

# EXHIBIT 67



**Greg Pohll, Ph.D.**  
Research Professor

## **EDUCATION**

**University of Nevada, Reno**

Doctor of Philosophy in Hydrology and Hydrogeology, 1996

**University of Nevada, Reno**

Master of Science in Hydrology, 1993

**University of Nevada, Reno**

Bachelor of Science in Education/Mathematics, 1991

## **PROFESSIONAL EXPERIENCE**

**Desert Research Institute, Division of Hydrologic Sciences**

*Deputy Director, 2010 – Present*

**Desert Research Institute, Division of Hydrologic Sciences**

*Research Professor, 2010 – Present*

**University of Nevada, Reno, Graduate Program of Hydrologic Sciences**

*Director, 2008 - 2011*

**Desert Research Institute, Division of Hydrologic Sciences**

*Associate Research Professor, 2001 – 2010*

**University of Nevada, Reno, Graduate Program of Hydrologic Sciences**

*Associate Director, 2007 - 2008*

**Desert Research Institute, Division of Hydrologic Sciences**

*Assistant Research Professor, 1997 - 2001*

**Desert Research Institute, Water Resources Center**

*Post-Doctoral Fellow, 1996 - 1997*

**University of Nevada, Reno, Graduate Program of Hydrologic Sciences**

*Faculty Member, 1997 – Present*

**Feather River Community College**

*Lecturer, 1995*

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## TEACHING EXPERIENCE

### University of Nevada, Reno

- Hydrology Seminar (Graduate)
- Groundwater Hydrology (Undergraduate/Graduate)
- Parameter Estimation and Uncertainty Analysis for Watershed Modeling (Graduate)
- Groundwater Modeling (Graduate)
- Contaminant Transport (Graduate)
- Stochastic Hydrology (Graduate)
- Numerous special topics courses related to hydrology (Graduate)

### Desert Research Institute

- Short Courses on Hydrologic Modeling

### Feather River Community College

- General Hydrology (Undergraduate)

## ACADEMIC ADVISEMENT

- Advisor for 23 M.S. and 3 Ph.D. students in the Graduate Program of Hydrologic Sciences at the University of Nevada, Reno
- Served on numerous graduate committees for students in hydrology, engineering, geology, environmental science, and ecosystem science
- Advised, supervised, and mentored numerous undergraduate students who worked on my research projects

## PUBLICATIONS

### Peer-Reviewed Publications

1. Naranjo, R.C., G. Pohll, R.G. Niswonger, M. Stone, and A. McKay, 2012 – In Review , Parametric Uncertainty of arrival time estimates in the hyporheic zone, Water Resources Research.
2. Beamer, J., J.L. Huntington, C.G. Morton, and G. Pohll, 2012 – In Review, Estimating Annual Groundwater Evapotranspiration from Phreatophytes in the Great Basin using Landsat EVI and Flux Tower Measurements, Journal of the American Water Resources Association.
3. Eissa, M., G. Pohll, and J. Thomas, 2012 – In Review, Groundwater Resource Sustainability in the Wadi Watir Delta, Gulf of Aqaba, Sinai, Egypt, Journal of Hydrology.
4. Morton, C., J.L. Huntington, G.M. Pohll, R.G. Allen, K.C. McGwire, and S.D. Bassett, 2012 – In Review, Assessing Calibration Uncertainty and Automation for Estimating Evapotranspiration from Agricultural Areas Using METRIC, Journal of the American Water Resources Association.

