

## Ken A. Rainwater, Ph.D., P.E., BCEE, D.WRE, CFM

### Address

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### Personal Data

Birth: December 16, 1957 in Fort Stockton, Texas.  
Marital Status: Married - May 22, 1982 to Kathryn Karol Killebrew.  
Two Children - Janice Kay (11/10/88) and Kirk Alan (8/24/92).

### Education

B.S.C.E.	Rice University	1979
M.S.C.E.	The University of Texas at Austin	1982
Ph.D.	The University of Texas at Austin	1985

### Professional Positions

Cost Engineer, Petrochemical Division, Brown and Root, Inc., Houston, Texas, 1979-80.  
Assistant Professor of Civil Engineering, Texas Tech University, Lubbock, Texas, 1985-91.  
Associate Professor of Civil Engineering, Texas Tech University, Lubbock, Texas, 1991-2002.  
Joint Faculty, Department of Geosciences, Texas Tech University, Lubbock, Texas, 1992-.  
Professor, Civil and Environmental Engineering, Texas Tech University, Lubbock, Texas, 2002-.  
Director, Texas Tech University Water Resources Center, 2002-12.

### Professional Societies

American Society of Civil Engineers, Member  
Co-Faculty advisor for Texas Tech J.H. Murdough Student Chapter of ASCE, 1985-2004  
National Committee for Student Services, 1995-99  
Texas Section Student Activities Committee, 1990-2004  
Texas Section Water Resource Technical Session Committee, 1987-88  
Texas Section Continuing Professional Development Committee, chair, 1999-2000  
Vice-President-Educational, Texas Section, 2000-01  
Texas Section Education Committee, 1999-2001, chair 2001  
Texas Section President-elect, 2005-06, President 2006-07, Past President 2007-08  
National Committee on the Academic Prerequisites for Professional Practice, 2008-12  
Region 6 Governor, 2012-  
National Committee for Student Members, 2012-  
American Geophysical Union, Member  
Association of Ground Water Scientists and Engineers, Member  
Associate Editor, Editorial Board for Ground Water, 1996-2001  
Delegate, Universities Council on Water Resources, 1998-  
Board Certified Environmental Engineer (Water/Wastewater), American Academy of Environmental Engineers, 2000-  
Diplomate Water Resources Engineer, American Academy of Water Resources Engineers, 2008-  
Certified Floodplain Manager, 2011-

### Awards

Ex-Students Association New Faculty Award	1987
Halliburton Education Foundation Research Award	1987
Tau Beta Pi Outstanding Professor Award	1988
Abell Faculty Teaching Award, College of Engineering	1989, 2001
President's Excellence in Teaching Award	1990
Zone III Faculty Advisor of the Year, American Society of Civil Engineers	1996, 1998

Texas Tech University Teaching Academy	1996-
Who's Who Among America's Teachers	1998
Department of Civil Engineering Teacher of the Year	2000
Service to Students Award, Texas Section, American Society of Civil Engineers	2001
Faculty Advisor Reward, American Society of Civil Engineers	2001, 2002
Department of Civil Engineering Researcher of the Year	2005
TechSpy Educator Award	2009
Whitacre College of Engineering Researcher of the Year (Barnie Rushing nominee)	2010

**Professional Registration**

Registered Professional Engineer, State of Texas No. 65348

**Courses Taught** (\* responsible for course development, \*\* shared course development)

Undergraduate	CE 1305	Engineering Analysis I	
	CE/ENVE 3301	Water Quality Engineering I *	
	CE 3305	Fluid Mechanics	
	CE/ENVE 3309	Environmental Engineering I	
	CE 3354	Engineering Hydrology	
	CE 3371	Environmental Engineering I	
	CE 3372	Water Systems Design	
	CE 4330	Design of Engineering Systems (w/Claborn, Lawson, or Vann)	
	CE 4333	Special Topics in Water Resources (Public Works in Brazil, w/Correa) **	
	CE 4353	Design of Hydraulic Systems *	
	CE 4363	Groundwater Hydrology *	
	Graduate	CE 5353	Water Resources I
		CE 5360	Open Channel Hydraulics (combined with CE 4353) *
		CE 5361	Advanced Surface Water Hydrology
CE 5362		Surface Water Modeling	
CE 5363		Groundwater Hydrology (combined with CE 4363) *	
CE 5364		Groundwater Transport Phenomena *	
CE 5366		Water Resources Management	
CE 5398		Risk Assessment and Public Policy (w/Urban, Mollhagen) **	
ENVE 5305/5306		Environmental Systems Design I&II (w/Ramsey) **	
CE 5101		Graduate Seminar	
CE 5331	Groundwater Hydrology (off-campus course for Chevron) *		
CE 5331	Hazardous Waste Management (w/Ramsey, Cosentino) **		

**Other Teaching Related Activities**

- Organized review session program for the Fundamentals of Engineering Exam for all College of Engineering students each semester, 1986-88.
- Taught fluid mechanics review session for Fundamentals of Engineering exam review, 1986-.
- Automated the departmental course evaluation process with Dr. Jim McDonald.
- Teamed with Drs. Heyward Ramsey and Tony Mollhagen in National Science Foundation grants for analytical and instructional equipment for the Environmental Sciences Laboratory.
- Attended a short course in 1991 in "New Techniques in Water Resources Sciences" sponsored by the U.S. Geological Survey and the National Science Foundation.
- Attended a short course in 1991 at the University of Texas-Austin on "Water Quality Modeling."
- Taught one of the first graduate courses to be videotaped for off-campus distribution by the College in 1992, CE 4355/5356 Groundwater Hydrology.
- Taught two intersession courses (Water and Wastewater Treatment/Air Pollution and Hazardous Waste Management) in May, 1994, at the Fachhochschule Wilhelmshaven in Wilhelmshaven, Germany, as part of an ongoing exchange program.
- Hosted two faculty members from the Van Hall Instituut in Fall, 1995, as they taught a short course in Risk Assessment Modeling for nine students.

- Served as the local advisor in 1995-96 for Marieke Wiersma and Thale Hadderingh, two seniors from the Van Hall Instituut, as they worked on their senior thesis project.
- Directed a special studies course in Summer, 1996, in which our graduate students participated in field investigation of subsurface contamination at a natural gas compressor station under an agreement with a regional energy company.
- Invited by Provost Burns in Fall, 1996 to join the new Texas Tech University Teaching Academy.
- Hosted exchange student Kerstin Koglin in 1998-99 for the Van Hall Instituut for senior project.
- Research Associate, Texas Tech Center for the Study of Regional Economic and Industrial Development.
- Hosted exchange student Yousif Aleskerov in 2000, for the University of Alaska-Fairbanks and the Soros International Scholars Program as he worked on his master's thesis project.
- Worked with Dr. Ramsey on the development and accreditation of the 5-year MEnvE program.
- Teaching Academy's Departmental Teaching Award Committee, 1999-2002, chair 2000-2.
- Led department ABET BSCE self-study, 2005, 2011.
- Co-led study abroad program on Public Works in Brazil with Drs. Correa, Hernandez, and Lawson, Summer 2009.
- Teaching Academy Selection Committee, 2009-.

### **Graduate Student Advising**

#### Major Professor, Doctoral Students

1. Mohammad R. Zaman (1993), Subsurface Remediation by Vacuum Extraction for Volatile Organic Chemicals: A Finite Element Model
2. David Harkins (1998), The Future of the Texas High Plains Aquifer System: Modeling and Projections
3. Amit Armstrong (1998), A Two-Dimensional Numerical Model for Soil Vapor Extraction
4. Jeff Stovall (2001), Groundwater Modeling for the Southern High Plains
5. Matt Jones (2007), Modelling Paleoclimate and Groundwater Elevation Changes on the Southern High Plains
6. Kartik Venkataraman (2010), Occurrence, Distribution, and Speciation of Arsenic in the Southern High Plains Aquifer System
7. Ange Abena Mbarga (pending)

#### Major Professor, Master of Science Students, Thesis Option

1. Teh-fang Lee (1987), A Mathematical Model for Estimation of Vertical Air Permeability in the Unsaturated Zone
2. Yu-Chi Chen (1987), Economic Potential for Development of Increasing Storage Beneath a High Plains Municipality
3. Mohammad Zaman (1989), Experimental and Theoretical Study of Volatilization for Hydrocarbon Removal in Unsaturated Porous Media
4. Jeff Wilkerson (1990), Forced Air Volatilization of Hydrocarbons in Porous Media
5. Mary Mayfield (1990), Increasing In Situ Bioremediation of Diesel Fuel by Cyclic Vertical Water Table Movement
6. Joe Ellison (1990), Evaluation of Carbon Dioxide Scale Control Techniques for Very Hard Waters
7. Gary Thomas (1990), Removal Of Calcium Carbonate Scaling by Carbon Dioxide Injection
8. Veen Chee Foong (1990), Numerical Simulation of the Hydraulic Parameters of an Alluvial Aquifer Using a 3-D Finite Element Computer Model
9. Sridhar Varadaraj (1991), Enhanced In Situ Bioremediation of Diesel Fuel Contamination of Groundwater: A Laboratory Investigation
10. Roy Chelagiri (1991), Study of Pulsed and Continuous Volatilization of Hydrocarbons from Unsaturated Porous Media
11. Charles Mehta (1993), Laboratory Study of In Situ Bioremediation of Petroleum Hydrocarbons
12. Steven Dean (1993), Estimation of Potential Evaporation Rates at the Double Lakes Basin, Tahoka, TX
13. Scott Wagaman (1993) Full-Scale Flow Visualization Over a Low-Rise Building
14. Collen Brownlow (1994), Trophic State Assessment of an Urban Playa, Lubbock, Texas
15. Scot Laun (1995), Chromium Contaminant Mobility in the Subsurface Soils at the Pantex Plant
16. Troy Dorman (1996), The Texas High Plains Aquifer System: Modeling and Predictions for the Southern Region
17. Dennis Givens (1997), Sorption of Chromium and High Explosives on Subsurface Soils from the Pantex Plant
18. Walter Medlock (1998), Laboratory Studies Indicating the Potential for Bioremediation of High Explosives in Soil at the Pantex Plant
19. Justin Brown (1999), In Situ Degradation of High Explosives
20. Jeff Stovall (1999), Sub-Regional Groundwater Modeling of the High Plains Aquifer of Texas
21. Matt Jones (2000), Evaluation of the Potential for Enzymatic Degradation of Defense Program Laboratory Waste
22. Sara Black (2002), Perched Aquifer Tracer Test, Pantex Plant, Amarillo, Texas

23. Nilesh Waghdhare (2003), Simulation of Septic System Disposal Unit
24. Ajay Ramachandran (2004), Evaluation of Groundwater Quality in Castro, Dawson and Terry Counties
25. Heather Keister (2004), Evaluation of the Texas Department of Transportation Design Procedure for Complex Drainage Networks
26. Bindu Kota (2004), Enzymatic Degradation of Cotton Used for Spill Absorption
27. Sanjaya Joshi (2005), Comparison of Groundwater Rights in the United States: Lessons for Texas
28. Rahish Khatri (2008), Preliminary Study on Effects of the Conservation Reserve Program (CRP) on Groundwater Resources in the Texas High Plains
29. Geetha Ganesan (2010), Estimating Recharge Through Playa Lakes to the Southern High Plains Aquifer
30. Joel Thai (2010), Water Yield Monitoring of Brush Management in Texas
31. Jeremy Kight (2011), Mechanics of Fluids Teach Laboratory Standard Operating Procedures
32. Robert Pavur (2012), Simulation of Unsaturated Flow and Heat Transport within Playa Soils

