irrigated Agriculture (EBID & MRGCD Inter-district Trading)	Min: \$46.00 per AFY (2017) Mean: \$53.48 per AFY Max: \$63.16 per AFY (2019)	Marginal (shadow) value of irrigation water for agricultural production in EBID and MRGCD. Estimated using Mathematical Programming in a basin-scale hydro-economic optimization model under inter-district water trading. Values represent at-source benefits of diverted irrigation water, 2017 to 2021, under basin-wide drought conditions, reported as weighted averages across irrigation technologies, with flood irrigation accounting for 85% and

		drip/pivot for 15% of total water applied (Idhirij & Ward, 2025). ⁹
Irrigated Agriculture (MRGCD Intra-district Trading)	Min: \$27.11 per AFY (2017) Mean: \$33.23 per AFY Max: \$35.79 per AFY (2021)	Marginal (shadow) value of irrigation water for agricultural production in MRGCD. Estimated using Mathematical Programming in a basin-scale hydro-economic optimization model under intra-district water trading. Values represent at-source benefits of diverted irrigation water, 2017 to 2021, under basin-wide drought conditions, reported as weighted averages across irrigation technologies, with flood irrigation accounting for 86% and drip/pivot for 14% of total water applied (Idhirij & Ward, 2025). ⁹
Irrigated Agriculture (MRGCD No Trading)	Min: \$3.05 per AFY (Wheat, 2018) Mean: \$101.68 per AFY Max: \$532.24 per AFY (Onions, 2020)	Marginal (shadow) value of irrigation water for agricultural production in MRGCD under no-trading conditions. The minimum value (\$3.05 per AFY) corresponds to wheat in 2018, while the maximum value (\$532.24 per AFY) corresponds to onions in 2020. The mean summarizes shadow prices across all crops and years under drought conditions, reported as weighted averages across irrigation technologies, with flood irrigation accounting for 81% and drip/pivot for 19% of total water applied (Idhirij & Ward, 2025). ⁹
Irrigated Agriculture (EBID Intra-district Trading)	Min: \$51.34 per AFY (2017) Mean: \$67.29 per AFY Max: \$87.57 per AFY (2019)	Marginal (shadow) value of irrigation water for agricultural production in EBID. Estimated using Mathematical Programming in a basin-scale hydro-economic optimization model under intra-district water trading. Values represent at-source benefits of diverted irrigation water, 2017 to 2021 (Idhirij & Ward, 2025). ⁹
Irrigated Agriculture (EBID No Trading)	Min: \$3.53 per AFY (Wheat, 2018) Mean: \$172.70 per AFY Max: \$1,010.72 per AFY (Onions, 2019)	Marginal (shadow) value of irrigation water for agricultural production in EBID under no-trading conditions. The minimum value (\$3.53 per AFY) corresponds to wheat in 2018, while the maximum value (\$1,010.72 per AFY) corresponds to onions in 2019. The mean summarizes shadow prices across all crops and years under drought conditions, reported as weighted averages across irrigation technologies, with flood

		irrigation accounting for 81% and drip/pivot for 19% of total water applied (Idhirij & Ward, 2025). ⁹
Environmental — Ecosystem Services (total)	\$62 per household/year	Average household willingness to pay for the full bundle of ecosystem services provided by the Rio Grande Basin (U.S.). At-source environmental value estimated using a standard WTP question format within a Contingent Valuation (CV) framework. Represents the aggregate of the four component services below (Wang, Mu & Ziolkowska, 2021). ¹⁰
Environmental — Ecosystem Services (freshwater supplies)	\$19.7 per household/year	Average household willingness to pay for the basin's provisioning service of freshwater supply. At-source environmental value, component of the total ecosystem services value above (Wang, Mu & Ziolkowska, 2021). ¹⁰
Environmental — Ecosystem Services (habitat for wildlife)	\$26.2 per household/year	Average household willingness to pay for the basin's supporting service of wildlife habitat maintenance — the highest-valued of the four components. At-source environmental value (Wang, Mu & Ziolkowska, 2021). ¹⁰
Environmental — Ecosystem Services (recreational activities)	\$8.1 per household/year	Average household willingness to pay for the basin's cultural service associated with recreational activities. At-source environmental value (Wang, Mu & Ziolkowska, 2021). ¹⁰
Environmental — Ecosystem Services (cultural heritage)	\$7.1 per household/year	Average household willingness to pay for the basin's cultural service associated with cultural heritage and sense of place. At-source environmental value (Wang, Mu & Ziolkowska, 2021). ¹⁰
Irrigated Agriculture (EBID & MRGCD Inter-district Trading)	Min: \$63.50 per AFY (2017) Mean: \$80.92 per AFY Max: \$92.27 per AFY (2019)	Marginal (shadow) value of irrigation water for agricultural production in the EBID and MRGCD. Estimated using Mathematical Programming in a basin-scale hydro-economic optimization model under inter-district water trading, where water moves freely across both districts and crops. Values represent at-source benefits of diverted irrigation water, 2017 to 2021 under basin-wide drought and water allocation constraints (Trail & Ward, 2024). ¹¹
Irrigated Agriculture (MRGCD Intra-district Trading)	Min: \$33.08 per AFY (2017) Mean: \$41.15 per AFY Max: \$44.49 per AFY (2020)	Marginal (shadow) value of irrigation water for agricultural production in MRGCD. Estimated using Mathematical Programming in a basin-scale hydro-

		economic optimization model under intra-district water trading, where water moves across crops but not between districts. Values represent at-source benefits of diverted irrigation water, 2017 to 2021 under basin-wide drought and water allocation constraints (Trail & Ward, 2024). ¹¹
Irrigated Agriculture (MRGCD No Trading)	Min: \$3.39 per AFY (Wheat, 2018) Mean: \$113.16 per AFY Max: \$592.35 per AFY (Onions, 2020)	Marginal (shadow) value of irrigation water for agricultural production in MRGCD. Estimated using a basin-scale hydro-economic optimization model under no-trading conditions, where water remains fixed under existing allocations and shortages are shared proportionally across all crops and districts. Values represent at-source benefits of diverted irrigation water, 2017 to 2021. The minimum value (\$3.39 per AF) corresponds to wheat in 2018, while the maximum value (\$592.35 per AFY) corresponds to onions in 2020. The mean value summarizes shadow prices across all crops and years under drought and no-trading conditions (Trail & Ward, 2024). ¹¹
Irrigated Agriculture (EBID Intra-district Trading)	Min: \$90.93 per AFY (2017) Mean: \$115.34 per AFY Max: \$142.22 per AFY (2019)	Marginal (shadow) value of irrigation water for agricultural production in EBID. Estimated using Mathematical Programming in a basin-scale hydro-economic optimization model under intra-district water trading, where water moves across crops but not between districts. Values represent at-source benefits of diverted irrigation water, 2017 to 2021 under basin-wide drought and water allocation constraints (Trail & Ward, 2024). ¹¹
Irrigated Agriculture (EBID No Trading)	Min: \$3.97 per AFY (Wheat, 2018) Mean: \$194.11 per AFY Max: \$1,136.01 per AFY (Onions, 2019)	Marginal (shadow) value of irrigation water for agricultural production in EBID. Estimated using Mathematical Programming in a basin-scale hydro-economic optimization model under no-trading conditions. Values represent at-source benefits of diverted irrigation water, 2017 to 2021. The minimum value (\$3.97 per AF) corresponds to wheat in 2018, while the maximum value (\$1,136.01 per AF) corresponds to onions in 2019. The mean value summarizes shadow prices across all crops and years under drought and no-trading conditions (Trail & Ward, 2024). ¹¹

Agriculture (Groundwater Rights Value)	\$1,213 per AF 3% the annual value is \$61.89 AFY 5% the annual is \$78.90 AFY	Hedonic value of groundwater access rights for irrigated agriculture in the Kansas High Plains Aquifer. Estimated using a Hedonic property value method (HPM). The reported land value premium was converted to a per acre-foot value using average authorized irrigation depth. Because this present value is not directly comparable to the per-AFY values reported elsewhere in this table, it was annualized using the capital recovery factor ($A = PV \times [i(1+i)^n] / [(1+i)^n - 1]$, $n = 30$ years, $i = 3\%$) to obtain an equivalent annual value. Values represent at-site agricultural groundwater benefits (Edwards et al., 2025). ¹²
Commercial Agriculture	Wet-Cool: \$47.96 Baseline: \$94.29 Dry-Hot: \$185.12	Marginal (shadow) value of irrigation water for agricultural production in the Middle Rio Grande Basin. Estimated using Mathematical Programming in a hydro-economic optimization model. Values represent the change in farm profits associated with an additional acre-foot (AF) of irrigation water under three climate scenarios (Olofinsao, 2026). ¹³
Irrigated Agriculture	\$28.30 per AF	Marginal (shadow) value of irrigation water for commercial agriculture in the Middle Rio Grande Basin. Estimated using Mathematical Programming in a hydro-economic optimization model. Values represent at-source benefits of diverted irrigation water (Olofinsao et al., 2025). ¹⁴
Urban Greenspace	Min: \$157.36 per AF Mean: \$205.26 per AF Max: \$263.87 per AF	Average value of water for urban greenspace in the Middle Rio Grande Basin. Estimated using a Benefit Transfer of household willingness-to-pay measures and converted to a per acre-foot value using greenspace irrigation requirements (Olofinsao et al., 2025). ¹⁴
Environmental (Instream Flow)	Min: \$151.43 per AF Mean: \$220.39 per AF Max: \$289.35 per AF	Average value of water for environmental instream flows in the Middle Rio Grande Basin. Estimated using Contingent valuation method (CVM) of household willingness to pay for instream flow protection and expressed on a per acre-foot basis (Olofinsao et al., 2025). ¹⁴
Municipal (Consumer Surplus)	\$4,189.52 per AF	Consumer surplus associated with residential water use in Albuquerque. Calculated using a calibrated linear demand

		function based on reported price, quantity, and elasticity estimates. Values represent at-site benefits of delivered municipal water (Samimimotlagh & Wang, 2024). ¹⁵
Commercial (Consumer Surplus)	\$11,572.29 per AF	Consumer surplus associated with commercial water use in Albuquerque. Calculated using a calibrated linear demand function based on reported price, quantity, and elasticity estimates. Values represent at-site benefits of delivered water (Samimimotlagh & Wang, 2024). ¹⁵
Institutional (Consumer Surplus)	\$11,832.59 per AF	Consumer surplus associated with institutional water use in Albuquerque. Calculated using a calibrated linear demand function based on reported price, quantity, and elasticity estimates. Values represent at-site benefits of delivered water (Samimimotlagh & Wang, 2024). ¹⁵
City (Consumer Surplus)	\$9,934.49 per AF	Consumer surplus associated with municipal city-sector water use in Albuquerque. Calculated using a calibrated linear demand function based on reported price, quantity, and elasticity estimates. Values represent at-site benefits of delivered water (Samimimotlagh & Wang, 2024). ¹⁵

