

APPENDIX E¹

**CONSERVATION OF GROUNDWATER RESOURCES IN THE UNITED STATES
PART OF THE MESILLA BASIN REGION (MBR – FIG. E9-1)**

**John W. Hawley, Ph.D., Visiting Sr. Hydrogeologist,
New Mexico Water Resources Research Institute, NMSU
Emeritus Sr. Environmental Geologist, NM Bureau of Geology & Mineral Resources,
NM Institute of Mining & Technology hgeomatters@gmail.com**

and

**J. Steven Walker, M.S., Program Manager at the Paseo Real Wastewater Reclamation Facility,
City of Santa Fe; and Former GIS Coordinator, NM Water Resources Research Institute
jwalker@santafenm.gov**

¹APPENDIX E *in* Hawley, J.W., Swanson, B.H., Walker, J.S., Glaze, S.H., and Ortega Klett, C.T., 2025, Hydrogeologic Framework of the Mesilla Basin Region of New Mexico, Texas, and Chihuahua (Mexico)—Advances in Conceptual and Digital Model Development: NM Water Resources Research Institute, NMSU, Technical Completion Report No. 363, 359 p., 8 Appendices.

**E1. CHALLENGES FACING WATER-RESOURCES CONSERVATION IN THE
AMERICAN SOUTHWEST** 1

E1.1. Twentieth Century Past..... 1

 E1.1.1. “Rio Grande: ‘Country’” (Harvey Fergusson, 1933, p. 10)..... 1

 E1.1.2. “New Mexico-A pageant of Three Peoples: ‘Water’” (Erna Fergusson, 1973, p. 381)... 1

 E1.1.3. “Lazy B – Growing up on a cattle ranch in the American Southwest” (SCOTUS
 Justice Sandra Day O’Connor [1930-2015], and [brother] H. Allen Day, 2002)..... 1

E1.2. Twenty-first Century and Future..... 2

 E1.2.1. The Tragedy of the Commons (Deming 2002, p. 22, 24) 2

 E1.2.2. The Colorado River Compact at 100: “Groundwater is Plan B for Arizona—Farmers,
 urban users have no idea how much river water use they’ll have to cut” (Tony Davis
 2022, p. A1, A6)..... 2

E2. CONTENT AND ORGANIZATION 3

**E3. REALITIES FACING CONSERVATION OF LIMITED WATER RESOURCES
IN A TWENTY-FIRST CENTURY CONTEXT** 4

E3.1. Realities of Uncertainty and Human Nature 4

E3.2. “The Black Swan – The Impact of the Highly Improbable,” a seminal work by Prof. Nassim
 Nichols Taleb (2010)..... 5

E4. CLIMATE CHANGE AND THE GLOBAL WARMING WILD CARD.....	6
E4.1. Nassim Taleb, 2010, <i>The Black Swan – Postscript Essay: On robustness and fragility</i> , deeper philosophical and empirical reflections	6
E4.2. “The Future for Geoscience in the Context of Emerging Climate Disruption” (<i>Excerpt from the 2019 Geological Society of America Presidential Address by Donald Siegel, 2020, p. 4</i>)	6
E4.3. Past and Future Climates in Western North America and New Mexico.....	7
E4.4. “Climate Change and Aridification of North America” (<i>Excerpt from Johnathan Overpeck and Bradley Udall, PNAS 2020</i>).....	7
E4.5. Climatologist: Dry Areas in Southwest getting drier – Precipitation declines as temperatures rise (Susan M. Bryan, ABQ Journal, September 27, 2020).....	7
E4.6. In 50 years: Hotter, Drier – New Mexico’s changing climate spells uncertainty for water (Theresa Davis, ABQ Journal, Monday, July 23, 2021	8
E4.7. Snowmelt and Upper Rio Grande Watershed Hydrology (Albert Rango, 2006).....	9
E4.8. Climate Change and Upper Rio Grande Watershed Hydrology (Creel, 2010).....	9
E4.9. Where’s the Snow? Rockies Winter Starts with a Whimper (Thomas Peipert and Brittany Peterson-ASSOCIATED PRESS, ABQ Journal, December 4, 2021).....	10
E4.10. Meeting the Challenges of Changing Climatic Conditions with “Resilience”	10
E5. AN ENVIRONMENTAL-GEOLOGIC PERSPECTIVE ON GROUNDWATER-RESOURCE CONSERVATION IN “DRY” REGIONS.....	11
E5.1. The Nebulous Concept of Groundwater-Resource Sustainability (W.M. Alley, T.M. Reilly, and O.L. Franke, 1999, U.S. Geological Survey Circular 1186, p. 3).....	11
E5.2. Arizona Perspectives on Groundwater-Resource Sustainability.....	11
E5.2.1. Robert Glennon (J.D., Morris K. Udall Professor of Law and Public Policy at the University of Arizona): Chapter 15 <i>in Water Follies – Glennon 2002, p. 210-211; cf. E3.2</i>	11
E5.2.2. “Report raises alarms over Arizona’s water supply” (Associated Press—ABQ Journal, Sunday, October 27, 2019 [<i>cf. Part E1.1.3</i>]).....	11
E5.3. Background on Groundwater Mining in Arid and Semiarid Regions.....	12
E5.3.1. Groundwater Mining – A Global Dry-Lands Perspective.....	12
E5.3.2. Groundwater Mining – Southern New Mexico Perspective.....	12
E6. A WATER LAW PERSPECTIVE ON SURFACE-WATER AND GROUNDWATER INTERRELATIONSHIPS.....	13