#### Major Professor, Master of Science Students, Report Option

1. Brian Moore (1989), Dewatering the Lubbock Lake Landmark: A Design Example
2. Ken Cody (did not complete report)
3. Chennakrishna R. Gunda (1992) Evaluation of Groundwater Storage Beneath Lubbock, Texas
4. Shane E. Nance (1992), Remediation of Soil Contamination at a Leaking Petroleum Storage Tank Site in Gomez, Texas
5. Subbarami Varidireddy (1993), A Critical Review on Depression Storage Description in Rainfall-Runoff Modeling
6. Mohammad Rahman (1993), Recent Developments of In Situ Bioremediation of Contaminated Soil and Groundwater: A Literature Review
7. Praveen Udtha (1993), Comparison of Remedial Technologies and Associated Costs for a Typical Gasoline-Contaminated Site in Lubbock, Texas
8. Abidur Khan (1993), The Scientific Background for the Development of Drinking Water Regulations for Radon-222
9. Rajesh Naidu (1993), Application of an Analytical Model for Prediction of Chloride Changes in Lake Meredith
10. Lakshmi Reddy (1993), Monitoring Groundwater Table Soil Moisture and Temperature in Area 13B, Lubbock Lake Site, Lubbock, Texas
11. F.M. Hasan (1993), Feasibility Study of Scale Removal for Recovery of Flow Capacity in the Central System Pipeline
12. Devin Smith (1994), Computer Simulation of Groundwater Flow at Double Lakes Basin, Tahoka, Texas
13. Prabir Maulik (1994), In Situ Air Sparging: Groundwater Remediation Technology of the Future
14. Amit Armstrong (1994), A Review of Mathematical Modeling of Soil Vapor Extraction Process
15. Paritosh Pathak (1994), Numerical Modeling of Groundwater Contamination at a Leaking Underground Storage Tank Site
16. Sreenivasa Patnam (1994), A Study of the Installation Procedure and the Methods of Leak Detection for Underground Storage Tanks
17. James Greer (1995), Comparison of Infiltration and Evaporation Volumes for the Five Pantex Playa Lakes
18. John S. Cox (1996), The Transport of Conservative and Reactive Solutes through a Physical Model of a Confined Aquifer
19. Jennifer L. Elms (1998), The Superfund Hazard Ranking System: A Discussion and Case Study
20. Carlton Hendrix (1998), Application of Groundwater Vistas for Industrial Water Supply
21. Dinesh Anbumani (2003), Analyzing Drainfield Requirements Across Texas in Comparison with Lubbock
22. Kavitha Pulugundla (2003), Estimating Groundwater Recharge in the Southern High Plains of Texas
23. Srinivasa Anandam (2004), Modeling of Unsaturated Zone Transport of Perchlorate
24. Ashok Bathulla (2004), Sorption of Selected Metals on Pantex Soils
25. Rajmani Subedi (2006), Investigation of Groundwater Levels in Dawson County
26. Shanker Man Shrestha (2007), Approximate Hydrologic Budgets of Four Playa Lakes in the Southern High Plains
27. Ryan Marshall (2008), Pilot Testing of a Small-Scale Integrated Wind-Water System
28. Chase Bentley (2008), Breach Analysis for Stamford Dam
29. Yeon-Tae Jeong (2012), Perchlorate Transport in the Unsaturated Zone
28. Levi Hein (pending)
30. Nicholas Hall (2013), Estimating Infiltration Through Playa Lakes in Texas for Different Land Uses

#### Committee Member, Doctoral Students

1. Neelakandan Sathiyakumar (1987)
2. Duane Rosa (Agricultural Economics, 1988)
3. Kate Trauth (1989)
4. Teh-fang Lee (1990)

5. Robert W. Brashear (1991)
6. Yu-Chi Chen (1991)
7. James R. Bartolino (Geosciences, 1991)
8. M. Asri (1995)
9. K.G.K. Jayakody (1998)
10. Victoria Harkins (1998)
11. Audra Morse (2003)
12. Eric Albers (EnvTox, 2004)
13. Marla Potess (Land Use, Planning & Mgmt, 2011)
14. Kui Tan (2003)
15. Srinath Rajagopalan (2005)
16. Eric Vasbinder (Ch E, 2004)
17. Spandana Tummuri (2008)
18. Annesly Nessthinge (Plant and Soil Science, 2008)
19. William Asquith (2011)
20. Cui Liu (2012)
21. Wade Barnes (pending)
22. Bryan Schuetze (pending)

Committee Member, Master of Science Students, Thesis (t) or Report (r)

1. Rushi Tasker (t, Biological Sciences, 1988)
2. J. Scott Taylor (t, 1988)
3. B.P. Acharya (t, 1988)
4. Kah Leong (t, 1988)
5. Kerry Howard (t, Geosciences, 1987)
6. Klim Maling (t, Independent Studies, 1988)
7. Yue-ying Deng (t, Agricultural Engineering, 1988)
8. Ron Smith (t, Chemical Engineering, 1988)
9. Vilka Scott (Biological Sciences, did not complete thesis)
10. Kimberlie A. West (r, 1994)
11. Don White (r, 1991)
12. Steven K. Ayres (t, 1991)
13. Ray Brady (r, 1991)
14. Charles R. Hughes (t, Geosciences, 1993)
15. Ai-zhen Huang (t, 1992)
16. Shahid Bhuiyan (r, 1992)
17. Vijay Kurki (r, 1992)
18. Nagi Patibandla (r, 1992)
19. Jeevan Shankar (r, 1992)
21. M. Sancharwala (r, 1993)
22. K. Dwaraganahalli (r, 1993)
20. Venkata Karanam (r, 1992)
23. David Durham (r, 1993)
24. David Dickerson (r, 1994)
25. Darren Harmel (t, Soil Sciences, 1994)
26. J. Alan Reed (t, 1994)
27. Derald Mabbitt (t, Geosciences, 1994)
28. Craig Bunting (t, Geosciences, 1994)
29. S.R. Kondisetty (t, 1994)
30. David Reinhart (r, 1995)
31. David Harkins (r, 1995)
32. Victoria Harkins (t, 1995)
33. Akm Huda (t, 1996)
34. Ken Mars (t, Geosciences, 1996)
35. Shaheed Sajjad (t, 1998)

36. Todd Musick (t, 2005)
37. Luke Swift (t, 2003)
38. Margaret Medellin (r, 1999)
39. Lisset Verde (r, ETM, 2000)
40. Wesley Ingram (t, 2000)
41. Amandeep Kang (t, 2000)
42. Erin Atkinson (t, 2001)
43. Paul Winn (r, 2002 candidate)
44. Mi-Ae Jeon (t, 2001)
45. Chang Yong Lee (r, 2002)
46. Shiva Sandrana (t, 2002)
47. Rawaa Al-Saadi (t, 2002)
48. David McClendon (t, 2002)
49. Anjali Bhangay (t, in progress)
50. Tony Rector (t, 2002)
51. Laxman Patil (t, 2005)
52. Cindy Jones (t, 2006)
53. Jared Lujan (t, 2008)
54. Amit Karki (t, 2007)
55. Phani Ponnada (t, 2011)
56. Chris van Nice (interdisciplinary studies, t, 2012)
57. Vamshi Thummuri (r, 2012)

### **Refereed Publications**

1. Rainwater, K.A. and Holley, E.R., 1984, "Laboratory Studies on Hydrocarbon Tracer Gases," Journal of the Environmental Engineering Division, ASCE, Vol. 110, No. 1, pp. 27-41.
2. Rainwater, K.A., Wise, W.R., and Charbeneau, R.J., 1987, "Parameter Estimation Through Groundwater Tracer Tests," Water Resources Research, Vol. 23, No. 10, pp. 1901-1910.
3. Rainwater, K.A., 1988, "Cation Exchange in Groundwater Solute Transport," Journal of the Hydraulics Division, ASCE, Vol. 114, No. 2, pp. 173-191.
4. Fedler, C.B., Rainwater, K.A., Yueying, D., Dvoracek, M.J. and Ramsey, R.H., 1989, "Field Study of Tracer Movement in a Shallow Alluvial Aquifer," Transactions of the ASAE, Vol. 32, No. 3, pp. 857-864.
5. Rainwater, K.A., Zaman, M.R., Claborn, B.J., and Parker, H.W., 1990, "Experimental and Modeling Study of Soil Venting," Proceedings of the 1990 National Conference on Environmental Engineering, ASCE, Arlington, VA, pp. 479-486.
6. Claborn, B.J. and Rainwater, K.A., 1991, "Well-Field Management for Energy Efficiency," Journal of the Hydraulics Division, ASCE, Vol. 117, No. 10, pp. 1290-1303.
7. Mohamed, F.A., Allen, E., and Rainwater, K.A., 1993, "Well Response Tests: III. The Inverse Problem," Inverse Problems, Institute of Physics, Vol. 9, pp. 483-493.
8. Rainwater, K.A., Mayfield, M.P., Heintz, C.E., and Claborn, B.J., 1993, "Enhanced In Situ Biodegradation of Diesel Fuel by Cyclic Vertical Water Table Movement," Journal of the Water Environmental Federation, WEF, Vol. 65, No. 6, pp. 717-725.
9. Armstrong, A., Rainwater, K.A., Vallabhan, C.V.G., and Parker, H.W., 1995, "A Finite Difference Approach for Mathematical Simulation of Soil Vapor Extraction from Unsaturated Zone," Proceedings of the International Symposium on Groundwater Management, ASCE, R.J. Charbeneau, ed., pp. 30-34.

10. Jayawickrama, P.W., Jayakody, K.G.K., and Rainwater, K.A., 1996, "System Identification Methodology for the Characterization of Contaminated Sites," Proceedings of the ASCE Specialty Conference on Uncertainty in the Geologic Environment: From Theory to Practice, C.D. Shackelford, P.P. Nelson, and M.J.S. Roth, eds., Vol. 2, pp. 897-911.
11. Kondisetty, S.R., Jayawickrama, P.W., and Rainwater, K.A., 1996, "Source Characterization at Contaminated Sites: An Inverse Optimization Approach," Proceedings of the ASCE Specialty Conference on Uncertainty in the Geologic Environment: From Theory to Practice, C.D. Shackelford, P.P. Nelson, and M.J.S. Roth, eds., Vol. 2, pp. 927-943.
12. Wood, W.W., Rainwater, K.A., and Thompson, D.B., 1997, "Quantifying Macropore Recharge: Examples from a Semi-Arid Area," Ground Water, NGWA, Vol. 35, No. 6, pp. 1097-1106.
13. Rainwater, K.A. and Ramsey, R.H., 1997, "The New Texas Tech Approach to Environmental Engineering Education: A Five-Year Master of Environmental Engineering Program," Proceedings of the Joint Symposium on Water Resources Education, Training, and Practice: Opportunities for the Next Century, J.J. Warwick, ed., AWRA/UCOWR, pp. 787-796.
14. Jayakody, K.G.K., Jayawickrama, P.W., and Rainwater, K.A., 1998, "Use of SID Technique to Determine Heterogeneity of Contaminated Sites," Proceedings of the First International Conference on Site Characterization, ASCE, pp. 171-176.
15. Harkins, D., Stovall, J., Rainwater, K., Frailey, S., and Urban, L., 1998, "Modeling the Ogallala Aquifer in the Texas High Plains," Proceedings of the UCOWR Cross Currents in Water Policy, pp. 43-50.
16. Rainwater, K.A., Ramsey, R.H., and Thompson, D.B., 1999, "A Five-Year Master of Environmental Engineering Program," Journal of Professional Issues in Engineering, ASCE, Vol. 125, No.2, pp. 40-46.
17. Harkins, V.R., Mollhagen, T.R., Heintz, C.E., and Rainwater, K.A., 1999, "Aerobic Biodegradation of High Explosives -- Phase I, HMX," Bioremediation Journal, Vol. 3, No. 4, pp. 285-290.
18. Wagaman, S.A., Rainwater, K.A., Mehta, K.C., and Ramsey, R.H., 2002, "Full-Scale Flow Visualization Over a Low-Rise Building," Journal of Wind Engineering and Industrial Aerodynamics, Vol. 90, No. 1, pp. 1-8.
19. Rainwater, K.A., Heintz, C.E., Mollhagen, T.R., Radtke, C., and Hansen, L, 2001. "Field Demonstration of In Situ Biodegradation of HE in Soils," Proceedings of the Sixth International Symposium on In Situ and On-Site Bioremediation, Battelle Press, Vol. 3, pp. 9-16.
20. Stovall, J.N. and Rainwater, K.A., 2002. "Evaluating Recharge and Irrigation Flow for the South Plains," Proceedings of the Ground Water/Surface Water Interactions Specialty Conference, AWRA, pp. 291-296.
21. Rainwater, K.A., Heintz, C.E., Mollhagen, T.R., and Hansen, L., 2003. "In Situ Biodegradation of HE in Soils: Field Demonstration," Bioremediation Journal, Vol. 6, No. 4, pp. 351-371.
22. Rector, T., Jackson, W.A., Rainwater, K.A., and Pickering, K., 2003. "Determination of the Fate and Behavior of a Commercial Surfactant in a Water Recycle System (WRS)," SAE Paper Number 2003-01-2558, 33<sup>rd</sup> International Conference on Environmental Systems (ICES).
23. Morse, A.N., Jackson, W.A., and Rainwater, K.A., 2003. "Nitrification Using a Membrane-Aerated Biological Reactor," SAE Paper Number 2003-01-2559, 33<sup>rd</sup> International Conference on Environmental Systems (ICES).
24. Muirhead, D.L., Rector, T., Jackson, W.A., Keister, H.R., Morse, A.N., Rainwater, K.A., and Pickering, K., 2003. "Performance of a Small Scale Biological Water Recovery System. SAE Paper Number 2003-01-2557, 33<sup>rd</sup> International Conference on Environmental Systems (ICES).
25. Williams, D.L., Timmons, J.C., Woodyard, J.D., Rainwater, K.A., Lightfoot, J.M., Richardson, B.R., Burgess, C.E., and Heh, J.L., 2004. "UV-Induced Degradation Rates of 1,3,5 Triamino 2,4,6 Trinitrobenzene (TATB)," Journal of Physical Chemistry, American Chemical Society, Vol. 107, no. 44, pp. 9491-9494.