Table B1 Notes

1. Light gray cells indicate estimates obtained from studies outside the Middle Rio Grande Basin (MRGB) and are included for comparison with MRGCD-specific values. Values marked with * represent estimates derived from hypothetical scenarios or model simulations rather than observed market transactions. Reported estimates may represent different economic concepts, including marginal values, average values, consumer surplus, willingness to pay, or capitalized land values, depending on the original study methodology.
2. Colby, B.G. (1989), *Estimating the Value of Water in Alternative Uses*, *Natural Resources Journal*, 29(2), 511–527. This article reviews economic studies on water values across agricultural, municipal, industrial, hydropower, and instream use in the western United States, drawing heavily on Gibbons (1986), *The Economic Value of Water*, as a primary synthesis source. Colby compares valuation approaches and reports the range of estimates across sectors, locations, and methodologies. The historical estimates sourced from this article were originally produced by the primary studies identified in each row of the table; Colby (1989) serves as the secondary source through which those estimates were accessed.
3. Brown, C.E., Tanner, S.J., Hrozencik, R.A., and Gramig, B.M. (2025), *The Agricultural and Environmental Value of Water*. This USDA Economic Research Service report reviews and synthesizes the economic literature on the value of water in agricultural and environmental uses across the United States. The report compares a wide range of valuation approaches, including hedonic pricing, travel cost, contingent valuation, choice experiments, production function methods, and water market analyses, highlighting how water values vary across sectors,

locations, and resource conditions. Many of the agricultural and environmental estimates included in this table were obtained from studies summarized in this review.\

4. Hurd, B.H., & Coonrod, J. (2012), Hydro-economic consequences of climate change in the Upper Rio Grande. This study combines a hydrologic model with a river basin-scale hydro-economic optimization model of the Upper Rio Grande Basin to estimate how changes in climate and population affect water availability and its economic value across agricultural and municipal uses. The model uses Mathematical Programming to derive the marginal value of water at key points in the watershed, subject to physical constraints and Rio Grande Compact delivery obligations. Reported estimates are at-source shadow values at the Rio Grande headwaters in Del Norte, Colorado, and at the Sangre de Cristo headwaters in northern New Mexico, under baseline conditions reflecting year 2000 population and climate.
5. Williams, R.B., Al-Hmoud, R., Segarra, E., & Mitchell, D. (2017), *An Estimate of the Shadow Price of Water in the Southern Ogallala Aquifer*. This study develops a dynamic optimal control model to estimate the shadow price of groundwater in the Southern Ogallala Aquifer and compare socially optimal extraction with competitive pumping behavior. The reported values represent marginal user cost (shadow price) of groundwater remaining in situ, measuring the opportunity cost of extracting groundwater today rather than conserving it for future agricultural use. Estimates vary across counties due to differences in aquifer conditions, pumping costs, and agricultural productivity, ranging from approximately \$11 to \$334 per AF, with an average value of about \$172 per AF.
6. Ward, F.A., & Pulido-Velázquez, M. (2009), *Incentive Pricing and Cost Recovery at the Basin Scale*. Ward, F.A., & Pulido-Velazquez, M. (2009), Incentive Pricing and Cost Recovery at the Basin Scale. This study develops a dynamic hydro-economic optimization model of the Upper Rio Grande Basin to evaluate water pricing policies that balance economic efficiency, equity, and cost recovery across urban, agricultural, and environmental water uses. The model integrates hydrologic constraints (surface water, groundwater, reservoir storage, and return flows) with institutional constraints, including interstate compact and international treaty obligations. Water values are estimated using mathematical programming, where urban demand is represented through calibrated demand functions and agricultural demand through farm income optimization. Environmental benefits are incorporated using recreation values associated with reservoir storage. Model calibration is based on basin conditions around 1998-2003, with simulations for 2006-2025 under alternative water availability and pricing scenarios. Reported estimates
7. Weber, M., & Stewart, S. (2009), Public Values for River Restoration Options on the Middle Rio Grande, *Restoration Ecology*, 17(6), 762–771. This study estimates public willingness to pay for alternative river restoration options along the Middle Rio Grande Bosque in New Mexico, comparing two stated-preference approaches: Choice Modeling (CM) and the Contingent Valuation Method (CVM). Under CM, households chose among restoration scenarios that varied in ecological scope and cost, allowing the implicit value of each attribute to be inferred from choice patterns. Under CVM, households were asked directly for their maximum willingness to pay for a specified restoration scenario. Reported values represent average annual household willingness to pay for full restoration under each method.
8. Yoskowitz, D.W., & Montagna, P.A. (2009), Socio-economic Factors that Impact the Desire to Protect Freshwater Flow in the Rio Grande, USA. This study estimates household willingness to pay to protect environmental (instream) flow in the Rio Grande, based on in-person

interviews with 417 households in the Lower Rio Grande Valley conducted in spring 2007. Using a double bounded-dichotomous choice (DBDC) Contingent Valuation technique — a CVM variant that asks respondents a first yes/no bid question and then a follow-up bid (higher if they said yes, lower if they said no) to narrow in on their true willingness to pay more precisely than a single-bid format — the authors find that 64% of respondents would make a one-time donation to a "water trust" to protect freshwater flow. The reported value (\$129) is the mean household willingness to pay for this one-time donation; applied to the relevant population of recreationists and conservationists, it generates an aggregate value of \$9.9 million.

9. Ildhirij, S., & Ward, F.A. (2025), *Water Management Innovations for Adapting to Climate Water Stress: New Evidence from the American Southwest*. Basin-scale hydro-economic optimization model evaluating how three water shortage-sharing institutions (Interdistrict trading, intradistrict trading, no trading) affect agricultural water allocation and economic outcomes in the Upper Rio Grande Basin, focusing on EBID and MRGCD. Shadow prices reflect the increase in agricultural net benefits from one additional acre-foot of water under a 25% reduction in water supply. Technology-weighted averages are calculated using flood and drip/pivot shares of total water applied under drought conditions.
10. Wang, W., Mu, J.E., & Ziolkowska, J.R. (2021), Perceived Economic Value of Ecosystem Services in the US Rio Grande Basin, *Sustainability*, 13(24), 13798. <https://doi.org/10.3390/su132413798>. This study estimates household willingness to pay for ecosystem services provided by the US Rio Grande Basin using the Contingent Valuation Method (CVM) — a non-market valuation approach that uses sample surveys to elicit respondents' stated willingness to pay (WTP) for changes in the provision of ecosystem services, applied here because no direct market price exists for these services. The authors find a mean household WTP for total ecosystem services across the basin of \$62/year, decomposed into four service categories: \$26.2/year for conservation of habitat for wildlife, \$19.7/year for provision of freshwater supplies, \$8.1/year for recreational activities, and \$7.1/year for cultural heritage. Income and respondents' perceptions of the importance of each ecosystem service were identified as key determinants of stated WTP.
11. Trail & Ward (2024), *Uniting agricultural water management, economics, and policy for climate adaptation through a new assessment of water markets for arid regions*. Mathematical Programming model of agricultural water allocation in the Rio Grande Basin, focusing on the Elephant Butte Irrigation District (EBID) and Middle Rio Grande Conservancy District (MRGCD). Values represent marginal at-site water values for offstream agricultural use under alternative water trading scenarios: between-district trading (water can be transferred between irrigation districts such as EBID and MRGCD), within-district trading (water can be reallocated among users within the same irrigation district), and no trading (water remains fixed under existing allocations). Values reflect the marginal increase in agricultural returns from one additional acre-foot of water.
12. Edwards, E.C., Hendricks, N.P., and Sampson, G.S. (2025), *The Capitalization of Property Rights to Groundwater*. This study uses a hedonic property value method to estimate how groundwater access rights are capitalized into agricultural land values in the High Plains Aquifer region of Kansas, examining three dimensions of groundwater rights: access, allocation, and seniority. Rather than observing water market prices directly, the reported value reflects the land market premium associated with groundwater access rights, estimated at an average of 71 percent, or \$1,445 per acre in 2019 dollars. The per acre-foot value reported in this table was derived by converting that per-acre land

premium using the average authorized irrigation depth for the region, which is standard practice for translating capitalized land value premiums into at-site water use values.

13. Olofinsao, O.A., Wang, J., & Berrens, R.P. (2025), *Reuse of Treated Municipal Wastewater in Drylands: Multi-Sector Optimization Analysis for Middle Rio Grande Case Study*. This study develops a multi-sector optimization model to evaluate the economic value of treated municipal wastewater (TMW) across competing uses in the Middle Rio Grande Basin, including commercial agriculture, urban greenspace, and environmental instream flows. The analysis combines Mathematical Programming to estimate agricultural water values with Benefit Transfer methods to estimate urban and environmental water values. Reported estimates represent marginal economic values (MEV) of water under alternative sectoral uses.
14. Olofinsao (2026), *Agricultural Water Management, Farmer Decision-Making, and Climate Adaptation in Dryland Agriculture: A Case of the Middle Rio Grande Basin*. Marginal (shadow) at-site water values for offstream agricultural use in the Middle Rio Grande Basin. Estimated using Mathematical Programming in a hydro-economic optimization model calibrated to regional agricultural production. Values measure the change in farm profits associated with one additional acre-foot (AF) of irrigation water under three climate scenarios: wet-cool, baseline, and dry-hot. Results indicate that water values rise substantially under hotter and drier conditions, reflecting increasing water scarcity and higher opportunity costs of irrigation water.
15. Samimimotlagh, N., & Wang, J. (2024), Heterogeneity in Price Elasticities of Urban Water Demand: The Case for Albuquerque, New Mexico. This study estimates urban water demand across major sectors in Albuquerque, New Mexico, using account-level water consumption and billing data from the Albuquerque Bernalillo County Water Utility Authority (ABCWUA) from 2018 to 2023. A fixed-effects econometric model is used to estimate sector-specific water demand elasticities across residential, multi-family, commercial, institutional, and city sectors while accounting for weather and socioeconomic factors. The reported values represent consumer surplus (at-site water values) for urban water use, derived from estimated demand functions. Results show substantial variation across sectors, with residential water valued lower than commercial and institutional uses, reflecting differences in willingness to pay and demand responsiveness.