5. Carroll, R., Pohll, G., Morton, C., and Huntington, J., 2012 - In Review. Calibrating Basin-Scale Groundwater Models to Landsat Indices of Groundwater Evapotranspiration. *Journal of Hydrology*.
6. Shanafield, M., R.G. Niswonger, D.E. Prudic, G. Pohll, R. Susfalk, and S. Panday, 2012. A method for estimating spatially variable seepage and hydraulic conductivity in channels with very mild slopes, *Hydrological Processes*, DOI: 10.1002/hyp.9545.
7. Shope, C., J. Constantz, C. Cooper, D.M. Reeves, G. Pohll, and W.A. McKay, (In Review). Influence of a semiarid channel bar on stream exchange with the adjacent streambed and streambank sediments, *Water Resources Research*.
8. McGraw, D, G. Pohll, R. Schumer, and M. Shanafield, 2011. Development of tools to estimate Truckee River conveyance losses, *Hydrogeology Journal*, 19(2), 329-338.
9. Huntington, J., S. Szilagyi, S. Tyler, and G. Pohll, 2011. Evaluating the Complementary Relationship for Estimating Evapotranspiration from Arid Shrublands, *Water Resources Research*, 47, doi:10.1029/2010WR009874.
10. Shanafield, M., C. Hatch, and G. Pohll, 2011. Uncertainty in time series analysis estimates of streambed water flux, *Water Resources Research*, 47, doi:10.1029/2010WR009574.
11. Shanafield, M., G. Pohll, and R. Susfalk, 2010. Use of heat-based vertical fluxes to approximate total flux in simple channels, *Water Resources Research*, 46, doi:10.1029/2009WR007956.
12. Ye, M., K. Pohlmann, J. Chapman, G. Pohll, D.M., Reeves, 2010. A model-averaging method for assessing groundwater conceptual model uncertainty, *Ground Water*, 48(5), 716-728.
13. Reeves, D.M., K. Pohlmann, G. Pohll, M. Ye, and J. Chapman, 2010. Incorporation of conceptual and parametric uncertainty into radionuclide flux estimates from a fractured granite rock mass, *Stochastic Environmental Research and Risk Assessment*, DOI: 10.1007/s00477-010-0385-0.
14. Carroll, R., G. Pohll, and R. Hershey, 2009. An unconfined groundwater model of the Death Valley Regional flow system and a comparison to its confined predecessor. *Journal of Hydrology*, 373, 316-328.
15. Epstein, B. J., G. Pohll, J. Huntington, and R. Carroll, 2010. Development and Uncertainty Analysis of an Empirical Recharge Prediction Model for Nevada's Desert Basins, *Nevada Water Resources Association Journal*, 5, 1-22.
16. Carroll, R., G. Pohll, D. McGraw, C. Garner, A. Knust, D. Boyle, T. Minor, and K. Pohlmann, 2010. Mason Valley Ground Water Model – Linking Surface and Ground Water Process in the Walker River Basin, Nevada, *Journal of the American Water Resources Association*, 46(3), 554-573.

17. Lutz, A, J. Thomas, G. Pohll, A. McKay, and B. Apambire, 2008. Sustainability of groundwater in Mali, West Africa, *Environmental Geology*. DOI 10.1007/s00254-008-1646-9.
18. Botros, F., A. Hassan, D.M. Reeves, and G. Pohll, 2008. On mapping fracture networks onto continuum. *Water Resources Research*. 44, doi:10.1029/2007WR006092.
19. Carroll, R., G. Pohll, S. Earman, R.L. Hershey, 2008. A comparison of groundwater fluxes computed with MODFLOW and a mixing model using deuterium: application to the eastern Nevada Test Site and vicinity. *Journal of Hydrology*, 361, 371-385.
20. Lutz, A., J. Thomas, G. Pohll, M. Keita, B. Apambire, B, and W.A. Mckay, 2007. Groundwater Resource Sustainability in the Nabogo Basin of Ghana, *Journal of African Earth Sciences*, 49(3), 61-70.
21. Carroll, R., Pohll, G., Earman, S., and Hershey, R., 2007. Global Optimization of a Deuterium Calibrated, Discrete-State Compartment Model (DSCM): Application to the Eastern Nevada Test Site. *Journal of Hydrology*, 345(3-4), 237-253.
22. Young, M., W. Albright, K. Pohlmann, G. Pohll, W. Zachritz, S. Zitzer., D. Shafer, L. Nester, , and L. Oyelowo, 2006. Incorporating Parametric Uncertainty in the Design of Alternative Landfill Covers in Arid Regions, *Vadose Zone Journal*, 5(2), 742-750.
23. Carroll, R., G. Pohll, J. Tracy, T. Winter, and R. Smith, 2005. Simulation of Semi-Permanent Wetland Basin in the Cottonwood Lake Area, East-Central North Dakota, *Journal of Hydrologic Engineering*, 1(10), 70-84.
24. Stevick, E., G. Pohll, and J. Huntington, 2005. Locating New Production Wells using a Probabilistic-Based Groundwater Model, *Journal of Hydrology*, 303(1-4), 231-246.
25. Niswonger, R., D. Prudic, G. Pohll, J. Constantz, 2005. Incorporating Seepage Losses into the Unsteady Streamflow Equations for Simulating Intermittent Flow along Mountain Front Streams, *Water Resources Research*, 41, DOI: 10.1029/2004WR003677.
26. Benson, D., C. Tadjeran, M. Meerschaert, I. Farnham, and G. Pohll, 2004. Radial Fractional-Order Dispersion through Fractured Rock, *Water Resources Research*, 40, DOI: 10.1029/2004WR003314
27. Dahan, O., D. McGraw, E. Adara, G. Pohll, B. Bohm, and J. Thomas, 2004. Multi-Variable Mixing Cell Model as a Calibration and Validation Tool for Hydrogeologic Groundwater Modeling, *Journal of Hydrology*, 293(1-4), 115-136.
28. Reimus, P., G. Pohll, T. Mihevc, J. Chapman, M. Haga, B. Lyles, S. Kosinski, R. Niswonger, and P. Sanders, 2003. Testing and Parameterizing a Conceptual Model for Solute Transport in a Fractured Granite using Multiple Tracers in a Forced-Gradient Test, *Water Resources Research*, 39(12), doi:10.1029/2002WR001597.