26. Jackson, W.A., Arunagiri, S., Tock, R.W., Anderson, T., and Rainwater, K.A., 2004, "Electrochemical Generation of Perchlorate in Municipal Drinking Water Systems," Journal of the American Water Works Association, Vol. 96, no. 7, pp. 103-108.
27. Rainwater, K.A., Stovall, J.N., Frailey, S.M., and Urban, L.V., 2005, "Transboundary Impacts on Regional Groundwater Modeling in Texas," Ground Water, NGWA, Vol. 43, no. 5, pp. 706-716.
28. Jackson, W.A., Anandam, S., Anderson, T., Lehman, T.M., Rainwater, K.A., Rajagopalan, S., Ridley, M., and Tock, W.R., 2005. "Occurrence of Perchlorate in the Texas Southern High Plains Aquifer System," Ground Water Monitoring and Remediation, NGWA, Vol. 25, no. 1, pp. 137-149.
29. Rainwater, K.A., Jackson, W.A., Ingram, W., Lee, C.Y., Thompson, D.B., Mollhagen, T.R., Ramsey, R.H., and Urban, L.V., 2005. "Field Demonstration of the Combined Effects of Absorption and Evapotranspiration on Septic System Drainfield Capacity," Water Environment Research, Vol. 77, no. 2, pp. 150-161.
30. Muirhead, D.L., Potess, M., and Rainwater, K.A., 2005. "Education Outreach Associated with Technology Transfer in a Colonia of South Texas: Green Valley Farms Science and Space Club for Middle School-aged Children in Green Valley Farms, San Benito, Texas," Paper No. 2004-01-2419, SAE 2004 Transactions, Journal of Aerospace, SAE International, pp. 930-936.
31. Rajagopalan, S., Anderson, T.A., Fahlquist, L., Rainwater, K.A., Ridley, M., and Jackson, W.A., 2006, "Widespread Presence of Naturally Occurring Perchlorate in High Plains of Texas and New Mexico," Environmental Science and Technology, Vol. 40, no. 10, pp. 3156-3162. [Response to Comment, Vol. 40, no. 22, p. 7102.]
32. Rao, B., Anderson, T.A., Orris, G.J., Rainwater, K.A., Rajagopalan, S., Sandvig, R.M., Scanlon, B.R., Stonestrom, D.A., Walvoord, M.A., and Jackson, W.A., 2007. "Widespread Natural Perchlorate in Unsaturated Zones of Dry Regions," Environmental Science and Technology, Vol. 41, no. 33, pp. 4487-4832.
33. Das, B.R., Willis, D.B., and Rainwater, K.A., 2013. "Regional Water Policy Modeling: An Interdisciplinary Approach," accepted by Journal of Regional Science, Policy and Practice, Blackwell Publishing, in press.
34. Liu, C., Rainwater, K., and Song, L. 2011. "Energy Analysis and Efficiency Assessment in Reverse Osmosis Desalination Process," Desalination, Vol. 276, pp. 352-358.
35. Liu C, Rainwater, K., and Song, L. 2012. "Calculation of Energy Consumption for Crossflow RO Desalination Processes," Desalination and Water Treatment, in press.
36. Ganesan, G., Rainwater, K., Gitz, D., Zartman, R. Hudnall, W., Smith, L., in revision. "Estimating Seepage through Playa Wetlands to the Southern High Plains Aquifer," submitted to Wetlands.
37. Villareal, C., Zartman, R., Hudnall, W., Gitz, D., Rainwater, K., and Smith, L., 2012. "Spatial Distribution and Morphology of Sediments in Texas Southern High Plains Wetlands," Texas Water Journal, Vol. 3, No. 1, pp. 1-13.
38. Schuetze, B., Rainwater, K., Song, L. "Closed Concentrate Circulation for High Recovery and Energy Efficiency in Small-Scale Reverse Osmosis System," submitted to Journal of Environmental Engineering.
39. Liu, C., Morse, A., Rainwater, K., Song, L., "Modeling of Concentration Polarization in a Reverse Osmosis Channel with Parabolic Crossflow," submitted to Water Environment Research.
40. Rainwater, K., Nash, P., Song, L., and Schroeder, J., "The Seminole Project: Renewable Energy for Municipal Water Desalination," submitted the Journal of Contemporary Water Research and Education.

**Peer-Reviewed Book (National Academy of Sciences Report)**

1. Committee for the Technical Assessment of Environmental Programs at the Los Alamos National Laboratory, 2007. Plans and Practices for Groundwater Protection at the Los Alamos National Laboratory, National Research Council, The National

Academies Press, Washington, D.C., 80 p. (ISBN 978-0-309-10619-1, Book, Rainwater was one of eleven committee members as co-authors with J.R. Wiley of NAS, and the report/book was peer-reviewed as preparation for its application by LANL)

### **Book Chapters**

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19. Scott, V., Heintz, C.E., Rainwater, K.A., Varadaraj, S., and Mehta, C.R., 1991, "Vertical Water Table Movement: Effects on Enhanced In Situ Bioremediation of Diesel Fuel," presented at the Southwestern Area Regional Meeting of the American Society for the Advancement of Science, Lubbock, Texas, April.
20. Parker, H.W., Rainwater, K.A., and Sharma, B.G., 1991, "In Situ Oxidation of Petroleum Contaminants in Soils and Aquifers," presented at the I&EC Special Symposium, Atlanta, Georgia, October 1-3.
21. Rainwater, K.A., Chelagiri, R.M., Cody, K., Claborn, B.J., and Parker, H.W., 1992, "Comparisons of Pulsed and Continuous Air Flow for Removal of VOCs by Soil-Venting," presented at the Subsurface Restoration Conference - Third International Conference on Water Quality Research, Dallas, Texas, June 21-24.
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25. Rainwater, K.A. and Thompson, D.B., 1994, "Playa Lake Influence on Ground-Water Mounding in Lubbock, Texas," presented at the Playa Basin Symposium, Texas Tech University Water Resources Center, Lubbock, Texas, May 25-27.
26. Ramsey, R. H., Rainwater, K.A., and Mollhagen, T.R., 1994. "Estimation of Wastewater Flows and Contaminant Levels from the Pantex Facility," presented at the Sixth Annual Symposium on Emerging Technologies in Hazardous Waste Management, American Chemical Society, I&EC Division, Atlanta, Georgia, September 19-21.
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28. Jayawickrama, P.W., Jayakody, K.G.K., and Rainwater, K.A., 1996, "System Identification Methodology for the Characterization of Contaminated Sites," presented at the ASCE Specialty Conference on Uncertainty in the Geologic Environment: From Theory to Practice, Madison, Wisconsin, July 31-August 1.
29. Kondisetty, S.R., Jayawickrama, P.W., and Rainwater, K.A., 1996, "Source Characterization at Contaminated Sites: An Inverse Optimization Approach," presented at the ASCE Specialty Conference on Uncertainty in the Geologic Environment: From Theory to Practice, Madison, Wisconsin, July 31-August 1.
30. Rainwater, K.A., 1996, "Contaminant Fate and Transport, or We Never Lost That Stuff and You Can't Prove That We Did!", presented at the Southwest Ground Water Symposium, Water Environment Association of Texas, Lubbock, Texas, June 21. (Invited)
31. Dorman, T.M., Rainwater, K.A., and Frailey, S.M., 1996, "The High Plains Aquifer System: Modeling and Projections for the Southern Region," poster presented at the Annual Meeting of the Geological Society of American, Denver, Colorado, October 28-31.

32. Wood, W.W., Rainwater, K.A., and Thompson, D.B., 1996, "Quantifying Macropore Recharge: An Example from the Southern High Plains of Texas and New Mexico," presented at the Annual Meeting of the Geological Society of American, Denver, Colorado, October 28-31.
33. Thompson, D.B. and Rainwater, K.A., 1996, "Recharge to the Ogallala Through Playa Lake Bed Sediments," presented at the Annual Meeting of the Geological Society of American, Denver, Colorado, October 28-31.
34. Rainwater, K.A. And Ramsey, R.H., 1997, "The New Texas Tech Approach to Environmental Engineering Education: A Five-Year Master of Environmental Engineering Program," presented at the Joint Symposium on Water Resources Education, Training, and Practice, American Water Resources Association and Universities Council on Water Resources, Denver, Colorado, June 29-July 3.
35. Harkins, V.R., Mollhagen, T.R., Heintz, C.E., and Rainwater, K.R., 1998, "Aerobic Degradation of HMX," presented at the First International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Battelle Memorial Institute, Monterey, California, May 18-21.
36. Heintz, C.E., Rainwater, K.A., and Barnes, D., 1998, "Enzymatic Degradation of Pu/U 'Suspect Contaminated' Waste," presented at the 1998 Researchers' Conference, Amarillo National Resource Center for Plutonium, Amarillo, Texas.
37. Rainwater, K.A., Heintz, C.E., and Mollhagen, T.R., 1998, "Feasibility of In Situ Remediation of Residual High Explosives in the Vadose Zone Beneath the Pantex Plant: Laboratory and Field Studies," presented at the 1998 Researchers' Conference, Amarillo National Resource Center for Plutonium, Amarillo, Texas.
38. Heintz, C.E., Rainwater, K.A., Swift, L.M., Jones, M.W., Barnes, D.L., and Worl, L., 1999. "Enzymatic Degradation of Plutonium-Contaminated Cellulose Products," Poster presentation at the 23rd Annual Actinide Conference, Kennewick, WA, June 7-10.
39. Heintz, C.E., Rainwater, K.A., Swift, L.M., Barnes, D.L., and Worl, L., 1999. "Enzymatic Degradation of Plutonium-Contaminated Cellulose Products," Poster presentation at the Waste Management 99 Conference, Tucson, AZ, February 28-March 4.
40. Heintz, C.E., Rainwater, K.A., Swift, L.M., Barnes, D.L., and Worl, L., 1999. "Enzymatic Degradation of Plutonium and Uranium Contaminated Cellulose Products," Poster presentation at the Ninth Annual Conference on the Environment, Waste Management Education & Research Consortium, Albuquerque, NM, April 26-29.
41. Burgess, C.E., Woodyard, J.D. , Rainwater, K.A., Lightfoot, J.M., and Richardson, B.R., 1998, "Mechanisms of Formation of Trace Decomposition Products in Complex High Explosive Mixtures," 1998 Researchers' Conference, Amarillo National Resource Center for Plutonium, Amarillo, Texas.
42. Harkins, D., Stovall, J., Rainwater, K., Frailey, S., and Urban, L., 1998, "Modelling the Ogallala Aquifer in the Texas High Plains," presented at UCOWR '98 Cross Currents in Water Policy, UCOWR, Hood River, Oregon, August 4-7.
43. Harkins, D., Stovall, J., Rainwater, K., Frailey, S., and Urban, L., 1998, "Modelling the Ogallala Aquifer in the Texas High Plains," presented at the Spring Meeting of the Texas Section of ASCE, South Padre Island, Texas, April 17.
44. Woodyard, J.D., Burgess, C.E., Rainwater, K.A., Schweikert, E., Van Stipdonk, M., Lightfoot, M., and Malcolm, S., 1999, "A Preliminary Study Using Mass Spectrometry to Investigate Weapons-Related Organic Material Degradation," 47<sup>th</sup> ASMS Conference on Mass Spectrometry and Allied Topics.
45. Heintz, C.E., Rainwater, K.A., Swift, L.M., Jones, M.W., and Barnes, D.L., 1999, "Degradation of Plutonium-Contaminated Cellulose Waste, 1999 Researcher's Conference, Amarillo National Resource Center for Plutonium, Amarillo, Texas.
46. Rainwater, K.A., Heintz, C.E., Mollhagen, T.R., and Brown, J.H., 1999, "Field Demonstration of In Situ Degradation of High Explosives," 1999 Researcher's Conference, Amarillo National Resource Center for Plutonium, Amarillo, Texas.