Table B2: Market Lease/sales Prices per Acre-Foot of water Rio Grande Basin and Comparable Western U.S. Markets¹

Category/ Region	Transaction Type	Observed Price (Sales: \$/AFY; Lease: \$/AF, reported year dollars)	Amount in Calculated \$2025 (Sales: \$/AFY; Lease: \$/AF)	Brief Notes
Gila-San Francisco Basin, NM (not part of Middle Rio Grande Basin)	Sales (permanent)	Gila Subbasin: Range = \$1,200 – \$1,850 (1987 dollars) Mean = \$1,800 in 1991 (1987 dollars) Peak in 1980 = \$3,300 (1987 dollars) San Francisco Subbasin: Range = \$1,400 - \$1,700 (1987 dollars)	\$3,400 – \$5,243 \$5,101 \$9,352 \$3,968 – \$4,818	One of the earliest econometric (hedonic) analyses of 95 water market transactions in New Mexico. The results of the study revealed that market prices are significantly determined by water right priority dates (pre-1940 commanding about \$370 per AFY premium), size of the transaction (larger volumes attracted lower unit prices), type of buyer (municipal or corporate buyers paid about \$1,125 per AFY more), subbasin location (Gila water rights were about \$1,155 per AFY higher than San-Francisco), all in 1987 dollars. Water prices rose by approximately \$47 per AFY during the study period (1971-1987), driven by mining, city growth, and vacation home development. Source: Colby et al. (1993)
Lower Rio Grande Basin, NM/TX	Sales (Permanent)	Range = \$490 - \$4,154 (1986 - 2007) Mean = \$2,128.65	\$761 - \$6,451 \$3,305	Prices were derived from observed transactions from 1980 to 2007 and modeled using supply and demand predictors, including urban water use, priority date, farm income, and reservoir levels. Source: De Mouche et al. (2011)
Lower Rio Grande Basin, NM/TX	Sales (Permanent)	Range = \$2964 - \$3,519* (2010 - 2020)	\$4,376 - \$4,377	²Prices are based on forecasted water rights values estimated from observed data, assuming no food price growth and no urban water conservation.¹ Source: De Mouche et al. (2011)

Lower Rio Grande Basin, NM/TX	Sales (Permanent)	Range = \$2964 - \$3,759* (2010 - 2020)	\$4,376 - \$4,676	² Prices are based on forecasted water rights values estimated from observed data, assuming food price growth and no urban water conservation. Source: De Mouche et al. (2011)
Lower Rio Grande Basin, NM/TX	Sales (Permanent)	Range = \$2964 - \$2,964* (2010 – 2020)	\$4,377 - \$4,964	² Prices are based on forecasted water rights values estimated from observed data, assuming no food price growth, but with urban water conservation. Source: De Mouche et al. (2011)
Lower Rio Grande Basin, NM/TX	Sales (Permanent)	Range = \$2964 - \$3,204* (2010 – 2020)	\$4,377 - \$3,986	² Prices are based on forecasted water rights values estimated from observed data, with food price growth and urban water conservation. ¹ Source: De Mouche et al. (2011)
Middle Rio Grande Conservancy District	Agricultural water right sales (permanent)	Mean = \$2,118 (1996 dollars)	\$4,346	Econometric analysis of water market transactions across three western basin markets, examining supply and demand determinants of water rights prices. The estimated model shows that buyer type is a statistically significant (<0.05 level) determinant of market prices. That is, Municipal buyers pay significantly higher prices than the Federal and State governments. Notably, institutional arrangements in each market contributed to variation in sales and prices across basins and over time. Source: Brookshire et al. (2004)
Central Arizona Project in the Lower Colorado basin in Arizona	Agricultural water right sales (permanent)	Mean = \$613 (1996 dollars)	\$1,258	Econometric analysis of water market transactions across three western basin markets, examining supply and demand determinants of water rights prices. The estimated model shows that buyer type is a statistically significant (<0.05 level) determinant of market prices. That is, Municipal buyers pay significantly higher prices than the Federal and State governments. Notably, institutional arrangements in each market contributed to variation in sales and prices across basins and over time. Source: Brookshire et al. (2004)

Colorado Big Thompson Project in the Upper Colorado	Agricultural water right sales (permanent)	Mean = \$5,312 (1996 dollars)	\$10,900	Econometric analysis of water market transactions across three western basin markets, examining supply and demand determinants of water rights prices. The estimated model shows that buyer type is a statistically significant (<0.05 level) determinant of market prices. That is, Municipal buyers pay significantly higher prices than the Federal and State governments. Notably, institutional arrangements in each market contributed to variation in prices across basins and over time. Source: Brookshire et al. (2004)
Monterey Peninsula Water Management District, California	Sales (Permanent)	\$250,000 (2007 dollars)	\$388,150	Highest price reported in the study, with price consisting of entitlement to recycling water and revenue from sales used to pay for the recycling plant. Source: Brown (2007)
Santa Fe Tributaries, New Mexico	Sales (Permanent)	\$35,000 - \$45,000 (2007 dollars)	\$54,341 - \$69,867	The highest price in New Mexico reported in this study. Source: Brown (2007)
Truckee River (Reno/Sparks area), Nevada	Sales (Permanent)	\$5,500 - \$45,000 (2007 dollars)	\$8,539 - \$69,867	Truckee River rights are priced comparably to the high prices seen for the Santa-Fe area tributary rights in New Mexico. Source: Brown (2007)
Middle Rio Grande (upper basin use), New Mexico	Sales (Permanent)	\$20,000 - \$35,000 (2007 dollars)	\$31,052 - \$54,341	Prices reported for the Middle Rio Grande differ across the basin, with upper-basin water rights priced above those in the lower basin. The study notes a premium paid by buyers wishing to transfer these rights to the Santa Fe area. Source: Brown (2007)
Colorado Big Thompson (CBT) Project, Colorado	Sales (Permanent)	\$12,500 - \$19,167 (2007 dollars)	\$19,408 - \$29,764	The CBT Project is one of the oldest water markets in the West and Colorado's largest transbasin diversion. Municipal and industrial users now own more shares than irrigators. Source: Brown (2007)

Middle Rio Grande (lower basin use), New Mexico	Sales (Permanent)	\$9,000 - \$20,000 (2007 dollars)	\$13,973 - \$31,052	Lower basin prices diverge from upper basin. Prices in the lower basin are much lower than those of the upper basin. Source: Brown (2007)
Rio Hondo (upper tributaries), New Mexico	Sales (Permanent)	\$10,500 - \$14,000 (2007 dollars)	\$16,302 - \$21,736	Higher prices here follow the pattern of tributary rights further up the watershed, attracting a premium over those lower down. Source: Brown (2007)
Prescott Active Management Area, Arizona	Sales (Permanent)	\$12,000 - \$12,700 (2007 dollars)	\$18,631 - \$19,718	Highest prices in Arizona as reported in the study. Source: Brown (2007)
Taos Tributaries, New Mexico	Sales (Permanent)	\$10,000 - \$12,000 (2007 dollars)	\$15,526 - \$18,631	Higher prices here follow the pattern of tributary rights further up the watershed, attracting a premium over those lower down. Source: Brown (2007)
Rio Hondo, New Mexico	Sales (Permanent)	\$7,000 (2007 dollars)	\$10,868	Follows the premium tributary rights pattern, with prices lower than those of the Rio Honda's upper tributaries. Source: Brown (2007)
Tucson Active Management Area, Arizona	Sales (Permanent)	\$2,000 - \$3,000 (2007 dollars)	\$3,105 - \$4,658	Prices lower than Prescott active management area. Source: Brown (2007)
Central Utah Water Conservation District, Utah	Sales (Permanent)	\$800 - \$2,500 (2007 dollars)	\$1,242 - \$3,882	Highest prices in Utah as reported in the study. Source: Brown (2007)
Roswell Artesian Basin, New Mexico	Sales (Permanent)	\$2,300 - \$2,400 (2007 dollars)	\$3,571 - \$3,726	Lowest prices in New Mexico as reported in the study. Source: Brown (2007)
Lower Rio Grande, Texas	Sales (Permanent)	\$2,000 - \$2,250 (2007 dollars)	\$3,105 - \$3,493	Highest prices reported in Texas. Comparable to NM Lower Rio Grande. Source: Brown (2007)

Little Thompson District, Colorado	Sales (Permanent)	\$1,852 - \$2,160 (2007 dollars)	\$2,875 - \$3,354	Located in Northern Colorado. Prices are lower than those of the CBT Project. Source: Brown (2007)
Edwards Aquifer Authority, Texas	Sales (Permanent)	\$2,000 (2007 dollars)	\$3,105	Large volume regulated groundwater serving the San Antonio area. Source: Brown (2007)
Cities of Olympia, Tumwater & Lacey, Washington	Sales (Permanent)	\$1,750 (2007 dollars)	\$2,717	Highest prices in Washington as reported in the study. Source: Brown (2007)
Phoenix Active Management Area, Arizona	Sales (Permanent)	\$1,000 - \$1,500 (2007 dollars)	\$1,553 - \$2,329	Moderate prices are relative to Prescott active management area. Source: Brown (2007)
John Day River, Oregon	Sales (Permanent)	\$700 (2007 dollars)	\$1,087	Among the lower-priced western rights reported in the study. Source: Brown (2007)
City of Madras, Oregon	Sales (Permanent)	\$302 - \$900 (2007 dollars)	\$469 - \$1,397	Cheapest Western rights reported in the study. Source: Brown (2007)
Middle Rio Grande Basin, NM	Lease (short term) Sales (permanent)	Range = \$50 - \$500 (2002-2019 dollars) Mean = \$148 (2002-2019 dollars) Range = \$3,649 - \$32,000 (2002-2019 dollars) Mean = \$13,253 (2002-2019 dollars)	\$73 - \$732 \$217 \$5,343 - \$46,851 \$19,404	³ Empirical analyses of over 7,000 water market transactions (leases and permanent sales) across multiple basins in the western United States for the period 2002 to 2019. Like Colby et al. (1993), the estimated hedonic model identified factors such as location, buyer type, volume, and transaction type (sale or lease) as important drivers of water right prices. New Mexico leases are among the lowest in the West. However, permanent water rights in the MRGB are among the most expensive. Source: Burns et al. (2022)