E7. NEW MEXICO WATER LAW AND WATER-RESOURCE MANAGEMENT	14
E7.1. New Mexico State Constitution.....	14
E7.1.1. Water Rights Transfers (T.G. Bahr, Ph.D., Former NM WRRI Director, 1998, p. 34) .	14
E7.1.2. Artificial Recharge and Prior Appropriation Doctrine (Tessa Davidson, J.D., 1998, p. 53).....	15
E7.2. Excerpts <i>from</i> “100 Years of Water Wars in New Mexico—1912-2012 (Catherine Ortega Klett, ed. 2012)”.....	15
E7.2.1. “Water Wars During Our Territorial Years;” John W. Hernandez (2012, p. 19-20)	15
E7.2.2. “Ready to Fight: Steve Reynolds-Institution-Engineer-Litigator;” John W. Hernandez (2012, p. 52-53).....	15
E7.2.3. Adjudications: Managing Water Wars in New Mexico (Judge Gerald A. Valentine, 2012, p. 30-31).....	16
E7.2.4. Future Water Wars in New Mexico (M. Karl Wood, Ph.D., Former NM WRRI Director, 2012, p. 264-265)	17
E8. BINATIONAL AND INTERSTATE CONVENTIONS AND COMPACTS	17
E8.1. “A Grand River” <i>from</i> “Whose water is it anyway? Anatomy of the water war between El Paso, Texas and New Mexico” (Linda Harris, 2012, p. 229-230)	17
E8.2. Convention between the United States and Mexico on Equitable Distribution of the Waters of the Rio Grande – Proclaimed, January 16, 1907 (United States and Mexico, 1907, Washington, DC; U.S. Government Printing Office, 3 p.)	18
E8.3. Elephant Butte Dam and Reservoir.....	18
E8.4. The Rio Grande Project (Clyde Conover 1954, p. 17).....	19
E8.5. The IBWC Rio Grande Canalization Project (Andrea Glover, IBWC, 2018, p. 63)	19
E8.6. The 1938-39 Rio Grande Compact (Kevin Flannigan 2007, p. 518-519).....	20
E8.7. Water Politics in Southern New Mexico—Gary L. Esslinger (1998, p. 101-102).....	21
E8.8. Management of Shared, Interstate-Water Resources—Progress and Pitfalls after 1980	22
E8.8.1. Feedbacks of irrigator decisions, hydrologic change, and long-term water planning, Mesilla Valley—Beene and others (2020)	23
E8.8.2. Confronting water shortages on the Lower Rio Grande—Gary Esslinger (2021)	23
E8.8.3. Importing water to NM? Challenges are stunning (Bruce Thomson, Ph.D., P.E., 2023)..	24
E9. POTENTIAL FOR LONG-TERM GROUNDWATER-RESOURCE DEVELOPMENT IN THE UNITED STATES PART OF THE MESILLA BASIN REGION	24
E9.1. Background.....	24

E9.2. Sustainable Groundwater-Resource Development in a Mesilla Basin Regional Context.....	25
E9.3. Conjunctive Management of Surface-Water and Groundwater Resources in the MBR.....	29
E10. AQUIFER AND VADOSE-ZONE VULNERABILITY TO CONTAMINATION	31
E10.1. Background	31
E10.2. Potential for Groundwater Pollution in New Mexico: Lee Wilson, Ph.D.; N.M. Geological Society, Special Publication No. 10	32
E10.3. Assessing Groundwater-Contamination Potential with the <i>DRASTIC</i> Model.....	32
E11. CONCLUDING REMARKS.....	33
E12. CITED REFERENCES (Topical-key codes for APNDIX. B entries on p. 45)	35