47. Woodyard, J.D., Burgess, C.E., Heh, J.L., McWilliams, J.R., Richardson, B.R., Lightfoot, J.M., Malcolm, S., Rainwater, K.A., Van Stipdonk, M.J., and Schwiekert, E.A., 1999, "Potential Degradation of 1,3,5-triamino-2,4,6-trinitrobenzene and Irganox 1010 as Monitored by EPR, Solid-State Mass Spectroscopy, Solid-State <sup>13</sup>C NMR, and Infrared and Ultraviolet Spectroscopy," 1999 Researcher's Conference, Amarillo National Resource Center for Plutonium, Amarillo, Texas.
48. Rainwater, K.A. and Urban, L.V., 2000, "Zooming In on a Power Plant Well Field for Operational Scheduling," Spring Meeting of the Texas Section of ASCE, Austin, Texas, April 5-8.
49. Rainwater, K.A., 2000, "Results of the Faculty Advisor Survey by Committee for Student Activities," Spring Meeting of the Texas Section of ASCE, Austin, Texas, April 5-8.
50. Rainwater, K.A., Stovall, J.N., Frailey, S., and Urban, L.V., 2000, "Impact of Political Boundaries on Groundwater Modeling for the Llano Estacado Region," AGSWE Annual Meeting and Conference, Las Vegas, Nevada, December 13-14.
51. Rainwater, K.A., Heintz, C.E., Mollhagen, T.R., Radtke, C., and Hansen, L., 2001. "Field Demonstration of In Situ Biodegradation of HE in Soils," Sixth International Symposium on In Situ and On-Site Bioremediation, San Diego, California, June 4-7.
52. Radtke, C.W., Rainwater, K.A., and Roberto, F.F., 2001. "In Situ Bioremediation of Explosives in the Vadose Zone," Fourth Tri-Service Environmental Technology Symposium, San Diego, California, June.
53. Rainwater, K.A., Stovall, J.N., Frailey, S., and Urban, L.V., 2002. "Impact of Political, Scientific, and Non-Technical Issues on Regional Groundwater Modeling in Texas," Zayed Prize International Conference on Integrated Water Management for the Third Millennium, Dubai, United Arab Emirates, February.
54. Urban, L.V., Jackson, A.J., and Rainwater, K.A., 2002. "Effects of Combining Absorbic and Evaporative Disposal Methods on Drainfield Sizing in Arid/Semi-arid Areas," Texas On-Site Wastewater Treatment Research Council Annual Conference, Waco, Texas, March 3.
55. Rainwater, K.A., 2002. "Mathematical Foundations of Groundwater Flow and Transport Modeling," 2002 Pantex Groundwater Modeling Workshop, BWXT Pantex Environmental Restoration Department, Amarillo, TX, April 20.
56. Stovall, J.N. and Rainwater, K.A., 2002. "Evaluating Recharge and Irrigation Flow for the South Plains," Ground Water/Surface Water Interactions Specialty Conference, AWRA, Keystone, CO, June.
57. Morse, A., Jackson, W.A., Rainwater, K.A., and Pickering, K., 2002. "Amoxicillin in a Biological Water Recovery System," 2002 Joint ASCE/EWRI of ASCE International Conference on Environmental Engineering, July 2002, Niagara Falls, Ontario, Canada.
58. Morse, A., Jackson, W.A., Rainwater, K.A., and Pickering, K., 2002. "Membrane Aerated Reactors for the Treatment of Simulated Wastewater," WEFTEC 2002, Chicago, Illinois, September 28-October 3. (Awarded Second Place in the WEFTEC 2002 Poster Symposium)
59. Morse, A., Jackson, W.A., Rainwater, K.A., and Pickering, K., 2002. "Amoxicillin in Biological Water Recovery System," Texas Space Grant Consortium, Spring Annual Meeting, Houston, Texas, May 16-17.
60. Rector, T., Jackson, W.A., Rainwater, K.A., and Pickering, K., 2002. "Evaluation of the Fate of Commonly Used Surfactants in a Water Recycle System (WRS)," Joint Canadian Society of Civil Engineers and Environment and Water Resources Institute of American Society of Civil Engineers International Conference on Environmental Engineering. An International Perspective on Environmental Engineering, Niagara Falls, Ontario, Canada, July 21-24.
61. Muirhead, D.L., Rainwater, K.A., Jackson, W.A., Urban, L.V., Morse, A., and Rector, T., 2002. "Assessment of a Constructed Wetland for Water Recovery and Beneficial Use of Shredded Tires in a *Colonia*." Joint Canadian Society of Civil Engineers and Environment and Water Resources Institute of American Society of Civil Engineers International Conference on

Environmental Engineering. An International Perspective on Environmental Engineering, Niagara Falls, Ontario, Canada, July 21-24.

62. Rector, T., Jackson, W.A., Rainwater, K.A., and Pickering, K., 2002. "Evaluation of a Common Commercial Surfactant in a Water Recycle System," Annual Spring Meeting for the Texas Space Grant Consortium (Advanced Life Support Systems), Houston, TX, May 16-17.

63. Rainwater, K.A., Stovall, J.N., Frailey, S.M., and Urban, L.V., 2002. "Impact of Political Boundaries on Groundwater Modeling for the Llano Estacado Planning Region," Transboundary Water Issues Conference, EWRI/ASCE, Traverse City, MI, July (invited).

64. Keister, H.R., Jackson, W.A., Rainwater, K.A., Morse, A.N., Rector, T., Muirhead, D.L., and Pickering, K., 2002, "Advanced Life Support Water Recovery System," Fall Meeting of the Texas Section of ASCE, Waco, Texas, October 2-5 (named Best of Session).

65. Jackson, W.A., Rainwater, K.A., Anderson, T., Mollhagen, T.R., Lehman, T.M., Ridley, M., and Tock, W.R., 2003. "Perchlorate in Groundwater in the Southern High Plains of Texas," Spring Meeting of the Texas Section of ASCE, Corpus Christi, Texas, April 2-5.

66. Jackson, W.A., Rainwater, K.A., Anderson, T., Lehman, T.M., Ridley, M., and Tock, W.R., 2003. "Perchlorate in Groundwater in the Southern High Plains of Texas," AWRA Annual Water Resources Conference, San Diego, CA, November 3-6.

67. Jackson, W.A., Tock, W.R., Rainwater, K.A., Anderson, T., 2003. "Potential for Perchlorate Generation in Drinking Water Storage Tanks," Texas Water 2003, Corpus Christi, Texas, April 2-4.

68. Jackson, W.A., Rainwater, K.A., Anderson, T., Lehman, T.M., Ridley, M., and Tock, W.R., 2003. "Perchlorate in Groundwater in the Southern High Plains of Texas," Southern High Plains Ground-Water Quality Meeting, USGS, Lubbock, Texas, December 10.

69. Jackson, W.A., Tock, W.R., Rainwater, K.A., Anderson, T., Mollhagen, T.R., Lehman, T.M., and Ridley, M., 2003. "Perchlorate in Groundwater in the Southern High Plains of Texas," Southwest Focus Conference National Groundwater Association, Phoenix, AZ, February 20-21.

70. Rainwater, K.A. and Jackson, W.A., 2004. "Evaluation of Absorption and Evapotranspiration Capacity," Texas On-Site Wastewater Treatment Research Council Annual Conference, Waco, Texas, March 2.

71. Jackson, W.A., Rainwater, K.A., Anderson, T., Lehman, T.M., Ridley, M., Walden, S., and Tock, W.R., 2004, "Occurrence and Source of Perchlorate in the High Plains Aquifer System of Texas," The 11<sup>th</sup> Symposium in GRA's Series on Groundwater Contaminants, Glendale, California, August 4.

72. McLamore, E., Morse, A., Jackson, A., Rainwater, K., and Muirhead, D., 2004. "Development of a Nitrifying Bioreactor for the Treatment of Wastewater in Long-Term Space Applications," Proceedings of the Ninth Annual ASCE Aerospace Division International Conference on Engineering, Construction, and Operations in Challenging Environments, Houston, Texas, March 7-10.

73. Jackson, W.A., Rainwater, K.A., Anderson, T., Lehman, T.M., Ridley, M., Walden, S., and Tock, W.R., 2004, "Perchlorate in Groundwater in the Southern High Plains," Texas Water Conservation Association 2004 Annual Convention, Houston, Texas, March 11-15.

74. Johnson, J.W., Johnson, P.N., Rainwater, K.A., Segarra, E. and Willis, D., 2004, "Evaluation of Water Policy Alternatives for Intertemporal Allocation of Groundwater in the Southern High Plains of Texas, Annual Meeting of the Universities Council on Water Resources, Portland, Oregon, July 20-22.

75. Jackson, W.A., Rainwater, K.A., Anderson, T., Lehman, T.M., Ridley, M., and Tock, W.R., 2004, "Occurrence of Perchlorate in Groundwater in the Southern High Plains of Texas," 2004 Water Quality Conference, East Valley Water District and American Water Works Association Research Foundation, Annual Convention, Ontario, California, Texas, October 27-29.