Active Management Areas, Arizona	Lease (Short term)	Range = \$18 - \$5,000 (2002-2019 dollars)	\$26 - \$7,321	³ Empirical analyses of over 7,000 water market transactions (leases and permanent sales) across multiple basins in the western United States for the period 2002 to 2019. Like Colby et al. (1993), the estimated hedonic model identified factors such as location, buyer type, volume, and transaction type (sale or lease) as important drivers of water right prices. Arizona recorded the highest lease price of about \$5,000 per AF. Source: Burns et al. (2022)
		Mean = \$232 (2002-2019 dollars)	\$340	
	Sales (permanent)	Range = \$100 - \$20,833 (2002-2019 dollars)	\$146 - \$30,502	
		Mean = \$2,382 (2002-2019 dollars)	\$3,488	
Central Valley, San Francisco Bay, South Coast Mojave Basin, California	Lease (Short term)	Range = \$6 - \$2,200 (2002-2019 dollars)	\$9 - \$3,221	³ Empirical analyses of over 7,000 water market transactions (leases and permanent sales) across multiple basins in the western United States for the period 2002 to 2019. Like Colby et al. (1993), the estimated hedonic model identified factors such as location, buyer type, volume, and transaction type (sale or lease) as important drivers of water right prices. Among the highest lease prices. Source: Burns et al. (2022)
		Mean = \$324 (2002-2019 dollars)	\$474	
	Sales (permanent)	Range = \$184 - \$5,850 (2002-2019 dollars)	\$269 - \$8,565	
		Mean = \$2,330 (2002-2019 dollars)	\$3,411	
Colorado-Big Thompson Project South Platte River Basin Native Surface Water Rights Arkansas River Basin Colorado	Lease (Short term)	Range = \$10 - \$4,060 (2002-2019 dollars)	\$15 - \$5,944	³ Empirical analyses of over 7,000 water market transactions (leases and permanent sales) across multiple basins in the western United States for the period 2002 to 2019. Like Colby et al. (1993), the estimated hedonic model identified factors such as location, buyer type, volume, and transaction type (sale or lease) as important drivers of water right prices. Among the highest lease prices. Colorado recorded the highest sales price of \$476,190 per AF. Source: Burns et al. (2022)
		Mean = \$466 (2002-2019 dollars)	\$682	
	Sales (permanent)	Range = \$49 to \$476,190 (2002-2019 dollars)	\$72 - \$697,193	
		Mean = \$20,465 (2002-2019 dollars)	\$29,963	
Truckee River Basin, Nevada	Lease (Short term)	Range = \$60 - \$60	\$88 - \$88	³ Empirical analyses of over 7,000 water market transactions (leases and permanent sales) across multiple basins in the western United States for the period 2002 to
			\$88	

	Sales (permanent)	Mean = \$60 (2002-2019) Range = \$112 - \$456,517 (2002-2019 dollars) Mean = \$14,610 (2002-2019 dollars)	\$164 - \$668,390 \$21,391	2019. Like Colby et al. (1993), the estimated hedonic model identified factors such as location, buyer type, volume, and transaction type (sale or lease) as important drivers of water right prices. Among the highest sales prices. Source: Burns et al. (2022)
Lower Rio Grande Valley, Texas	Lease (Short term) Sales (permanent)	Range = \$10 - \$1,000 (2002-2019 dollars) Mean = \$311 per AF (2002-2019) Range = \$300 - \$4,835 (2002-2019 dollars) Mean = \$2,388 (2002-2019 dollars)	\$15 – 1,464 \$455 \$439 - \$7,079 \$3,496	³ Empirical analyses of over 7,000 water market transactions (leases and permanent sales) across multiple basins in the western United States for the period 2002 to 2019. Like Colby et al. (1993), the estimated hedonic model identified factors such as location, buyer type, volume, and transaction type (sale or lease) as important drivers of water right prices. Moderate sales values relative to western averages. Source: Burns et al. (2022)
Salt Lake City Area, Utah	Lease (Short term) Sales (permanent)	Range = \$109 - \$197 (2002-2019 dollars) Mean = \$150 (2002-2019 dollars) Range = \$18 - \$14,569 (2002-2019 dollars) Mean = \$2,614 (2002-2019 dollars)	\$160 - \$288 \$220 \$26 – \$21,331 \$3,827	³ Empirical analyses of over 7,000 water market transactions (leases and permanent sales) across multiple basins in the western United States for the period 2002 to 2019. Like Colby et al. (1993), the estimated hedonic model identified factors such as location, buyer type, volume, and transaction type (sale or lease) as important drivers of water right prices. Source: Burns et al. (2022)
NM statewide Transactions	Lease (short term) Sales (Permanent)	Mean = \$107.36 (1987 dollars) Mean = \$1,847.18 (1987 dollars)	\$304 \$5,235	Based on Water Strategist dataset with 1,351 rights transfers and 690 lease transactions across western states. Prices reflect state-level averages for New Mexico transactions. Toll et al. (2019)

Arizona statewide transactions	Lease (short term)	Mean = \$304.76 (1987 dollars)	\$864	Based on Water Strategist dataset with 1,351 rights transfers and 690 lease transactions across western states. Prices reflect state-level averages for Arizona transactions. Toll et al. (2019)
	Sales (Permanent)	Mean = \$1,017.67 (1987 dollars)	\$2,884	
California statewide transactions	Lease	Mean = \$319.51 (1987 dollars)	\$905	Based on Water Strategist dataset with 1,351 rights transfers and 690 lease transactions across western states. Prices reflect state-level averages for California transactions. Toll et al. (2019)
	Sales (Permanent)	Mean = \$10,825.74 (1987 dollars)	\$30,680	
Colorado statewide transactions	Lease	Mean = \$386.56 (1987 dollars)	\$1,095	Based on Water Strategist dataset with 1,351 rights transfers and 690 lease transactions across western states. Prices reflect state-level averages for Colorado transactions. Toll et al. (2019)
	Sales (Permanent)	Mean = \$4860.24 (1987 dollars)	\$13,773	
Nevada statewide transactions	Lease	Mean = \$1,309.74 (1987 dollars)	\$3,712	Based on the Water Strategist dataset with 1,351 rights transfers and 690 lease transactions across western states. Prices reflect state-level averages for Nevada transactions. Source: Toll et al. (2019)
	Sales (Permanent)	Mean = \$4,228.72 (1987 dollars)	\$11,984	
Texas statewide transactions	Lease	Mean = \$383.60 (1987 dollars)	\$1,087	Based on the Water Strategist dataset with 1,351 rights transfers and 690 lease transactions across western states. Prices reflect state-level averages for Texas transactions. Source: Toll et al. (2019)
	Sales (Permanent)	Mean = \$563.31 (1987 dollars)	\$1,596	
Utah statewide transactions	Lease	Mean = \$29.89 (1987 dollars)	\$85	Based on Water Strategist dataset with 1,351 rights transfers and 690 lease transactions across western states. Prices reflect state-level averages for Utah transactions. Source: Toll et al. (2019)
	Sales (Permanent)	Mean = \$872.29 (1987 dollars)	\$2,472	
Middle Rio Grande Basin	Sales (Permanent)	Range: \$3,332 - \$33,289 (2009 dollars) Median = \$12,483.32 (2009 dollars)	\$5,000 - \$49,955 \$18,733	Econometric analyses of 135 water rights transactions transferring about 3,758 AF of consumptive use to municipal and industrial water buyers for the period 2000 to 2009. The model revealed that sales prices of water rights are statistically (<0.01) determined by housing

		Mean = \$12,776.56 (2009 dollars)	\$19,173	prices, per capita income in the user's county, buyer type, volume, and diversion point. Source: Payne & Smith (2013)
Albuquerque Bernalillo County Water Utility Authority (ABCWUA)	Replacement cost (willingness to pay)	Range = \$476 to \$1,500 (2016 dollars)	\$639 - \$2,012	⁴ These figures serve as a proxy for ABCWUA's willingness to pay for the continued replacement of lost San Juan Chama water. Source: Hartwell et al. (2016)
Albuquerque Bernalillo County Water Utility Authority (ABCWUA)	New supply development cost,	Eastside (Tijeras): \$1,465 (2016 dollars) Westside (Bosque): \$1,643 (2016 dollars)	\$1,965 \$2,204	⁴ High-end cost of developing potable and non-potable water reuse projects in Albuquerque, per the ABCWUA Water 2120 Strategy. Source: Hartwell et al. (2016)
City of Santa Fe, New Mexico	Replacement cost / avoided cost (marginal willingness-to-pay)	Range: \$532 - \$1,000 (2016 dollars)	\$714 - \$1,341	⁴ Santa Fe relies on SJ-C water for 40–50% of its supply via the Buckman Direct Diversion (\$221M in infrastructure). Lower bound of \$532 per AF reflects the marginal cost of rehabilitating city well fields. The upper bound of \$1,000 denotes speculative new-supply options. Source: Hartwell et al. (2016)
Jicarilla Apache Nation / NM Interstate Stream Commission	Lease (short term)	Year 1 (2023) = \$88	\$93	A 10-year lease of untreated bulk surface water from the Jicarilla Apache Nation to the NM Interstate Stream Commission, with support from the Nature Conservancy, executed in June 2023. The agreement allows the NMISC to lease up to 20,000 AF annually to support endangered species and to increase water security for New Mexico. The full 20,000 AF ordered in 2023 cost \$88 per AF, with the lease price adjusted for inflation every two years. Source: KRQE News 13,2022 https://www.krqe.com/news/new-mexico/new-mexico-ordering-6-5-billion-gallons-of-water-from-jicarilla-apache-nation/
Arizona Active Management Areas (Phoenix, Pinal, Tucson),	Wholesale of Long-Term Storage Credits	Baseline = \$500* (2025 dollars)	\$500	⁵ Water prices in the study are forecasted using an econometric model of 968 transactions for the period 2013-2025. Typical buyers include roughly 50% government entities, 18% municipal (main cities), 7%

Long-term Storage Credit (LTSC) markets, Central Arizona Project, effluent, and other supply types	(LTSCs) and CAP water entitlements.			industrial users, and 25% developers. Typical sellers are the CAP Tribal contractors – the largest storers and suppliers of LTSCs. At a baseline of 900,000 AF of CAP supplies, the model projects an LTSC price of about \$500 per AF, consistent with currently observed prices. Source: WestWater Research, 2026
Arizona Active Management Areas CAP/LTSC Markets	Wholesale of Long-Term Storage Credits (LTSCs) and CAP water entitlements.	\$1,550* (2025 dollars)	\$1,550	⁵ Forecasted prices under the basic coordination scenario, which assumed a reduction of CAP deliveries to 236,900 AF per year. Prices are projected to increase to \$1,550 per AF, about a 210% increase above the baseline. Source: WestWater Research (2026).
Arizona Active Management Areas CAP/LTSC Markets, Arizona	Wholesale of Long-Term Storage Credits (LTSCs) and CAP water entitlements.	\$12,840* (2025 dollars)	\$12,840	⁵ Forecasted prices under the extreme shortage scenario which assumes no deliveries. Prices are projected to increase to \$12, 840 per AF, representing about a 2,468% increase above the baseline. Source: WestWater Research (2026).
Upper Colorado River Basin, western Colorado (excluding San Juan/Dolores division)	Temporary environmental instream flow lease	M&I seller premium = +\$119* (2017 dollars) Transbasin source premium = +\$642* (2017 dollars) Unprotected diversion lease premium = +\$97* (2017 dollars)	\$156 \$843 \$127	⁶ An HPM econometric model is employed to estimate environmental instream-flow water right prices in the Upper Colorado using 115 water-lease prices for the period 2012 to 2023. Typical sellers include agricultural irrigators, transbasin diversion operators and reservoir storage account holders. Buyers are governmental agencies and NGOs. The estimated hedonic model predicted higher prices for leases from M&I suppliers than agricultural suppliers. Transbasin diversion sources carried additional premium and unprotected diversion leases command higher prices compared to other leases. Source: Womble et al. (2025)
San Juan/Upper Dolores Rivers Basin,	Temporary water lease	Lemon Reservoir = \$389 (2023 dollars)	\$410	Prices reflect publicly advertised water lease prices in certain reservoir storage accounts. Since these prices are