29. Morse, B., G. Pohll, J. Huntington, and R. Castillo, 2003. Stochastic Capture Zone Analysis of an Arsenic-Contaminated Well using the Generalized Likelihood Uncertainty Estimator (GLUE) Methodology, *Water Resources Research*, 39(6), doi:10.1029/2002WR001470.
30. Pohll, G., J. Warwick, and D. Benson, D., 2000. On the Errors Associated with Two-Dimensional Stochastic Solute Transport Models, *Transport in Porous Media*, (3), 281-293.
31. Pohll, G., A. Hassan, J. Chapman, C. Papeis, and R. Andricevic, 1999. Modeling Groundwater Flow and Radionuclide Transport in a Fractured Aquifer, *Ground Water*, 37(5), 770-784.
32. Pohll, G., J. Warwick, and S. Tyler, 1996. Coupled Surface/Subsurface Hydrologic Model of a Nuclear Subsidence Crater at the Nevada Test Site, *Journal of Hydrology*, 186(1-4), 43-62.
33. Pohll G. and J.Guitjens, 1994. Modelling regional flow and flow to drains, *Journal of Irrigation Drainage Engineering*, 20(5), 71-82.

#### **Conference Proceedings (Previous 5 Years)**

1. Cooper, C.A., J.M. Thomas, B.F. Lyles, D.M. Reeves, G. Pohll, and R. Parashar, 2012. A Preliminary Geochemical Description of the Geothermal Reservoir at Astor Pass, Northern Pyramid Lake, Nevada, Geothermal Resources Council Annual Meeting, Reno, NV.
2. D.M. Reeves, G. Pohll, B. Lyles, J. Faulds, J. Louie, B. Ehni, C. Kratt, C. Cooper, R. Parashar, and S. Pullammanappallil, Geothermal Resource Characterization and Evaluation at Astor Pass, Nevada, Geothermal Resources Council Annual Meeting, Reno, NV.
3. Reeves, D.M., R. Parashar, R., and G. Pohll, 2011. A numerical investigation of soil-bedrock interface flow impedance MODFLOW and MORE 2011: Integrated Hydrologic Modeling. Golden, CO.
4. Beamer, J P, C. Morton, J. Huntington, and G. Pohll, 2011. Annual Evapotranspiration Estimation Using Landsat and Flux Tower Data Nevada Water Resources Association 2011 Annual Conference. Reno, NV.
5. Carroll, R., G. Pohll, and D.M. Reeves, 2011. Design guidelines for horizontal drains used for slope stabilization MODFLOW and MORE 2011: Integrated Hydrologic Modeling. Golden, CO.
6. Huntington, J, C. Morton, J. Beamer, A. Sullivan, B. Lyles, R. Allen, and G. Pohll, 2011. Estimating Evapotranspiration From Irrigated Agriculture and Groundwater Discharge Areas in Nevada using Remote Sensing and Weather Station Data AWRA 2011 Annual Water Resources Conference. American Water Resources Association. Albuquerque, New Mexico.
7. Reeves, D.M., J. Huntington, S. Rajagopal, G. Pohll, Y. Zhang, and R. Parashar, 2011. Integrated ground water - surface water modeling of Martis Valley for assessment of climate change impacts on basin-scale water resources Nevada Water Resources Association 2011 Truckee River Symposium. Reno, NV.