76. Reeves, J.A. and Rainwater, K.A., 2004. "Volume of Water in Storage (An Ogallala Example with Applicability to All Aquifers in Texas)," 2004 Conference on High Plains Groundwater Resources: Challenges and Opportunities, Texas Tech University Water Resources Center, Lubbock, Texas, December 7-9.
77. Jackson, W.A., Rainwater, K.A., Anderson, T., Lehman, T.M., Ridley, M., and Tock, W.R., 2004, "Occurrence of Perchlorate in Groundwater in the Southern High Plains of Texas," 2004 Conference on High Plains Groundwater Resources: Challenges and Opportunities, Texas Tech University Water Resources Center, Lubbock, Texas, December 7-9.
78. McEnergy, J.A., Joshi, S.R., and Rainwater, K.A., 2004. "Lessons in Regulation of Groundwater Rights," 2004 Conference on High Plains Groundwater Resources: Challenges and Opportunities, Texas Tech University Water Resources Center, Lubbock, Texas, December 7-9.
79. Berge, M.D., Harkins, D., Rainwater, K.A., Stovall, J.N., and Barber, F., 2004. "Groundwater Management Plan for Mustang Station Power Plant," 2004 Conference on High Plains Groundwater Resources: Challenges and Opportunities, Texas Tech University Water Resources Center, Lubbock, Texas, December 7-9.
80. Coimbatorem, G., Cobb, G., Anderson, T., Rajagopalan, S., Jackson, W.A., and Rainwater, K.A., 2004. "Geological Formation of Perchlorate: Evidence from the Presence of Other Anions," 2004 Conference on High Plains Groundwater Resources: Challenges and Opportunities, Texas Tech University Water Resources Center, Lubbock, Texas, December 7-9. (poster)
81. Rainwater, K.A., 2005. "Review of Systems for Restaurant Wastewater Pretreatment," Texas On-Site Wastewater Treatment Research Council Annual Conference, Waco, Texas, March 9.
82. Rainwater, K.A., 2005. "Groundwater Hydrology Issues in the Texas High Plains," Farm Bureau Water Summit, Kansas City, Kansas, September 6-7 (invited).
83. Jackson, W.A., Anderson, T., Rainwater, K.A., Dasgupta, P.K., Rajagopalan, S., Fahlquist, L., 2005. "Natural Sources, Occurrence, and Fate of Perchlorate," 16<sup>th</sup> Annual Quality Assurance Conference, EPA Region 6, Dallas, Texas, October 20.
84. McEnergy, J.A., Joshi, S.R., and Rainwater, K.A., 2005. "Lessons in Regulation of Groundwater Rights," AWRA 2005 Annual Water Resources Conference, Seattle, Washington, November 7.
85. Jones, M.W. and Rainwater, K.A., 2005. "Climate Change and Groundwater Elevation Fluctuations on the Southern High Plains of Texas," 2005 Ground Water Expo, NGWA, Cobb County, Georgia, December 13.
86. Jackson, W.A., Rajagopalan, S., Rao, B., Anderson, T., Rainwater, K., Stonestrom, D., Fahlquist, L., Orris, G., and Harvey, G., 2006. "Occurrence of Atmospherically Generated Perchlorate in Arid and Semi-Arid Regions of North America," The 16<sup>th</sup> Symposium in GRA's Series on Groundwater Contaminants, Perchlorate 2006, Santa Clara, California, January 26.
87. Jackson, W.A., Anderson, T., Rainwater, K.A., Dasgupta, P.K., Rajagopalan, S., Fahlquist, L., 2006. "Natural Sources, Occurrence, and Fate of Perchlorate," AWWA Inorganic Contaminants Workshop, Austin, Texas, January 29 (invited).
88. Rainwater, K.A., Barbato, L., Mulligan, K., and Reeves, J., 2006. "Mapping and Analysis of the Southern High Plains Aquifer," 2006 Spring GIS Specialty Conference, American Water Resources Association, Houston, Texas, May 8-10.
89. Rainwater, K.A., Gitz, D., Hudnall, W., Smith, L.M., Stout, J., and Zartman, R., 2006. "Estimating Aquifer Recharge through Playas of the Great Plains Using Temperature Probes," Annual Meeting of the Universities Council on Water Resources, Santa Fe, New Mexico, July 18-20.
90. Rainwater, K.A., Joshi, S., and McEnergy, J.A., 2006. "Comparison of Groundwater Rights in the United States: Lessons for Texas," Annual Meeting of the Universities Council on Water Resources, Santa Fe, New Mexico, July 18-20.

91. Jackson, W.A., Anderson, T., Rainwater, K.A., Dasgupta, P.K., Rajagopalan, S. and Fahlquist, L. 2006. "Natural Sources, Occurrence, and Fate of Perchlorate," 3<sup>rd</sup> Public Drinking Water Conference 2006, Texas Commission on Environmental Quality, Austin, Texas, August 16.
92. Rainwater, K.A., Joshi, S., and McEnergy, J.A., 2006. "Comparison of Groundwater Rights in the United States: Lessons for Texas," Austin ASCE Branch Meeting, Austin, Texas, September 19 (pdh).
93. Rainwater, K.A., Joshi, S., and McEnergy, J.A., 2006. "Comparison of Groundwater Rights in the United States: Lessons for Texas," Rio Grande Valley ASCE Branch Meeting, McAllen, Texas, September 20 (pdh).
94. Rainwater, K.A., Joshi, S., and McEnergy, J.A., 2006. "Comparison of Groundwater Rights in the United States: Lessons for Texas," Brazos ASCE Branch Meeting, College Station, Texas, September 21 (pdh).
95. Jackson, W.A., Anderson, T., Rainwater, K.A., Dasgupta, P.K., Rajagopalan, S. and Fahlquist, L. 2006. "Natural Sources, Occurrence, and Fate of Perchlorate," East Valley Water District Water Quality Conference, Ontario, California, October 11-13.
96. Barbato, L., Mulligan, K., and Rainwater, K.A., 2006. "Development of a Geospatial Database for Mapping the Ogallala Aquifer on the Southern High Plains of the United States," ICASALS 2006 International Conference, Lubbock, Texas, November 15.
97. McGee, S., Jackson, W.A., Rainwater, K.A., and Seshaiyer, P., 2006. "Modeling Contaminated Flow in the Unsaturated Zone in the Presence of Roots," ICASALS 2006 International Conference, Lubbock, Texas, November 15.
98. Zartman, R., Hudnall, W., Rainwater, K., Smith, L., and Gitz, D., 2006. "Estimating High Plains Aquifer Recharge Using Temperature Probes," ICASALS 2006 International Conference, Lubbock, Texas, November 16.
99. Rainwater, K.A., 2007. "Subsurface Hydrogeologic Transport Modeling: Unraveling the Perchlorate Mystery," Geotechnical Seminar, Geo-San Antonio, San Antonio Branch of ASCE, San Antonio, Texas, January 26.
100. Jones, C., Rainwater, K.A., and Thompson, D.B., 2007. "Five-Minute Unit Hydrographs for Texas Watersheds," HEC-HMS User's Conference: Current Trends and Applications, ASCE/AAWRE/EWRI, Austin, Texas, April 5 (invited).
101. Jones, M.W. and Rainwater, K.A., 2007. "Simulation of Paleoclimate Impacts on Groundwater Elevations in The Southern High Plains Of Texas," AGU Fall Meeting, San Francisco, California, December 10.
102. Venkataraman, K. and Rainwater, K.A., 2007. "Subsurface Occurrence, Distribution, and Speciation of Arsenic in the Southern High Plains," AGU Fall Meeting, San Francisco, California, December 10. (invited)
103. Jones, M.W. and Rainwater, K.A., 2007. "Simulation of Paleoclimate Impacts on Groundwater Elevations in The Southern High Plains Of Texas," II International Conference on Water in Arid and Semiarid Lands, Gravata, Brazil, September 11.
104. Rainwater, K.A., Joshi, S., and Eckstein, G., 2007. "Diversity in American Groundwater Management: Lessons for Texas," NGWA Ground Water Summit, Albuquerque, New Mexico, May 3.
105. Eckstein, G. and Rainwater, K.A., 2007. "Can Ground Water Science Make Ground Water Law Less Mysterious and Occult?," NGWA Ground Water Summit, Albuquerque, New Mexico, May 4. (invited)
106. Rainwater, K.A., Joshi, S., and Eckstein, G., 2007. "Diversity in American Groundwater Management: Lessons for Texas," Fort Worth ASCE Branch Meeting, Fort Worth, Texas, September 17.
107. Rainwater, K.A., Joshi, S., and Eckstein, G., 2007. "Diversity in American Groundwater Management: Lessons for Texas," San Antonio ASCE Branch Meeting, San Antonio, Texas, May 14.
108. Rainwater, K.A., Joshi, S., and Eckstein, G., 2007. "Diversity in American Groundwater Management: Lessons for Texas," Northeast ASCE Branch Meeting, Tyler, Texas, May 17.

109. Rainwater, K.A., Joshi, S., and Eckstein, G., 2007. "Diversity in American Groundwater Management: Lessons for Texas," High Plains ASCE Branch Meeting, Amarillo, Texas, May 18.
110. Smith, L.M., Haukos, D.A., McMurry, S.T., Gitz, III, D., Rainwater, K.A., Zartman, R.E., and Hudnall, W.H. 2007. "Influence of Conservation Practices on Ecosystem Services Provided by Playa Wetlands in the High Plains," presented at the High Plains CEAP-Wetlands Symposium, 2007 SWCS Annual Conference, Tampa, Florida, July 21-25.
111. Rainwater, K.A., 2008. "Rainwater Harvesting in a Residential and Community Scale," 19<sup>th</sup> Annual Southern Plains Conference, Managing Energy, Water, and Carbon: Rural Communities Respond to Global Climate Change, Hereford and Nazareth, Texas, February 13.
112. Rainwater, K.A., 2008. "Realistic Approaches to Deal with Climate Change Impacts on Water Resources Management and Policy," Climate Change Impacts on Texas Water, Texas River Systems Institute, Austin, Texas, April 29. (invited)
113. Rainwater, K.A. and Reeves, J.A., 2008. "The Dockum Aquifer in Texas: Municipal Replacement for the Ogallala?," NGWA International Conference on Nonrenewable Ground Water Resources – Sociotechnological Aspects of Nonrenewable Ground Water Resources: Half-Empty, Half-Full, Top-Down, Bottom-Up, and Some Paths Forward, Portland, Oregon, October 13. (invited)
114. Mulligan, K.R., Barbato, L., Warren, A., Van Nice, C. and Rainwater, K.A., 2008. "A Regional Analysis of Groundwater Depletion in the Ogallala Aquifer in Texas," 2008 Joint Meeting of GSA/SSSA-ASA-CSSA/GCAGS-GCSSEPM, Houston, Texas, October 8. (invited)
115. Rainwater, K.A., 2008. "West Texas Water Issues," Permian Basin Regional Planning Commission, Annual Meeting, Seminole, Texas, November 20. (invited keynote)
116. Jackson, W.A., Rao, B., Anderson, T.A., Orris, G.J., Rainwater, K.A., Rajagopalan, S., Sandvig, R.M., Scanlon, B.R., Stonestrom, D.A., Walvoord, M.A., Harvey, G., Fahlquist, L., and Andraski, B., 2008. "Background Concentrations of Perchlorate in Arid and Semi-arid Regions of North America and Its Impact on Site Assessment," Sixth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, California, May 19-22.
117. Mulligan, K.R. and Rainwater, K.A., 2009. "Current Status of the Ogallala Aquifer," Irrigation Training Program, High Plains Irrigation and Trade Show, Texas AgriLife, Amarillo, Texas, January 14.
118. Rainwater, K.A., 2009. "Wind Power and Water Desalination Technology Integration," Final Presentation to the Bureau of Reclamation, Denver, Colorado, January 23.
119. Rainwater, K.A., 2009. "The Texas Tech University Water Resources Center – Making the Best of a Half-full Glass," Texas Tech University System Community Engagement Conference, Lubbock, Texas. March 27.
120. Rainwater, K.A., 2009. "Groundwater in Texas: Boone Pickens Doesn't Sound Quite So Crazy," Oregon State University Water Resources Graduate Seminar, Impending Water Crises and Solutions, Corvallis, Oregon, April 8. (invited)
121. Rainwater, K.A., 2009. "Protecting Your Groundwater," Annual Meeting of Far West Texas Judges and Commissioner's Conference, Terlingua, TX, September 25. (invited)
122. Rainwater, K.A., 2009. "Who Owns the Groundwater? Well, That Depends..." Osher Lifelong Learning Institute, Texas Tech University, Lubbock, TX, November 10. (invited)
123. Venkataraman, K., Rainwater, K.A., Jackson, W.A., and Ridley, M., 2009. "Speciation and Source Identification for Arsenic in the Southern High Plains Aquifer," AGU Fall Meeting, San Francisco, California, December 18. (poster)
124. Rainwater, K., Ganesan, G., Gitz, D., Zartman, R., Hudnall, W., and Smith, L., 2009. "Estimating Recharge through Playa Lakes to the Southern High Plains Aquifer," AGU Fall Meeting, San Francisco, California, December 18. (poster)