southwestern Colorado		Vallecito Reservoir = \$232 (2023 dollars)	\$245	already known, the study plainly reports them rather than using the HPM approach to estimate the lease prices. Source: Womble et al. (2025).
		McPhee Reservoir = \$180 (2023 dollars)	\$190	
		Groundhog Reservoir = \$70 (2023 dollars)	\$74	
Upper Colorado River Basin, Colorado	Procedural transaction cost (legal/hydrologist fees) for permanent or long-term water rights transfer	For 100 AFY senior rights transfer Division 1 (South Platte River Division) = \$2,208* per AFY (2017 dollars) Division 4/6/7 (Gunnison, Yampa/White, San Juan/Dolores) = \$787* per AFY (2017 dollars) For 40,000 AFY senior right transfer Division 1 (South Platte River Division) = \$20* per AFY (2017 dollars)	\$2900 per AFY \$1,034 per AFY \$26 per AFY	⁷ Distinct from water prices, procedural transaction costs (legal and hydrologist fees) required to secure state approval for water rights transfers are estimated based on a survey of 100 water professionals. Key findings reflect significant scale economies. That is, unit transaction costs decline sharply with larger transaction volume. Also, factors such as senior water rights, higher conflict outcomes, and water-scarce regions are important drivers of transaction costs. Interestingly, the study revealed that transaction costs for smaller transfers can exceed the market price for water. Womble and Hanemann (2020b).
Colorado – Statewide, 37 counties	Agricultural land sales transactions.	Surface water access premium = +\$6,460 per acre (2022 dollars) Seniority (priority) premium = +\$46 per acre (2022 dollars)	\$7,106 per acre \$51 per acre	⁸ In the absence of direct water-right sales data, an HPM econometric model is applied to examine the capitalization of surface water access and water-right seniority in agricultural land values in Colorado, using roughly 18,000 agricultural land-sale transactions from 1990 to 2022. The estimated model revealed that surface water access raises land value by about 64% relative to comparable dryland parcels, with value increasing by approximately 0.6% per year over the sample period. Among irrigated parcels, each additional year of seniority raises value by 0.34%, with largest premium for pre-1900

				rights and diminishing gain for rights established after 1930-1950. Both results are robust to matching, fixed effects, sample restriction, placebo tests, and Oster (2019) sensitivity bounds. Source: Bahrami et al. (2026)
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Table B2 Notes

1. Rows colored in light grey denote studies with transactions outside the Middle Rio Grande Basin and other places in New Mexico but included for comparison with MRGB or any NM specific areas. * denotes estimated/forecasted prices rather than observed prices. The observed and estimated prices reported in the table are expressed in 2025 dollars using the CPI-U, adjusting from each study's reported base year (shown in brackets). Converted figures are all approximated.
2. These figures are water right values under different assumptions about food price growth and urban water conservation and not observed market prices. The four rows denote different scenario combinations used to forecast a range of possible future values.
3. The observed sales and lease prices for the different regions are converted into 2025 U.S. dollars using the average annual CPI-U (219.8904) for the years 2002-2019.
4. These figures are cost proxies, replacement cost, new supply development cost, or a utility's willingness to pay, not the prices from water-rights transactions. They denote what the utility company will pay to secure or replace supply through infrastructure.
5. These are projected prices from an econometric model under hypothetical future delivery scenarios and not observed market prices. The \$1,550 and \$12,840 per AF values represent modeled estimates under reduced and zero CAP deliveries, respectively.
6. These values are hedonic-model price premiums and not observed market transactions or lease prices. A premium represents how much extra a lease commands when it has that characteristic, holding other factors in the model constant.
7. These figures are the expected or modeled procedural transaction costs, not observed prices, and they measure the legal and hydrologist fees rather than the price of water. They are reported in the survey's period dollars (2017) as the source does not explicitly state the year of reported figures.
8. The values for this study are reported in dollars per acre of land, not per AF of water, and therefore not directly comparable to the \$/AF or \$/AFY figures reported elsewhere in the table. The values reflect agricultural land prices rather than direct water-right sales or lease transactions.

Table B3: Administrative Charges/Payments for Water in Alternative Settings (delivery/provision/Lease)¹

Category	Year note	Amount in Calculated \$2025	Brief Note
MRGCD Water Service Charge	Based on the 2024 charge (\$51.25 per acre), inflated to 2025 dollars	\$21.73 per AF	² Irrigated acreage derived from 2022 ISO-log parcel records identifying 42,351 acres of irrigable parcels within the MRGCD service area. Charge converted from per-acre service fee to per-acre-foot using 2024 consumptive use estimates (2.42 acre-feet per acre). This is an average rate for consumptive use, billed on irrigable acreage
MRGCD's Water Bank Leasing Rate	Based on the 2025 charge	\$23.81 per AF	³ Irrigators holding pre-1907 rights deposit water into the District's Water Bank. Other irrigators lease at \$50 per acre per year, subject to curtailment per a gage-based flow schedule (Rule 23) and Rio Grande Compact status. Plus, a \$100 admin fee per 5-year term. Converted using a consumptive irrigation requirement of 2.1 acre-feet per acre. This is a flat rate for consumptive use (conditional, as delivery is not guaranteed), charged per acre of leased water bank land paid annually to the MRGCD.
USBR Supplemental Water Leasing Program (Minnow water)	Average 2003-2021, inflated to 2025 dollars	\$96.81 per AF	⁴ Compensation paid to conserve water for environmental flows. This is a flat, non-consumptive rate. Payments are made per acre-foot of water leased from San Juan–Chama Project contractors, who receive compensation in exchange for releasing water from storage into the Rio Grande to support environmental flows for the Rio Grande silvery minnow.
MRGCD Environmental Water Leasing program (EWLP)	2020 Partial Season (\$150 per acre)	Commercial = \$71.22 per AF Small Non-Commercial = \$106.02 per AF	⁵ Lease payments compensate irrigators for reducing consumptive acre use. Converted from per-acre payments using effective ET of 2.62 acre-feet per acre (commercial) and 1.76 acre-feet per acre (small irrigators). This is an average, non-consumptive rate, with payments made per acre of land enrolled in the following program.
MRGCD Environmental Water Leasing program (EWLP)	2021 Partial Season (\$150 per acre) 2021 Full Season (\$275 per acre)	Commercial = \$71.22 per AF Small Non-Commercial = \$106.02 per AF Commercial = \$124.69 per AF Small Non-Commercial = \$185.62 per AF	⁵ Lease payments compensate irrigators for reducing consumptive acre use. Converted from per-acre payments using effective ET of 2.62 acre-feet per acre (commercial) and 1.76 acre-feet per acre (small irrigators). This is an average, non-consumptive rate, with payments made per acre of land enrolled in the following program.

MRGCD Environmental Water Leasing program (EWLP)	2022 Full Season (\$425 per acre)	Commercial = \$178.45 per AF Small Non-Commercial = \$265.64 per AF	⁵ Lease payments compensate irrigators for reducing consumptive acre use. Converted from per-acre payments using effective ET of 2.62 acre-feet per acre (commercial) and 1.76 acre-feet per acre (small irrigators). This is an average, non-consumptive rate, with payments made per acre of land enrolled in the following program.
MRGCD Environmental Water Leasing program (EWLP)	2023 Partial Season (\$200 per acre)	Commercial = \$81.45 per AF Small Non-Commercial = \$121.25 per AF	⁵ Lease payments compensate irrigators for reducing consumptive acre use. Converted from per-acre payments using effective ET of 2.62 acre-feet per acre (commercial) and 1.76 acre-feet per acre (small irrigators). This is an average, non-consumptive rate, with payments made per acre of land enrolled in the following program.
	2023 Full Season (\$350 per acre)	Commercial = \$141.20 per AF Small Non-Commercial = \$210.20 per AF	
MRGCD Environmental Water Leasing program (EWLP)	2024 Full Season (\$700 per acre)	Commercial = \$274.12 per AF Small Non-Commercial = \$408.07 per AF	⁵ Lease payments compensate irrigators for reducing consumptive acre use. Converted from per-acre payments using effective ET of 2.62 acre-feet per acre (commercial) and 1.76 acre-feet per acre (small irrigators). This is an average, non-consumptive rate, with payments made per acre of land enrolled in the following program.
MRGCD Environmental Water Leasing program (EWLP)	2026 Partial Season: June 1 – October 31, 2026 (\$175 per acre)	Commercial = \$66.79 per AF Small Non-Commercial = \$99.43 per AF	⁵ Lease payments compensate irrigators for reducing consumptive acre use. Converted from per-acre payments using effective ET of 2.62 acre-feet per acre (commercial) and 1.76 acre-feet per acre (small irrigators). This is an average, non-consumptive rate, with payments made per acre of land enrolled in the following program. Figures are maintained in 2026 dollars.
	2026-2027 Multi-Year (Late Season 2026 + 2027 Full Season) (\$550 per acre)	Commercial = \$210 per AF Small Non-Commercial = \$313 per AF	
Lower Rio Grande (LRG) Groundwater Conservation Program (GCP)	2024–2025 rates, inflated to \$2025 dollars	1-year: Diverted = \$171 per AF Consumptive = \$296 per AF 3-year: Diverted = \$182 per AF Consumptive = \$316 per AF	⁶ This voluntary grant program compensates LRG irrigators to suspend groundwater use for 1–3 years. Like the MRGB EWLP but targeting groundwater, payments are based on per-acre rates, with the \$/AF conversion using a CIR of 2.6 acre-feet per acre for GW-only land per the 2025 Groundwater Settlement Agreement. This is an average rate for consumptive use (groundwater diversion for irrigation), paid per