125. Rainwater, K., Fish, E., Zartman, R., and Beierle, M., 2010. "Evaluation of the White River Watershed," Presentation to White River Municipal Water District, Spur, Texas, March 9.
126. Rainwater, K.A., 2010. "Recharge of Over-Exploited Aquifers: Playa Project," International Workshop on Policies of Management for Sustainability in the Zacatecas State, Zacatecas, Mexico, May 28. (invited)
127. Rainwater, K.A., 2010. "Municipal Demonstration of a Wind-Powered RO System," South Central Membrane Association 2010 Annual Conference, South Padre Island, TX, September 28. (invited)
128. Maidment, D.R. and Rainwater, K.A., 2010. "The Texas Water Digital Library," Global Resources Network Forum: Global Water – 2010 and Beyond, Center for Research Libraries, Denver, CO, October 21. (invited)
129. Rainwater, K.A., 2011. "Reducing the Stress of Rural Community Desalination with Wind Energy," Multi-States Salinity Coalition, 2011 Annual Salinity Summit, San Antonio, TX, February 17. (invited)
130. Rainwater, K.A., 2011. "When Is the Aquifer Officially Depleted," National Ground Water Association Webinar, February 25. (invited)
131. Rainwater, K.A. and Johnson, J., 2011. "When Is the Aquifer Officially Depleted," Annual Meeting of Universities Council on Water Resources, Boulder, CO, July 13. (invited)
132. Rainwater, K.A., 2011. "Permian Basin Groundwater Issues," Permian Basin Regional Planning Commission Annual General Membership Meeting, Big Spring, TX, October 12. (keynote speaker)
133. Rainwater, K.A., 2011. "Declining Aquifers: What Future Do We Deserve?" National Ground Water Association Virtual Conference on Declining Groundwater Levels: Measuring, Monitoring, and Mitigation, October 19. (keynote speaker)
134. Rainwater, K.A., 2011. "Desalination Program," Innovative Farming: Integrating Limited Water Resources into Today's Farming Conference, Llano Estacado Underground Water Conservation District and AgriLife Extension, Seminole, TX, December 6.
135. Scheutze, B., Rainwater, K., and Song, L., 2011. "Development of a Small-Scale Reverse Osmosis System for Energy Efficient Brackish Water Desalination at High Recoveries," 2001 North American Membrane Society Conference, Las Vegas, NV, June 4-8.
136. Liu, C., Rainwater, K., and Song, L., 2011. "Accurate Quantification of Energy Consumption in Crossflow RO Desalination Processes," A Global Platform for Water Solutions, 2011 Qingdao International Desalination Conference, A Symposium on Desalination and Water Treatment, China Desalination Association/European Desalination Society, Qingdao, China, June 20-23.
137. Rainwater, K., 2012. "West Texas Water Issues 2012," Texas Society of Professional Engineers, South Plains Chapter, Lubbock, TX, March 20.
138. Rainwater, K., 2012. "West Texas Water Issues 2012," Keynote Speaker, Annual Appreciation Luncheon, Keep Midland Beautiful, Midland, TX, March 22.
139. Rainwater, K., 2012. "Fracking and the Energy/Water Nexus: A Look at Every Aspect and Every Question Surrounding this Timely Issue," Panelist, Texas Water Symposium, Schreiner University, Kerrville, TX, April 12.
140. Rainwater, K., Nash, P., Song, L., and Schroeder, J., 2012. "Wind-powered Brackish Groundwater Treatment for Municipal Water Supply," Storage and Power Electronics Team, Department of Energy Sandia National Laboratory, Lubbock, TX, April 25.
141. Rainwater, K., 2012. "West Texas Water Issues 2012," West Texas County Judges and Commissioners Annual Conference, Odessa, TX, April 25.

142. Rainwater, K., 2012. "Engineering the Challenges of Energy and Water," Texas Tech University Water Summit, Lubbock, TX, July 10.
143. Rainwater, K., Nash, P., and Song, L., 2012. "Wind-powered Desalination of Brackish Groundwater for Municipal Supply," Managing Water, Energy, and Food in an Uncertain World, Annual Meeting of Universities Council on Water Resources, Santa Fe, NM, July 19.
144. Rainwater, K., Fish, E., and Beierle, M., 2012. "Demonstration of Brush Removal Criteria for Water Supply Enhancement," presented to Senator Robert Duncan on behalf of the Texas State Soil and Water Conservation Board, Lubbock, TX, August 22.
145. Rainwater, K., 2012. "West Texas Water Issues 2012," Osher Lifelong Learning Institute, Texas Tech University, Lubbock, TX, September 27.
146. Rainwater, K., Fish, E., and Beierle, M., 2012. "Demonstration of Brush Removal Criteria for Water Supply Enhancement," Testimony to the Agriculture and Livestock Subcommittee of the Natural Resources Committee, Texas Legislature, Austin, TX, September 13.
147. Rainwater, K., 2012. "Hydrology 101, Texas Style," Texas Lyceum Water Conference, Amarillo, TX, August 10.
148. Rainwater, K., Fish, E., and Beierle, M., 2012. "Demonstration of Brush Removal Criteria for Water Supply Enhancement," Presentation to the Texas State Soil and Water Conservation Board Annual Meeting, Temple, TX, July 27.
149. Rainwater, K., 2012. "Hydrology 101, Texas Style," Society of Environmental Journalists Annual Conference, Lubbock, TX, October 19.
150. Rainwater, K., Ganesan, G., Gitz, D., Zartman, R., Hudnall, W., and Smith, L., 2012. "Comparison of Seepage Rates in Playa Lakes in Grassland and Cropland Basins, Texas High Plains," National Ground Water Association Conference on Great Plains Aquifers: Beyond the Ogallala, Omaha, NE, October 25.
151. Rainwater, K., Nash, P., and Song, L., 2012. "Wind-powered Desalination of Brackish Groundwater for Municipal Supply," Wind Science and Engineering Seminar, Texas Tech University, Lubbock, TX, September 26.
152. Rainwater, K., 2012. "The Seminole Project: Renewable Energy for Municipal Water Desalination," Webinar Report to Department of Energy, Lubbock, TX, December 19.

**Research Projects** – collaborators CEE unless noted in brackets

1. Principal Investigator (with B.J. Claborn), "Atmospheric Influence on Air Pressure in the Unsaturated Zone," Texas Tech University Water Resources Center, 1985-86, \$10,000.
2. Principal Investigator, "Feasibility of Field Experiments on Groundwater Contaminant Transport," State Organized Research Funds for New Faculty, 1985-86, \$5,000.
3. Co-Principal Investigator (with C.B. Fedler [AgE], M.J. Dvoracek [AgE], and R.H. Ramsey), "Study of the Movement of Chemicals Through the Soil Profile to the Groundwater," Texas Water Development Board, 1986-87, \$82,000.
4. Assistant (with L.V. Urban, R.H. Ramsey, R.M. Sweazy, and B.J. Claborn), "Evaluate the Water Supply and Treatment System for City of Midland, Texas," 1985-86, \$20,832.
5. Principal Investigator (with R.H. Ramsey), "Rising Groundwater in West Texas Municipalities--Economic Potential for Development," Texas Tech University Water Resources Center, 1986-87, \$10,500.

6. Co-Principal Investigator (with H.W. Parker [ChE]), "Chemical In Situ Oxidation for Rehabilitation of Aquifers--Laboratory Demonstration of Feasibility," Texas Tech University Water Resources Center, 1986-87, \$9,200; Phase II 1987-88, \$12,000; Phase III 1988-89, \$11,300; Phase IV 1989-90, \$9,800.
7. Co-Principal Investigator (with B.J. Claborn), "Air Injection for Removal of Contaminants in the Unsaturated Zone," Texas Tech University Water Resources Center, 1986-87, \$12,000; Phase II 1987-88, \$12,250; Phase III 1988-89, \$10,200.
8. Co-Principal Investigator (with B.J. Claborn and C.E. Heintz [Bio]), "Increasing In-Situ Biodegradation of Diesel Fuel by Cyclic Water Table Movement," Texas Tech University Water Resources Center, 1988, \$11,500; 1988-89, \$12,375.
9. Co-Principal Investigator (with L.V. Urban), "Demonstration of Carbon Dioxide Scale Technique in Water Systems with Very Hard Water," U.S. Army Construction Engineering Research Laboratory, 1988-89, \$20,000.
10. Co-Principal Investigator (with R.H. Ramsey and T.R. Mollhagen), "Development of a State-of-the-Art Instructional Laboratory for Environmental Analyses," National Science Foundation, 1988-90, \$46,992 (plus \$46,993 match from State of Texas HEAF).
11. Co-Principal Investigator (with L.V. Urban), "Evaluation of Carbon Dioxide Scale Control Techniques for Very Hard Waters," U.S. Army Construction Engineering Research Laboratory, 1989-90, \$22,500.
12. Co-Principal Investigator (with B.J. Claborn and C.E. Heintz [Bio]), "Laboratory Investigation of Cyclic Vertical Water Table Modulation for Enhancement of In Situ Aerobic Biodegradation," Texas Tech University Water Resources Center, 1989-90, \$8,500 (matching funds for following grant).
13. Co-Principal Investigator (with B.J. Claborn and C.E. Heintz [Bio]), "Laboratory Investigation of Cyclic Vertical Water Table Modulation for Enhancement of In-Situ Aerobic Biodegradation," U.S. Environmental Protection Agency, 1989-91, \$116,794.
14. Co-Principal Investigator (with R.H. Ramsey and T.R. Mollhagen), "Development of Interactive, Multimedia Courseware as a Supplemental Learning Strategy for Undergraduate Engineering Courses," Academic Donation Program, Apple Computer, Inc., 1989, \$11,560.
15. Co-Principal Investigator (with B.J. Claborn), "A Comparison of Pulsed and Steady Vaporization of Residual Hydrocarbons in Unsaturated Porous Media," Texas Tech University Water Resources Center, 1989-91, \$20,500.
16. Co-Principal Investigator (with F. Mohamed [Math]), "Well Response Test: Application to Partially Penetrating Wells in Unconfined Aquifers," Texas Tech University Water Resources Center, 1990-92, \$24,000.
17. Co-Principal Investigator (with R.H. Ramsey and T.R. Mollhagen), "Development of a Hypermedia Learning Laboratory for Undergraduate Engineering Students," National Science Foundation, 1990-92, \$33,000.
18. Principal Investigator (with B.J. Claborn, L.V. Urban, R.H. Ramsey, T.R. Mollhagen, R. Zartman [PSS], and E.B. Fish [RWM]), "Geologic and Hydrologic Site Characterization of the Pantex Plant in Support of DOE's Environmental Monitoring and Hazardous Waste Remediation Program," Department of Energy, Subcontract to the University of Texas at Austin Bureau of Economic Geology, 1990-1995, \$1,092,000.
19. Co-Principal Investigator (with C.V.G. Vallabhan and B.J. Claborn), "A Computer Model to Evaluate Efficiency of Soil Venting for Restoration of Unsaturated Soil," U.S. Army Construction Engineering Research Laboratory, 1991, \$24,795.
20. Co-Principal Investigator (with T.M. Lehman [Geo] and G.B. Asquith [Geo]), "Investigation of Radon Occurrence in the Ogallala Aquifer in the Southern High Plains of Texas," Texas Tech University Water Resources Center, 1992-93, \$13,500.
21. Co-Principal Investigator (with D.B. Thompson), "Feasibility Study of Scale Removal for Recovery of Flow Capacity in the Central System Pipeline," Canadian River Municipal Water Authority, 1993-94, \$45,740.
22. Co-Principal Investigator (with P.W. Jayawickrama), "A Dual-Porosity Model for the Characterization of Aquifer Recharge through Playa Lakes," Texas Tech University Water Resources Center, 1993-94, \$14,225, 1994-95, \$7,800.

23. Principal Investigator, "Demonstration of New Techniques for Remediation of Petroleum-Contaminated Soils," Texas Tech University Office of Research Services, 1993, \$4,000.
24. Co-Principal Investigator (with S. Frailey [PetE]), "Management and Development of the Ogallala Aquifer: An Application of a Full-Field Reservoir Simulation Model," Texas Tech University Water Resources Center, 1994-95, \$10,000, 1995-96, \$11,000.
25. Principal Investigator (with R.H. Ramsey, L.V. Urban, T.R. Mollhagen, C.E. Heintz [Biol] and D.B. Thompson), "Environmental Related Studies at Pantex - TBEG," Department of Energy, Texas Higher Education Consortium, 1994-95, \$120,452.
26. Co-Principal Investigator (with D.B. Thompson), "Field Study of Scale Removal for Recovery of Flow Capacity in the Central System Pipeline," Canadian River Municipal Water Authority, 1995, \$10,000, 1996, \$10,000.
27. Principal Investigator (with C.E. Heintz [Biol], R. Zartman [PSS], R.H. Ramsey, L.V. Urban, T.R. Mollhagen, and D.B. Thompson), "Pantex Environmental Restoration," Department of Energy, Texas Higher Education Consortium, 1995-96, \$335,899.
28. Principal Investigator, "Field Treatability at Pantex," engineering-environmental Management, Inc., 1995-96, \$49,563.
29. Co-Principal Investigator (with S. Frailey [PetE]), "High Plains Ogallala Area Management Plan: The Development of the Ogallala Aquifer Hydrologic Model," Texas Tech University Water Resources Center and Texas Tech University, 1996-98, \$90,674 (matching funds for following grant).
30. Co-Principal Investigator (with S. Frailey [PetE]), "High Plains Ogallala Area Management Plan: The Development of the Ogallala Aquifer Hydrologic Model," Texas Water Development Board through the High Plains Underground Water Conservation District No. 1, 1996-98, \$81,052.
31. Principal Investigator (with C.E. Heintz [Biol] and T.R. Mollhagen), "Feasibility of In Situ Remediation of Residual High Explosives in the Vadose Zone Beneath the Pantex Plant," Amarillo National Resource Center for Plutonium, Department of Energy, 1997, \$274,633.
32. Co-Principal Investigator (with D.B. Thompson and L.V. Urban), "Interactions Between Precipitation, Evapotranspiration, Streamflow, and Ground Water," Texas Tech University Water Resources Center, 1997-98, \$5,000 (matching funds for following grant).
33. Co-Principal Investigator (with D.B. Thompson and L.V. Urban), "Interactions Between Precipitation, Evapotranspiration, Streamflow, and Ground Water," Texas Water Development Board through the High Plains Underground Water Conservation District No. 1, 1997-98, \$12,611.
34. Co-Principal Investigator (with S. Frailey [PetE]), "Groundwater Modeling for the Southern High Plains," Texas Tech University Water Resources Center, 1998-99, \$12,650.
35. Principal Investigator (with C.E. Heintz [Biol] and T.R. Mollhagen), "Continuation of Feasibility of In Situ Remediation of Residual High Explosives in the Vadose Zone Beneath the Pantex Plant," Amarillo National Resource Center for Plutonium, Department of Energy, 1998, \$239,506, 1999, \$156,080.
36. Co-Principal Investigator (with W.A. Jackson), "Assessment of the Potential for Natural Attenuation of Chlorinated Solvents in Contaminated Groundwater in the Texas High Plains," Texas Tech University Water Resources Center, 1998-99, \$10,800.
37. Co-Principal Investigator (with J.D. Woodyard [Chem, WTAMU] and B.R. Richardson [Mason&Hanger, Pantex]), "Mechanisms of Formation of Trace Decomposition Products in Complex High Explosive Mixtures," Amarillo National Resource Center for Plutonium, Department of Energy, 1998, \$197,889 (TTU share \$68,579), 1999, \$199,478 (TTU share \$54,954).
38. Co-Principal Investigator (with C.E. Heintz [Biol]), "Enzymatic Degradation of Pu/U 'Suspect Contaminated' Waste," Amarillo National Resource Center for Plutonium, Department of Energy, 1998, \$105,105, 1999, \$105,761.

39. Co-Principal Investigator (with D.B. Thompson and R. Zartman [PSS]), "Updating Site Topographic Survey," Mason & Hanger Corporation, Inc., 1999, \$58,710.
40. Co-Principal Investigator (with T.M. Lehman [Geos] and L.V. Urban), "Evaluation of Shallow Groundwater Resources of Andrews County, Texas," Andrews Industrial Foundation, 1999, \$113,747.
41. Co-Principal Investigator (with S. Frailey [Petr]), "Groundwater Modeling for the Southern High Plains," Texas Water Development Board, 1999-2000, \$130,744.
42. Co-Principal Investigator (with L.V. Urban, R.H. Ramsey, D.B. Thompson, T.R. Mollhagen, W.A. Jackson, and R.E. Zartman [PSS]), "Effects of Combining Absorbic and Evaporative Disposal Methods on Drainfield Sizing in Arid and Semiarid Areas," Texas On-Site Wastewater Treatment Research Council, 1999-2001, \$293,954.
43. Co-Principal Investigator (with W.A. Jackson), "Potential for In Situ Remediation of Perchlorate Contamination in Sediments and Groundwater," Texas Tech University Water Resources Center, 1999-2000, \$11,000, 2000-2001, \$12,000.
44. Principal Investigator, "Field Demonstration of In Situ Degradation of High Explosives in Soil," U.S. Army Corps of Engineers Waterways Experiment Station, 1999-2000, \$18,226.
45. Principal Investigator (with H. Gurrola [Geos] and N. Guven [Geos]), "Evaluation of Brine Extent and Migration in the Brownfield Basin Area, Terry County, Texas," Texas Tech University Water Resources Center, 1999-2000, \$12,000.
46. Co-Principal Investigator (with L.V. Urban, W.A. Jackson, and R.H. Ramsey), "Evaluation of NASA's Advanced Wastewater Recycling Process for Non-Optimal Conditions and Evaluation of Terrestrial Applications," NASA, 2000-2001, \$291,185, 2001-2002, \$409,096.
47. Principal Investigator (with H. Gurrola [Geos] and N. Guven [Geos]), "Variable-Density Groundwater Model for the Brownfield Basin Area, Terry County, Texas," Texas Tech University Water Resources Center, 2000-2001, \$10,000.
48. Principal Investigator (with T.R. Mollhagen and C.E. Heintz [Bio]), "In Situ Bioremediation of Explosives in the Vadose Zone," Idaho National Engineering and Environmental Laboratory, Department of Energy, 2000-01, \$30,000.
49. Principal Investigator (subcontract to WTAMU), "Mechanisms of Formation of Trace Decomposition Products in Complex High Explosive Mixtures," BWXT - Pantex Plant, Department of Energy, 2000-01, \$23,737.
50. Principal Investigator (with T.R. Mollhagen and C.E. Heintz [Bio]), "Expansion of In Situ HE Biodegradation System," BWXT – Pantex Plant, Department of Energy, 2001, \$34,702.
51. Principal Investigator (with T.R. Mollhagen), "Design & Modeling of Large-Scale Laboratory Tests for Treatment of Contaminated Soils from Small Arms Firing Ranges," U.S. Army Corps of Engineers Environmental Research and Development Center, 2001, \$15,000.
52. Principal Investigator (with D.B. Thompson), "Groundwater Balances for Recharge Estimation in Selected Counties in the Southern High Plains," Texas Tech University Water Resources Center, 2001-2002, \$14,000.
53. Principal Investigator (with T.R. Mollhagen and C.E. Heintz [Bio]), "Demonstration of In Situ Biodegradation of High Explosives in Soil Zone," Idaho National Engineering and Environmental Laboratory, Department of Energy, 2002, \$95,000, 2003, \$40,000.
54. Co-Principal Investigator (with G.P. Cobb [TIEHH], E.E. Smith [TIEHH], and F.F. Roberto [INEEL]), "Quantifying Cancer Risks Following In-situ Remediation of Explosives: Strengthening Collaboration with the Idaho National Environmental and Engineering Laboratory, United States Department of Energy," Texas Excellence Funds, State of Texas, 2002, \$52,463.
55. Co-Principal Investigator (with L.V. Urban and W.A. Jackson), "Evaluation of Drainfield Absorption and Evapotranspiration Capacity," Texas On-Site Wastewater Treatment Research Council, 2002-03, \$199,125.

56. Co-Principal Investigator (with W.A. Jackson, A. Morse, D.L. Muirhead, and T. Anderson), "Evaluation of NASA's Advanced Life Support Integrated Water Recovery System for Non-Optimal Conditions and Terrestrial Applications," NASA, 2002-03 (Year 3), \$459,164, 2003-04 (Year 4), \$581,460.
57. Principal Investigator (with T.R. Mollhagen and C.E. Heintz [Biol]), "Expansion of In Situ HE Biodegradation System," BWXT-Pantex Plant, Department of Energy, 2002-03, \$16,133, 2003-04, \$30,861.
58. Co-Principal Investigator (with W.A. Jackson, L.V. Urban, T.R. Mollhagen, T.M. Lehman [Geos], M. Ridley [Geos], T. Anderson [TIEHH], and R.W. Tock [ChE]), "Distribution and Potential Sources of Perchlorate in the Southern High Plains Aquifer," Texas Commission on Environmental Quality, 2002, \$295,376, 2003, \$115,000, 2003-04, \$482,300.
59. Co-Principal Investigator (with Jackson, Anderson [TIEHH], Ridley [Geos], and Dasgupta [Chem]), "Identification and Characterization of Natural Sources of Perchlorate," Strategic Environmental Research and Development Program, DOD/DOE/EPA, 4/05-3/08, \$518,754, 2005-06, \$45,000.
60. Principal Investigator (with J.A. McEnery), "Column Transport of Selected Metals," BWXT-Pantex Plant, Department of Energy, 2004, \$102,515.
61. Principal Investigator, "Review of Systems for Restaurant Wastewater Pretreatment," Texas On-Site Wastewater Treatment Research Council, 2003-04, \$33,988.
62. Principal Investigator, "Operation and Maintenance of the Zone 12 HE Biodegradation Site," BWXT-Pantex Plant, Department of Energy, 2003-05, \$27,566.
63. Principal Investigator (with K. Mulligan [Geog] and L. Barbato [Geog]), "Ogallala Initiative: Hydrology and Climatology," Department of Agriculture, 2004, \$35,570, 2004-05, \$37,251, 2005-06, \$30,044.
64. Principal Investigator (with J.A. McEnery), "Evaluation of Mobile Dual Phase Extraction Applications at LPST Sites in Texas," Texas Commission on Environmental Quality, 2005, \$93,671.
65. Principal Investigator (with J.A. McEnery), "Measurements of Uranium Sorption in Blackwater Draw Formation Soils," BWXT-Pantex Plant, Department of Energy, 2005, \$75,925.
66. Principal Investigator (with L.M. Smith [RWF], R. Zartman [PSS], W. Hudnall [PSS], and D. Gitz [USDA]), "High Plains Aquifer Recharge: Importance of Playas and Influence of Sediments," Department of Agriculture, 2005-06, \$109,749, 2006-07, \$109,000, 2007-08, \$83,000, 2008-09, \$75,000.
67. Co-Principal Investigator (with W.A. Jackson and A.N. Morse), "Evaluation of NASA's Advanced Life Support Integrated Water Recovery System for Non-Optimal Conditions and Terrestrial Applications, Year 5," NASA, 2005-06, \$411,180.
68. Principal Investigator (with A. Swift and W.A. Jackson), "Wind Power and Water Desalination Technology Integration," Bureau of Reclamation, 2005-06, \$99,735.
69. Principal Investigator (with L. Barbato [Geog] and K. Mulligan [Geog]), "Transmissivity Distribution in the Ogallala Aquifer for Floyd, Hale, Lubbock, Randall and Swisher Counties," Canadian River Municipal Water Authority, 2006, \$15,264.
70. Co-Principal Investigator (with P.K. Dasgupta [Chem] and C. Martin [Math]), "Perchlorate and Iodide Intake and Excretion in Breastfed Infants," Texas Higher Education Coordination Board Advanced Research Program, 2006-08, \$100,000.
71. Co-Principal Investigator (with A. Swift), "DOE Integrated Wind-Water System," Department of Energy/Texas State Energy Conservation Office, 2005-07, \$50,000.