			acre of land enrolled in the fallowing program. Farmers receive \$750 per acre per year for a 1-year enrollment, or up to \$800 per acre per year for a 3-year enrollment, with payments made by the New Mexico Interstate Stream Commission Source: Follingstad et al. (2026).
Lower Colorado River Basin – Agricultural Districts (direct USBR Colorado River water)	Based on 2023–2024 data, inflated to 2025 dollars	\$31.57 per AF (weighted price)	⁷ These are volume-weighted average wholesale prices paid by 217 agricultural and municipal districts across AZ, CA, and NV for consumptive use. Agricultural districts purchasing directly from USBR pay as little as \$0.00 per AF, since prices cover only delivery costs and the water itself is free; payment is per diversion. Source: Garrison et al. (2025)
Lower Colorado River Basin – Municipal Districts (all wholesale sources)	Based on 2023–2024 data, inflated to 2025 dollars	\$540 per AF (weighted average)	⁸ Municipal wholesale prices vary dramatically by state and water source, with almost all water purchased above \$150/AF going to municipal districts and water acquired from USBR for no charge sometimes exceeding \$2,800/AF after multiple transfers; payment is made per acre-foot at the wholesale level to the supplying agency (USBR, CAWCD/CAP, MWD, SDCWA, SWP contractors, etc.), reflecting conveyance, operation and maintenance (O&M), and capital cost recovery, not the intrinsic value of the water resource. Source: Garrison et al. (2025)
Arizona – Central Arizona Project (CAP)	Based on 2023–2024 data, inflated to 2025 dollars	\$0.26 per AF (USBR to CAWCD) \$241 per AF (CAWCD to end users)	⁹ USBR sells water to CAWCD for \$0.25/AF, and CAWCD then delivers to districts and utilities through the CAP system at \$227.93/AF (weighted average). This is an average flat rate for municipal and agricultural consumptive use, paid per acre-foot to CAWCD, with the rate covering O&M and capital cost recovery only Source: Garrison et al. (2025)
California – State Water Project (SWP wholesale rate)	2023 pricing (pre-Jan 2024), inflated to 2025 dollars	Municipal = \$386/AF Agricultural = \$100/AF	¹⁰ These are volume-weighted average rates for municipal and agricultural consumptive use. Agricultural districts pay much less than municipal agencies because they are closer to the source and face lower pumping costs, while Southern CA municipal users must pay to pump water over the Tehachapi Mountains, which drives their price significantly higher. Payment is made per acre-foot to the CA Department of Water Resources, covering capital, operating, and transportation charges. Source: Garrison et al. (2025)

California – Central Valley Project (CVP wholesale rate)	2023–2024 data, inflated to 2025 dollars	Municipal = \$50/AF Agricultural = \$40/AF	¹¹ These are volume-weighted average rates for primarily agricultural consumptive use. Agricultural districts receive nearly 86% of the water and prices cover partial infrastructure costs only, with the water itself carrying no charge and rates long falling short of full cost recovery. Payment is per acre-foot to USBR under 40-year terms. Source: Garrison et al. 2025
Middle Rio Grande – Isleta Reach Environmental Water Transactions (Audubon NM / Pueblo donations)	2016–2018 (ongoing)	No monetary transaction	Since 2016, Audubon New Mexico has facilitated environmental water transactions along the 34-mile Isleta Reach (from the Isleta Diversion Dam to the San Acacia Dam). Four sovereign Pueblos (Sandia, Isleta, Cochiti, Santa Ana) donated or exchanged 100 AF each in summer 2016 for in-stream flow: Sandia and Isleta voluntarily donated water, while Cochiti and Santa Ana supplied water in exchange for funding of riparian restoration on tribal land. A private golf club (Club at Las Campanas, Santa Fe) subsequently donated an additional 399 AF, bringing the 2016 total to 799 AF, and in 2018, during the extremely dry season, 999 acre-feet of water were supplied from Isleta Pueblo, Los Lunas, and Belen, including an option for a ten-year renewal. This is non-consumptive (in-stream environmental flow), arranged through voluntary donation or in-kind exchange (riparian restoration funding). Source: Simpson & Grabau (2018)
Municipal Bulk Fill Station – City of Rio Rancho	Effective as of July 1, 2025	\$3, 421 per AF	Charge for treated potable water sold at a 24-hour automated bulk-fill station for domestic and construction haulers. Sold at \$10.50 per 1,000 gallons, converted to \$/AF using 325,851 gallons per AF. The published rate increases by 5% annually, effective each July 1 through 2030. Source: City of Rio Rancho, Bulk Fill Station: https://rrnm.gov/1852/Bulk-Fill-Station
Municipal Bulk Fill Station – Ojo de Agua, Santa Fe County	Current rate (2025)	Residential = \$3,259 per AF Commercial = \$6,517 per AF	Charge for potable water sold at a 24-hour automated Ojo de Agua bulk dispensing facility. Residents pay \$0.01 per gallon, and commercial customers pay \$0.02 per gallon. A one-time application fee of \$18 applies with no monthly service fee. Converted to \$/AF using 325,851 gallons per AF. Source: Santa Fe County Utilities, Ojo de Agua: https://www.santafecountynm.gov/public-works/utilities/ojodeagua

Municipal Bulk Water / Rural Hauling Sales – Town of Mountainair	Current rate (2025)	Residential = \$16,293 per AF Commercial = \$48,878 per AF	Charge for treated potable water sold per gallon at a town hydrant/fill point and self-hauled by the buyer. Charges differ by customer class. Water is sold on a pay-as-you-go basis at \$0.05 per gallon for residential customers and \$0.15 per gallon for commercial customers. Out-of-town haulers pay 50% above town rates. Converted to \$/AF using 325,851 gallons per AF. Source: Town of Mountainair, https://mountainairnm.gov/services-2/services
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Table B3 Notes

1. Rows colored in light grey denote studies with charges outside the Middle Rio Grande Basin.
2. Irrigated acreage (42,351 acres) is based on 2022 ISO-log parcel records for actively irrigated lands within the Middle Rio Grande Conservancy District (MRGCD). We assumed that parcel extent remained unchanged in 2024. The total 2024 effective evapotranspiration (Effective ET) is approximately 102,475 acre-feet, equal to 2.42 AF per acre. The 2024 water service charge (\$51.25/ac) was converted to a volumetric charge: $51.25/2.42 = 21.18/\text{AF}$. This value was converted to 2025 dollars using CPI-U ($\times 1.026$): $21.18 \times 1.026 = \$21.73/\text{AF}$.
3. The MRGCD Water Bank, established under [Revised Rule No. 23](#), allows irrigators holding pre-1907 surface water rights to deposit water into a District-managed pool. Other irrigators may then lease Water Bank water for agricultural use at a flat rate of \$50 per acre per year plus a one-time administrative fee of \$100 per five-year lease period. Source: [MRGCD Assessment Department](#). Converted to a volumetric basis using the NM State Engineer’s working Consumptive Irrigation Requirement (CIR) of 2.1 AF/acre for MRGCD lands: $\$50 \div 2.1 = \$23.81/\text{AF}$.
4. Average payment equals \$88 per acre-foot (2022 dollars) based on program averages from 2003–2021 and converted to 2025 dollars using CPI-U ($\times 1.10$): $\$88 \times 1.10 = \96.81 . These payments compensate irrigators for reducing their consumptive use to support endangered species flows in the Middle Rio Grande.
5. Environmental Water Leasing Program payments are made per acre enrolled and vary by program year. Payment values were obtained from the MRGCD EWLP summaries reported in Wood (2023), MWR Professional Project, and the U.S. Fish & Wildlife Service Middle Rio Grande water leasing program (2024 full-season rate). Payments were expressed in 2025 dollars using CPI-U and converted to per acre-foot charges using average 2021 effective ET estimates from Olofinsao (2026), dissertation. The author reported 2.62 AF/ac for large commercial irrigators (averaging about 290 acres in size) and 1.76 AF/ac for small non-commercial irrigators (averaging about 3 acres in size). For example, the calculation for the 2024 full season is expressed as $(\$700 \times 1.026)/2.62 = \274.12 per AF and $(\$700 \times 1.026)/1.76 = \408.07 per AF.

6. Lower Rio Grande Groundwater Conservation Program payment rates are \$750/ac/year and 800/ac/year for 1-year and 3-year enrollments, respectively. Values are inflated to 2025 dollars using CPI-U ($\times 1.026$) and converted to \$/AF using the Consumptive Irrigation Requirement (CIR) of 2.6 AF/ac for groundwater-only lands, as established in the 2025 Groundwater Settlement Agreement (Texas v. New Mexico). The same Settlement Agreement also establishes a CIR of 1.97 AF/ac for combined-right lands (GW + surface water). Calculations for consumptive use are based on the following: 1-year GW-only: $(\$750 \times 1.026) / 2.6 = \296 per AF; 3-year GW-only: $(\$800 \times 1.026) / 2.6 = \316 per AF. Calculation (diverted) using Farm Delivery Requirement (FDR) of 4.5 AF/ac 1-year: $(\$750 \times 1.026) / 4.5 = \171 per AF; 3-year: $(\$800 \times 1.026) / 4.5 = \182 per AF.
7. Based on a study of 217 wholesale water purchase transactions across AZ, CA, and NV. Five agricultural districts together receive nearly 4 MAF per year at \$0.00 per AF through federal diversion rights. The prices paid in this category reflect only the cost of moving water through delivery infrastructure. No charge is applied to the water resource itself.
8. Volume-weighted average across 159 municipal purchase points. State averages vary widely. California = \$722 per AF, Nevada = \$193 per AF and Arizona = \$72 per AF. The highest prices, all above \$1,000 per AF, are in California. The gap between states largely reflects how many times water has changed hands. Each resale adds conveyance, treatment, and distribution costs on top of an underlying resource that was originally free.
9. The Central Arizona Project is a 336-mile aqueduct carrying Colorado River water from Lake Havasu across the Sonoran Desert to Phoenix, Tucson, and surrounding areas. USBR charges CAWCD just \$0.25 per AF at the point of diversion. The \$227.93 per AF end-user rate exists entirely to recover the cost of building and operating the delivery system, not the price of water itself. Arizona's overall weighted average across all water sources is \$49.17 per AF.
10. The SWP pumps water from the Sacramento–San Joaquin Delta 444 miles south and nearly 3,000 feet over the Tehachapi Mountains to serve 27 million Californians. The large gap between agricultural (\$95 per AF) and municipal (\$364 per AF) rates reflects both distance traveled and loan terms. The Central Valley agricultural districts have proximity to source, while Southern CA municipal agencies face higher pumping energy costs and repay their capital share. California's overall weighted average across all water sources is \$343.32 per AF.
11. About 86% of CVP water goes to agricultural users. Rates were intended to cover construction and operating costs, but by 2006, they had consistently fallen short; only about 21.5% of total capital costs had been repaid. As with Colorado River diversions, the water itself is provided free of charge

Table B4: Comparable Community Water Provider Rates for Water and Sewer Services for Standardized Residential Indoor Monthly Use in the MRGB (Providers with $\geq 1,000$ Residential Connections)