72. Co-Principal Investigator (with L. Smith [NRM], R. Zartman [PSS], W. Hudnall [PSS], and D. Gitz [USDA]), "High Plains Aquifer Recharge: Importance of Playas and Influence of Sediments," Panhandle Groundwater Conservation District, 2006-07, \$20,000.
73. Co-Principal Investigator (with J. Johnson [AAEC], D. Willis [AAEC], D. Ethridge [AAEC], K. Mulligan [Geog], and E. Fish [NRM]), "Ogallala Initiative: Sustainable Rural Economics Through New Water Management Technologies," Department of Agriculture, 2007-2009, \$1,000,000.
74. Co-Principal Investigator (with A. Swift), "Great Plains Wind Power Test Facility," Department of Energy, 2006-07, \$1,485,000.
75. Principal Investigator (with K.R. Mulligan [CGT], L. Barbato [CGT], R.E. Zartman [PSS], W.H. Hudnall [PSS], and D. Gitz, III, [USDA-ARS]), "Influence of USDA Programs on Ecological Services Provided by Playa Wetlands in the High Plains," USGS/NRCS, 2007-08, \$83,807, 2008-09, \$76,930.
76. Principal Investigator (with S. Smirnov [ME]), "Hydraulic Performance Evaluation of Horizontal Inlet Type H," Texas Department of Transportation, 2007-08, \$143,520, 2008-09, \$138,320.
77. Principal Investigator (with D. Thompson [ROA], T. Cleveland, and W. Asquith [USGS]), "Develop Statewide Regression Equations for Improved Flood Peak Estimation," Texas Department of Transportation, 2008-09, \$8,503.
78. Principal Investigator (with E.B. Fish [NRM] and R.E. Zartman [PSS]), "Evaluation of the TSSWCB Brush Control Program: Monitoring Needs and Water Yield Enhancement," Texas Commission on Environmental Quality, 2008, \$150,000.
79. Principal Investigator (Task 2 with L. Song, A. Jackson, A. Morse, and P. Nash), "Great Plains Wind Power Test Facility," Department of Energy, 2008-10, \$688,000 (total project \$1,968,000).
80. Co-principal Investigator (with A. Jackson and T. Anderson [TIEHH]), "Laboratory Demonstration of In Situ Treatment Effectiveness for Reduction of Perchlorate, TCE, and Chromium at Pantex Plant," B&W Pantex LLC, 2008-09, \$115,776.
81. Principal Investigator (with R.E. Zartman [PSS]), "Managing Effects of Agronomic Systems on Playa Wetland Hydrology and Ecology," USDA-ARS, 2008-13, \$30,000.
82. Principal Investigator (with K. Hayhoe [Atmo]), "Quantifying Effects of Long-Term Climate Change on Precipitation and Evapotranspiration," USDA-ARS, 2008-09, \$50,000.
83. Principal Investigator (with E.B. Fish [NRM], R.E. Zartman [PSS], and E.A. Hernandez), "Design of Monitoring Program for Water Yield Enhancement Program," Texas State Soil and Water Conservation Board, 2008-10, \$100,000.
84. Co-Principal Investigator (with A. Jackson and T. Anderson [TIEHH]), "Research Needs Related to Natural Perchlorate: Production, Occurrence, and Stable Isotopic Signatures," AFOSR/SAIC, 2008-09, \$112,668, 2009-11, \$115,000.
85. Co-principal Investigator (with K. Hayhoe [Geos], J. Johnson [Ag Eco], and E.A. Hernandez), "Climate Change Impacts on Water Supply in West Texas," Bipartisan Policy Center, 2009-2010, \$54,188.
86. Principal Investigator (with D.B. Thompson [R.O. Anderson] and S. Tummuri [CDM]), "Assessment of General Circulation Models for Water-Resources Planning Applications," Texas Water Development Board, 2009-2010, \$90,918.
87. Principal Investigator (with E.A. Hernandez), "Impact of Climate Change on Depletion of the Ogallala Aquifer," USDA-ARS, 2010-12, \$39,297.
88. Co-Principal Investigator (with R.E. Zartman [PSS]), "Texas High Plains Playa Instrumentation Network," USDA-ARS, 2010-12, \$18,972.

89. Co-Principal Investigator (with L. Song and P. Nash), "FY 10 Great Plains Wind Power Test Facility, Task 2," Department of Energy, 2010-12, \$1,902,998.
90. Co-Principal Investigator (with L. Song and P. Nash), "FY 11 Great Plains Wind Power Test Facility, Task 2," Department of Energy, 2011-13, \$2,000,000.
91. Principal Investigator (with A. Jackson, A. Morse, T. Cleveland, and A. Hernandez), "City of Lubbock Canyon Lakes Water Reuse Project," 2009-13, \$57,700.
92. Co-Principal Investigator (with L. Song), "Demonstration of a High Recovery and Energy Efficient RO System for Small-scale Brackish Water Desalination," Texas Water Development Board, 2010-2012, \$101,597.
93. Principal Investigator (with R.E. Zartman [PSS] and W.H. Hudnall [PSS]), "Playa Lake Recharge Monitoring," Texas Water Development Board, 2010-2011, \$57,540.
94. Principal Investigator (with J. Schroeder [WISE]), "SECO Renewable Technology Grant," State Energy Conservation Office, 2010-11, \$162,000.
95. Principal Investigator (with E.B. Fish [NRM], R.E. Zartman [PSS], and E.A. Hernandez), "Application of the EDYS Decision Tool for Modeling of Target Sites for Water Yield Enhancement through Brush Control," Texas State Soil and Water Conservation Board, 2011-12, \$224,230.
96. Co-Principal Investigator (with K. Mulligan [CGST] and L. Barbato [CGST]), "TCU 359: CRP Effects on the Ogallala Aquifer," USGS, 2011, \$60,030.
97. Co-Principal Investigator (with T. Arsuffi [LRFS]), "Llano River Watershed Protection Plan," Texas State Soil and Water Conservation Board, 2011-14, \$519,053.
98. Co-Principal Investigator (with A. Jackson and T. Anderson [TIEHH]), "Identification and Characterization of Naturally Occurring Perchlorate Phase 4," USAF-AFMC, 2009-13, \$162,280.
99. Co-Principal Investigator (with A. Jackson), "High Plains Chromium Investigation," Department of Energy, BWXT Pantex, 2012-13, \$70,000.

### **Consulting Clients**

1. B.L. Williams Farm, near Tahoka, TX (1987). Surface water contamination assessment.
2. McWhorter, Cobb, and Johnston legal firm, Lubbock, TX (1988). Surface water contamination assessment.
3. Mike Irish Ranch, near Dickens, TX (1988). Surface and groundwater contamination assessment.
4. Bolton Oil Company, Lubbock, TX (1989-93). Leaking petroleum storage tank (LPST) site assessments and remediation design.
5. U.S. Army Corps of Engineers Construction Engineering Research Laboratory, Champaign, IL (1988-89). Literature review on the state-of-the-art of in situ bioremediation of aquifers and soil.
6. S.B. Campbell Trucking Company, Lubbock, TX (1989). LPST site assessment.
7. Ralph George for Estate of Roy George, Lubbock, TX (1990-94). LPST site assessment and remediation design.
8. Compliance Services Group, Inc., Lubbock, TX (1990-91). Four LPST site assessments for clients in Amarillo and Lubbock.
9. Oller Engineering, Inc., Lubbock, TX (1990-91). Three LPST site assessments for clients in Lubbock. Hazardous waste site assessment for cottonseed delinting company in Shallowater.

10. Technical Coatings, Inc., Lubbock, TX (1991-95). LPST site assessment.
11. University Medical Center, Lubbock, TX (1992). Jet-fuel leak site assessment review.
12. JB Fluids Services, Inc., Seminole, TX (1993-94). LPST court case site assessment.
13. Andrews Industrial Foundation, Inc., Andrews, TX (1993-98). Hazardous waste landfill site evaluation.
14. St. Anthony's Hospital, Amarillo, TX, (1993). LPST site assessment.
15. Hughes Remediation, Inc., Lubbock, TX (1992-93). LPST site monitoring.
16. Glovier and Associates, Dumas, TX (1994). Groundwater monitoring plan for city landfill, Dumas, TX.
17. McFall, Sherwood, and Sheehy, Attorneys, Houston, TX (1994-95). Expert for defendants Farm and Home Association, Brio landfill site, near Friendswood, TX.
18. Provost and Umphrey, Attorneys, Beaumont, TX (1994-97). Expert for plaintiff home owners (two depositions), Austin Tank Farm site, Austin, TX.
19. Reich and Binstock, Attorneys, and Susman Godfrey, L.L.P., Houston, TX (1994-98). Expert for plaintiff home owners (three depositions), potential damage by petrochemical plants in Corpus Christi, TX.
20. Clark, Thomas, and Winters, Attorneys, Austin, TX (1994-95). Expert for plaintiff land owner affected by groundwater contamination from Reese Air Force Base (one courtroom testimony), Lubbock, TX.
21. Newton Schwartz, Attorney, Houston, TX (1997-99). Expert for plaintiffs, potential damage by the MOTCO facility, Houston, TX.
22. ENPROTEC, Lubbock, TX (1997). Consult on petroleum contamination and remediation issues for sites in Lubbock, TX.
23. Cowles and Thompson, Attorneys, Dallas, TX (1998-99). Expert for defendant oil lease operator on surface and subsurface contamination in Ward County (one deposition).
24. engineering-environmental Management, Inc. (1998). Slug tests at Pantex monitoring well sites.
25. Denver City Energy Associates, Denver City, TX (1998-). Groundwater resources evaluation for power plant development.
26. U.S. Department of Energy Pacific Northwest Laboratory, Hanford, WA (1998-99). Review hydrologic research report.
27. U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, MI (1999-2000). Field demonstration of degradation of high explosives in soil.
28. Texas Instruments (2000-2). Groundwater contamination assessment.
29. Stubbeman, McRae, Sealy, Laughlin and Browder, Attorneys, Midland, TX (2000). Expert for defendant oil lease operator on surface and subsurface contamination in Reeves County.
30. LS Power, LLC, St. Louis, MO (2000-01). Groundwater resources evaluation for power plant development.
31. Jimmy May, P.E., Lubbock, TX (2001). Expert for well productivity loss (one deposition, one courtroom testimony).
32. Environmental Technologies Group, Inc. (2001-3). Groundwater and subsurface contamination assessment and remediation (one deposition, two courtroom testimonies).

33. Willis Gresham, Attorney, Lubbock, TX (2001-3, 2008-9). Groundwater contamination assessment.
34. Water Preservation Committee, LLC, Garden City, KS (2002-03). Groundwater allocation assessment (hearing testimony).
35. Hope, Mills, Bolin, Collins, Ramsey, and Heydman, Attorneys, Garden City, KS (2002-03). Groundwater allocation assessment (one deposition).
36. BWXT-Pantex, Amarillo, TX (2003-). Outside review of remediation and investigation of groundwater contamination.
37. Espey Consultants, Inc., Austin, TX (2003-04). Water quality sampling in playa lakes.
38. Craig, Terrill, Hale & Grantham, L.L.P., Lubbock, TX (2003-06). Expert in groundwater contamination assessment (one deposition).
39. The Sher Law Firm, P.L.L.C., Houston, TX (2004-06). Expert witness in groundwater contamination assessment (one deposition).
40. Quilling, Selander, Cummiskey, Lownds, P.C., Dallas, TX (2004). Expert witness for groundwater presence in pipeline construction (one deposition).
41. Foulston Siefken LLC, Wichita, KS, (2004-05). Groundwater rights issues in Kansas (hearing testimony).
42. J.C. Adams, Morton, TX, (2005). Groundwater contamination assessment.
43. C.H. Guernsey & Company, Oklahoma City, OK (2005). Groundwater and surface water assessment for municipal supply.
44. Lower Colorado River Authority, Austin, TX (2005-10). Scientific review of LCRA/SAWS project.
45. Temple Dickson, Attorney, Sweetwater, TX (2005-06). Groundwater contamination assessment.
46. Foulston Siefken LLC, Wichita, KS, (2005-06). Groundwater rights issues in Kansas (hearing testimony).
47. Foulston Siefken LLC, Wichita, KS, (2006-07). Surface water rights issues in Kansas.
48. Zach Brady, attorney, Lubbock, TX (2006-07). Groundwater availability assessment.
49. BWXT-Pantex, Amarillo, TX, (2007). Evaluation of expansion of groundwater pump-and-treat system.
50. Lynch, Chappell & Alsup PC, Midland, TX, (2007-08). Expert witness for groundwater contamination assessment.
51. Texas State Soil and Water Conservation Board, Temple, TX, (2007-). Determination of selection criteria for brush control/streamflow enhancement sites.
52. John Visser, Lariat, Texas, (2008). Evaluation of groundwater availability and use at dairy.
53. Terracon, Dallas, TX (2009-). Modeling groundwater contamination site for City of Lubbock.
54. Clay Gaston, Midland, TX (2009-12). Groundwater contamination assessment (one deposition).
55. Foulston Siefken LLC, Wichita, KS, (2010). Groundwater contamination assessment.
56. Housing Authority of Corpus Christi, Corpus Christi, TX (2010-11). Groundwater contamination assessment.
57. Jasper Quintanilla, LLC, Dallas, TX, (2011). Well permit application review.

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