Provider & (County)	Type & Number of Residential water connections (Year)	Residential Rate Water Only (2002-2003) average inflated to 2025 U.S. dollars	Residential Rate Water Only (2022-2023) average inflated to 2025 U.S. dollars	Residential Rate Sewer Only (2002-2003) average inflated to 2025 U.S. dollars	Residential Rate Sewer Only (2022-2023) average inflated to 2025 U.S. dollars	Combined Water + Sewer for early years (2002-2003)	Combined Water + Sewer for recent years (2022-2023)	Percentage Change in Water rates
Albuquerque Water System (Bernalillo)	Public 182,326 (2023)	\$29.88	\$32.83	\$30.35	\$21.01	\$60.22	\$53.84	-10.59%
Entranosa Water and Wastewater Co-operation (Bernalillo)	Private 3,714 (2023)	-	\$60.98	-	-	-	-	-
Sandia Peak Utility (Bernalillo)	Private 2,410 (2022)	-	\$21.93 (based on only 2022 rates)	-	\$36.37 (based on only 2022 rates)	-	\$58.31 (based on only 2022 rates)	-
Bernalillo (Town) Water System (Sandoval)	Public 3,366 (2022)	\$32.60	\$35.64 (based on only 2022 rates)	\$33.11	\$48.73 (based on only 2022 rates)	\$65.71	\$84.37	28.40%
Rio Rancho Water & Wastewater Services (Sandoval)	Public 22,283 (2003)	\$34.52	-	\$59.05	-	\$93.57	-	-
Belen Water System (Valencia)	Public 2,452 (2003)	\$31.03	-	\$29.68	-	\$60.71	-	-
Bosque Farms Water Supply System (Valencia)	Public 1,450 (2023)	\$35.39	\$38.60	\$35.39	\$37.28	\$70.78	\$75.89	7.22%

Los Lunas Water System (Valencia)	Public 6,951 (2023)	\$41.67	\$45.26	\$44.26	\$50.22	\$85.93	\$95.48	11.11%
Rio Communities Water System (Valencia)	Private 1,840 (2023)	-	\$35.16 (based on only 2023 rates)	-	\$75.14 (based on only 2023 rates)	-	\$110.30	-
Rio Del Oro Water System (Valencia)	Private 1,729 (2023)	-	\$35.16 (based on only 2023 rates)	-	\$75.14 (based on only 2023 rates)		\$110.30	
Socorro Water System (Socorro)	Public 3,368 (2023)	\$24.67	\$26.23 (based on 2023 rates only)	\$37.34	\$41.83 (based on 2023 rates only)	\$62.01	\$68.06	9.76%

Notes: All rates are inflated to 2025 U.S. dollars. Nominal rates are averaged across available survey years within each period and then multiplied by the averaged CPI-U multiplier. The average CPI-U multiplier for the early period (2002-2023) is 1.769, and that for the recent period is 1.078. 2022 rates are drawn from the 2023 NMED survey (December 2022 rates) and 2023 rates from the 2024 NMED survey (December 2023 rates). Only community water providers with 1,000 or more residential connections are included in the table. A dash (-) indicates no data submitted for that period. Some providers fail to report their rates to NMED every year. For those providers, we report only the years with available rate submissions and convert those values to 2025 dollars using the CPI-U for the year in which the rate was reported. For example, Bernalillo Water System reported a rate in 2022 but not in 2023. Accordingly, the 2022 rate was converted to 2025 dollars as follows: $[321.943 \div 292.655] \times \$32.40 = \$35.6$.

Appendix C:

Technical Background Support for Section III.2.e.: What Do We Pay for 1.5 AF of Consumptive Water Use?— *Preliminary Investigation and Comparisons Across Various Sources.*

I. Purpose and Scope

This appendix supports Figure 16 in Section III.2.e (replicated below). It reports the annual dollar cost of sourcing 1.5 AF/yr of consumptive water use across a range of options in Greater Albuquerque. The analysis is comparative: sixteen sourcing options are examined, from \$0-cost Pueblo *Prior & Paramount* delivery to the high conservation incentives of the Santa Fe municipal rates. Only water charges are included (wastewater charges excluded). All calculations use: 1.5 AF/yr = 653 CCF = 488,777 gallons. Costs are computed on 1.5 AF/yr of consumptive-use (CU) water, as depleted by ET. Metered options charge on applied water, which exceeds CU: Applied water = CU ÷ application efficiency (see Table C1). For flat-rate options (MRGCD, Pueblo P&P), billing is independent of applied volume, and application efficiency does not affect cost. Assumed application efficiencies reflect managed systems consistent with picking the upper range for each category in the literature (Burt et al., 1997; NRCS NEH Part 623). For domestic wells, it is assumed that depth affects pumping energy cost but not application efficiency; valley floor and NAA wells both have a 75% application-efficiency assumption (Table 1). Pumping energy cost is instead governed by TDH and pump wire-to-water efficiency η (see the Total Dynamic Head (TDH)-Based Pumping Electricity methods laid out in Table C2 below); the depth premium is captured in the resulting energy pumping cost differentials (\$321/yr for NAA vs. \$113/yr on the valley floor at 2.00 AF applied). It is assumed that water rights are based on CU, not diversions, and that percolation from irrigation recharges the aquifer and can satisfy downstream benefits (Fernald & Guldán, 2006).

All electricity costs use the NRCS pump-energy relation (NRCS, 2016, *National Engineering Handbook* Part 623, Chapter 9). This is the same relation applied to San Joaquin Valley groundwater pumping cost estimation by Hurley (2025):

$$kWh/AF = (TDH \times 1.023) \div \eta$$

where TDH is total dynamic head in feet and η (eta) is pump wire-to-water efficiency (pump and motor combined — the mechanical/electrical conversion efficiency of the pumping plant). This η is *distinct* from the irrigation application efficiency reported in Table 1 above: application efficiency determines how much water must be applied to deliver a given consumptive-use volume, while η determines how much electricity is required to lift and pressurize that applied volume. The two efficiencies are independent and should not be conflated.

TDH is built up from its three physical components: TDH = static depth to water + drawdown + friction losses + system pressure head, following the NRCS NEH Part 623 pump-energy accounting also used by Hurley (2025). Open-discharge delivery (MRGCD canals, agricultural gated-pipe/sprinkler systems) carries no pressure-head term. Piped domestic and municipal systems carry a household/system pressurization requirement, assumed here at 50 PSI ($\approx$ 115 ft of head). This pressurization term is applied to *both* the valley-floor and North Albuquerque Acres (NAA) domestic wells below. Table C2 reports the TDH build-up and η used for each pumped-water option; the resulting kWh/AF and dollar costs appear in each option's table later in this appendix.

Table C1. Irrigation Application Efficiency Assumptions by Option Type

Option / Irrigation Method	Efficiency	Applied Water for 1.5 AF CU	Key References
Pueblo P&P, MRGCD surface/furrow (managed)	65%	2.31 AF — cost unchanged (flat rate)	NRCS NEH Part 623; Fernald & Guldán (2006)
Residential smart-controller sprinkler: ABCWUA residential, domestic wells (valley floor & NAA), Rio Rancho, SF	75%	2.00 AF = 872 CCF / 651,702 gal	Burt et al. (1997); NRCS NEH Part 623
Professional ET-scheduled turf: ABCWUA institutional park, non-potable/reclaimed	80%	1.875 AF = 817 CCF	ABCWUA SmartUse
Advanced golf course irrigation: ABCWUA commercial golf	82%	1.829 AF = 796 CCF	GCSAA(2022)
Agricultural well, gated pipe / low-pressure sprinkler	75%	2.00 AF applied	NRCS NEH Part 623

Notes: All costs are annual for 1.5 AF/yr consumptive use (CU); water charges only, wastewater excluded). Fixed charges are constant; volumetric charges scale with water applied. MRGCD WSC is flat per-acre.

Pueblo P&P: \$0; federally mandated delivery.

Domestic wells: Electricity scales with applied volume; capital and maintenance are fixed.

ABCWUA residential: †Base rate (no surcharge): \$2,007/yr; with conservation surcharge: \$4,271/yr. Fixed meter \$11.51/mo (post [Q-24-1](#)); WA = 8 CCF/mo. † = counterfactual (no surcharge applied).

ABCWUA institutional/commercial: 2-inch connection charge (\$1,581/yr) = 49% of park total at 2.00 AF applied (\$3,249/yr).

Rio Rancho: FY2027 rate schedule; summer usage (this equates to 130 CCF/mo) falls in the upper tier.

Santa Fe: \$21.72/1,000 gal upper tier captures virtually all irrigation volume at 2.00 AF applied.

Ag. well: Costs allocated from a 200-acre farm; the 1.5-AF share = 1/200 of farm capital and maintenance.

Mortgage, after-tax: 6.75%, 30-year loan; itemized federal + NM deduction at 26.9% combined marginal rate.

Assumed Well depths: Valley-floor = 60 ft; NAA = 400 ft (see Table 1a for full TDH build-up including household pressurization).

Table C2. TDH Components and Pump Efficiency (η) by Pumped-Water Option

Option	Static depth (ft)	Drawdown + friction (ft)	Pressure head (ft)	TDH (ft)	η (pump)
Valley-floor domestic well (Tables 3–4)	60	5 + 10	115 (50 PSI)	190	55%
NAA domestic well (Table 6)	400	10 + 15	115 (50 PSI)	540	55%
Valley-floor ag./irrigation well (Tables 9–10)	10	10 + 10	n/a (open discharge)	30	70%

Notes: Static depths from Bartolino & Cole (2002) and Peter (1987) (valley floor) and Galanter & Curry (2019) (NAA/East Mesa). Domestic-well η (55%) reflects the smaller, often older pump stock typical of residential systems, near the lower end of the wire-to-water efficiency range reported for older/poorly maintained systems (NRCS NEH Part 623). The agricultural well η (70%) reflects larger, better-maintained irrigation pumps and matches NRCS standard practice, consistent with Hurley (2025). MRGCD ditch water (Table 5) is gravity-fed and requires no pumping electricity.

II. Summary Assumptions & Calculation for Different Water Source Costs

II.1 Option: Pueblo Prior and Paramount Water Rights — No Charge

Cost Item	1.5 AF/yr
MRGCD WSC (non-Pueblo irrigators, for reference)	\$61.03/acre/yr
Pueblo P&P: federally mandated delivery at no charge	\$0
TOTAL — Annual water cost (Pueblo P&P)	\$0 — No Charge
Notes: Six Middle Rio Grande Pueblos; ~8,847 MRGCD acres. Federally mandated delivery; the Water Service Charge does not apply.	

II.2. Option: ABCWUA Residential (City Water, Albuquerque)

Cost Item	1.5 AF/yr
Fixed charge (12 months × \$11.51)	\$138
Commodity, base rate: 872 CCF × \$2.143 (no surcharge)	\$1,869
Commodity WITH conservation surcharges applied	\$4,133
TOTAL — Base rate (no surcharge) – used as hypothetical reference only	\$2,007/yr
TOTAL — With conservation surcharges	\$4,271/yr
Notes: Standard 5/8" × 3/4" meter; \$11.51/mo fixed (post Q-24-1); commodity \$2.143/CCF. At 75% efficiency, 2.00 AF applied (872 CCF/yr) averages ~125 CCF/mo in summer; which is easily above the 400% WA threshold (WA = 8 CCF/mo); conservation surcharge applies.	

II.3 Option: Private Domestic Well, Valley Floor (New Drill)

Cost Item	1.5 AF/yr
Annualized capital (CRF 7%, 20 yr: \$8,300 × 0.0944)	\$784
Electricity (706.4 kWh × \$0.16/kWh)	\$113
Annual maintenance + water testing	\$250
TOTAL — New well, cash (20-yr life)	\$1,147/yr
TOTAL — New well, mortgage after-tax (30 yr @ 6.75%, 26.9% rate)	\$869/yr
Notes: Valley-floor alluvial aquifer at ~60 ft depth (Bartolino & Cole, 2002; Peter, 1987). TDH (Eq. 1, Table 1a) = 60 ft static + 5 ft drawdown + 10 ft friction + 115 ft household pressurization (50 PSI) = 190 ft; $\eta = 55\% \rightarrow kWh/AF = 190 \times 1.023 \div 0.55 = 353.4 kWh/AF \times 2.00 AF applied = 706.4 kWh \times \$0.16/kWh = \$113/yr$. Capital \$8,300 (2024–2025 Albuquerque pricing: drilling, pump, electrical, OSE permit); CRF(7%, 20 yr) = \$784/yr. Mortgage scenario: \$8,300 financed at 6.75%/30 yr = \$646/yr P&I. After federal + NM mortgage interest deduction (26.9% combined marginal rate, itemized), year-1 after-tax P&I cost equates to \$506; plus \$113 electricity + \$250 maintenance = \$869/yr. The deduction declines over the loan life.	

II.4. Option: Private Domestic Well, Valley Floor (Existing Well)

Cost Item	1.5 AF/yr
Electricity (706.4 kWh × \$0.16/kWh)	\$113
Annual maintenance + water testing	\$250
TOTAL — Existing well, operating costs only	\$363/yr
Notes: No capital outlay where a well already exists; electricity and maintenance only. TDH (Eq. 1, Table 1a) = 60 ft static + 5 ft drawdown + 10 ft friction + 115 ft household pressurization (50 PSI) = 190 ft; $\eta = 55\% \rightarrow kWh/AF = 190 \times 1.023 \div 0.55 = 353.4 kWh/AF \times 2.00 AF \text{ applied} = 706.4 kWh \times \$0.16/kWh = \$113/yr$.	

II.5. Option: MRGCD Ditch Water (Surface Water, Gravity Delivery)

Cost Item	1.5 AF/yr
MRGCD Water Service Charge (\$61.03/acre, 2026 rate)	\$61
Pumping electricity (gravity-fed ditch delivery)	\$0
TOTAL — MRGCD ditch water *	\$61/yr *
Notes: Gravity-fed surface water via MRGCD canal/lateral; flat annual WSC regardless of volume; no pumping electricity. Assumes pre-1907 senior rights appurtenant to the land.	

II.6. Option: North Albuquerque Acres Well (East Mesa, Deep Aquifer)

Cost Item	1.5 AF/yr
Drilling: 450 ft × \$35/ft	\$15,750
Pump, electrical, tank, permit, contingency	\$6,200
Total capital (new NAA well)	\$21,950
Annualized capital (CRF 7%, 20 yr)	\$2,072
Pumping electricity (2,008.8 kWh × \$0.16/kWh)	\$321
Routine maintenance + water testing	\$250
TOTAL — New NAA well, cash (20-yr life)	\$2,643/yr
TOTAL — Existing NAA well, operating costs only	\$571/yr
Notes: East Mesa escarpment; Santa Fe Group aquifer at ~400 ft static depth (Galanter & Curry, 2019) — roughly 6.7× the valley-floor static depth. TDH (Eq. 1, Table 1a) = 400 ft static + 10 ft drawdown + 15 ft friction + 115 ft household pressurization (50 PSI) = 540 ft; $\eta = 55\% \rightarrow kWh/AF = 540 \times 1.023 \div 0.55 = 1,004.4 kWh/AF \times 2.00 AF \text{ applied} = 2,008.8 kWh \times \$0.16/kWh = \$321/yr$. Capital \$21,950; CRF(7%, 20 yr) = \$2,072/yr.	

II.7. Option: Rio Rancho City Municipal Water

Cost Item	1.5 AF/yr
Monthly base charge (\$13.17/mo × 12)	\$158
Volume charges — tiered residential (mostly at \$7.10/1,000 gal upper tier) <i>Rio Rancho rates reflect City of Rio Rancho Utilities FY2027 rate schedule (effective July 1, 2026; Ordinance Title V, Chapter 51.12). The City approved 3% annual rate increases through 2030.</i>	\$4,677
Water Rights Acquisition Fee (\$0.52/1,000 gal billed)	\$339
TOTAL — Rio Rancho municipal water (1.5 AF/yr)	\$5,174/yr
Notes: City of Rio Rancho Utilities; San Juan–Chama + local groundwater; outside MRGCD; all irrigation metered. Water Rights Acquisition Fee (\$0.52/1,000 gal) on all metered volume. FY2027 rate schedule (Ordinance Title V, Ch. 51.12); 3% annual increases through 2030.	

II.8. Option: Santa Fe City Municipal Water (Conservation Incentive Rates)

Cost Item	1.5 AF/yr
Monthly base charge (\$18.42/mo × 12)	\$221
Volume charges — conservation pricing (\$21.72/1,000 gal above threshold) <i>Note: Rates effective May 29, 2019 (Rate Schedule 1E, Chapter 25 SFCC 1987). The \$21.72 upper tier is an explicit conservation penalty, not cost recovery.</i>	\$13,608
TOTAL — Santa Fe municipal water (1.5 AF/yr)	\$13,829/yr
Notes: City of Santa Fe Public Utilities (Rate Schedule 1E, Ch. 25 SFCC 1987). Strongly tiered: \$6.06/1,000 gal (low) to \$21.72/1,000 gal (upper). At 2.00 AF applied, virtually all volume falls in the upper conservation tier.	

II.9. Option: Agricultural Groundwater Well, Valley Floor (200-Acre Farm)

Cost Item	1.5 AF/yr
Electricity (43.8 kWh/AF × 1.5 AF CU @ \$0.0929/kWh summer, Rate 10A)	\$6
Maintenance share (÷ 200 acres): \$350/yr ÷ 200	\$2
TOTAL — Existing ag well, 1.5-AF reference share	\$8/yr
Notes: For discussion of commercial ag operation, Middle Rio Grande valley, see: Olofinsao et al., (2026). TDH (Eq. 1, Table 1a) = 10 ft static + 10 ft drawdown + 10 ft friction = 30 ft (open furrow/canal discharge, no pressure head); $\eta = 70\% \rightarrow kWh/AF = 30 \times 1.023 \div 0.70 = 43.8 kWh/AF$, consistent with NRCS NEH Part 623. Electricity: $43.8 kWh/AF \times 1.5 AF CU = 65.7 kWh$ at PNM Rate 10A (\$0.0929/kWh summer) = \$6.10 ≈ \$6/yr. Farm-level costs (200-acre basis): maintenance \$350/yr ÷ 200 = \$2/yr.	

Cost Item	1.5 AF/yr
Electricity	\$6
Maintenance share ($\div 200$)	\$2
Capital share ($\div 200$): \$1,888/yr $\div 200$	\$9
TOTAL — New ag well, 1.5-AF reference share (200-acre farm basis)	\$17/yr
Notes: Capital: valley-floor well 150–200 ft, pump, electrical — \$15,000–\$25,000; midpoint \$20,000; CRF(7%, 20 yr) = \$1,888/yr $\div 200$ acres = \$9/yr. Electricity and maintenance same as existing well scenario. Source: PNM Rate 10A (24th Revised, Advice Notice No. 651); FPPCAC Rider 23, Q4 2025. Pumping energy per NRCS standard. Capital cost from WellDrillingCosts.com (2026). The Rate 10A annual customer charge (\$210/yr) applies only to qualifying 3-acre+ operations with 5-HP+ pumps and is not allocated to this 1.5-AF reference case	

II.10. Option: ABCWUA Institutional Rate: Irrigated City Park

Cost Item	1.5 AF/yr
Fixed monthly charge ($12 \times \$131.74$)	\$1,581
Commodity: 817 units $\times \$2.042$	\$1,668
SmartUse surcharge (24 in < 35-in budget)	\$0
TOTAL — Institutional rate, park (1.5 AF/yr)	\$3,249/yr
Notes: ABCWUA Institutional classification (O-20-3); SmartUse water-budget program (35 in/acre for parks, 45 in/acre for athletic fields). At 2.00 AF applied (80% efficiency, ~24 in), usage stays within budget — no SmartUse surcharge.	

II.11. Option: ABCWUA Non-Potable (Reclaimed / Treated Municipal Wastewater)

Cost Item	1.5 AF/yr
Fixed monthly charge ($12 \times \$131.74$; 2-inch Institutional connection) <i>Note: Infrastructure connection may require capital investment not reflected</i>	\$1,581
Non-potable commodity: 817 units $\times \$1.695$	\$1,385
Surcharge (within budget)	\$0
TOTAL — Non-potable rate (1.5 AF/yr)	\$2,966/yr
Savings vs. potable institutional rate	–\$303/yr
Notes: ABCWUA non-potable system (treated municipal wastewater, ~48 MGD from Southside WRP). Mandatory connection within 200 ft of distribution line (O-20-3 §1-1-4(H)). Commodity = 80% of potable rate.	

II.12. Option: ABCWUA Commercial Rate: Private Golf Course

Cost Item	(1.5 AF/yr)
Fixed monthly charge (12 × \$132.06; 2-inch Commercial connection)	\$1,585
Commodity: 796 units × \$2.143	\$1,706
SmartUse surcharge (24 in < 37-in budget)	\$0
TOTAL — Commercial rate, private golf course (1.5 AF/yr, Jan 2024)	\$3,291/yr
Post-July 2024 (after 12% rate increase, estimated) Rates from ABCWUA Ordinance O-24-1 (effective July 2024).	\$3,863/yr
Notes: Assumed that private golf courses billed at ABCWUA Commercial classification; Annual SmartUse water budget (37 in/acre). At 1.829 AF applied (82% efficiency, ~24 in), usage within budget — no surcharge. Post-July 2024 estimate after 12% rate increase: \$3,863/yr.	

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