8. Huntington, J., L.A. Sullivan, T. Minor, T. Mihevc, B. Lyles, G. McCurdy, R. Allen, G. Pohll, and J. Thomas, 2011. Towards Updating & Enhancing Existing Agricultural Consumptive Use & Basin Water Budgets Throughout the State of Nevada Nevada Water Resources Association 2011 Annual Conference. Nevada Water Resources Association. Reno, NV.
9. Gilbertson, L., G. Pohll, and J. Huntington, 2011. Using Vegetation Indices from MODIS to Estimate Evapotranspiration for the Godomey Well Field in Benin. American Geophysical Union 2011 Fall Conference. American Geophysical Union. San Francisco, CA.
10. Huntington, J., A. Sullivan, R. Allen, T. Minor, C. Morton, G. Pohll, and J. Thomas, 2011. Water Transfers from Agriculture to Cities and Basin Management - ET Mapping Contributions in Nevada First Annual Western States ET Workshop. Western States Evapotranspiration Workshop. Boise, ID.
11. Comartin, L., D.M. Reeves, G. Pohll, and J. Huntington, 2010. A basin-scale model of Pahrump Valley, Nevada for water resources management National Ground Water Association Summit.
12. Comartin, L., D.M. Reeves, G. Pohll, and J. Huntington, 2010. A basin-scale model of Pahrump Valley, Nevada for water resources management Nevada Water Resources Annual Conference. Las Vegas
13. Beamer, J.P., C. Morton, J. Huntington, G. Pohll, 2010. Comparison of Methods for Estimating Evapotranspiration using Remote Sensing Data American Geophysical Union Fall Conference. American Geophysical Union. San Francisco, CA.
14. Eissa, M.A., J. Thomas, M. Dawoud, G. Pohll, M. Gomaa, K. Dahab, and R. Hershey, 2010. Groundwater resource sustainability in Wadi Watir, Gulf of Aqaba, Sinai, Egypt 10th International Conference on Development of Drylands, Cairo, Egypt, December 12-15, 2010.
15. Reeves, D.M., S. Humphrey, G. Pohll, J. Huntington, and B. Epstein, 2010. Incorporation of recharge uncertainty in basin-scale water resource models in semi-arid environments National Ground Water Association Summit 2010.
16. Jia, L., Stone, G. Pohll, and D. McGraw, 2010. Response of Riparian Evapotranspiration to Groundwater Fluctuations World Environmental & Water Resources Congress. EWRI. Providence, RI.
17. Huntington, J.L., C. Morton, J. Beamer, T. Minor, R. Allen, A. Sullivan, G. Pohll, B. Lyles, and J. Thomas, 2010. Western Nevada Water Resources Evaluation Program The USBR-Alliance University Applied Remote Sensing of Evapotranspiration Conference. The USBR-Alliance University. Las Vegas.
18. Boyle, D.P., T. Minor, G. Pohll, A. Knust, C. Garner, R. Carroll, D. McGraw, S. Bassett, C. Barth, D. Norpchen, and A. Stroud, 2009. Development and Testing of a Decision Support

- Tool in Support of Water Right Acquisitions in the Walker River Basin International Symposium on Terminus Lakes. NSHE: Walker Basin Project. Reno, NV.
19. Comartin, L., D.M. Reeves, G. Pohll, and J. Huntington, 2009. Development of a groundwater flow model of Pahrump Basin, Nye County, Nevada and Inyo County, California Devils Hole Workshop.
  20. Comartin, L., D.M. Reeves, G. Pohll, J. Huntington, 2009. Development of a validated groundwater flow model of Pahrump Basin, Nevada Nevada Water Resources Association Annual Conference. Reno, Nevada.
  21. Reeves, D.M., S. Humphrey, G. Pohll, G. Oppliger, J. Huntington, 2009. Evaluation of parametric uncertainty on drawdown predictions from the interbasin groundwater transfer at Honey Lake Valley, Nevada Nevada Water Resources Association Annual Conference. Reno, Nevada.
  22. Carroll, R.W, J. Warwick, G. Pohll, 2009. Mercury Transport Modeling of the Carson River System, Nevada: An Investigation of Total and Dissolved Species and Associated Uncertainty Fall Conference. AGU. San Francisco, California.
  23. Chapman, J., K. Pohlmann, G. Pohll, and C. Russell, 2009. Role of Groundwater Monitoring for Closure of Underground Nuclear Tests on the Nevada Test Site American Geophysical Union. American Geophysical Union. San Francisco.
  24. Huntington, J, R. Niswonger, S. Markstrom, R. Regan, and G. Pohll, 2009. Using GSFLOW and Hydrologic Tracers to Assess Surface and Groundwater Interactions, Residence Times, and Flowpaths in Two Lake Tahoe Watersheds, American Geophysical Union, Fall Meeting, San Francisco.
  25. Humphrey, S., D.M.Reeves, G. Pohll, G. Oppliger, and J. Huntington, J.; 2008. A stochastic approach to a groundwater flow model for the southern Honey Lake Valley in Lassen County, California and Washoe County, Nevada Nevada Water Resources Association Annual Conference. Mesquite, Nevada.
  26. Ye, M., K. Pohlmann, J. Chapman, G. Pohll, and D. Reeves, 2008. Assessing recharge and hydrostratigraphic model uncertainty in the Climax Mine area of the Nevada Test Site MODFLOW and MORE 2008: Ground Water and Public Policy. Golden, CO.
  27. Shanafield, M., G. Pohll, and R. Susfalk, 2008. Comparison of Numerical Models to Predict Vertical Water Flux American Geophysical Union, San Francisco.
  28. Reeves, D.M, Y. Zhang, G. Pohll, and D. Benson, D.; 2008.FRACK: A freeware flow and transport suite for fractured media MODFLOW and MORE 2008: Ground Water and Public Policy. Golden, CO.
  29. Carroll, R., G. Pohll, K. Pohlmann, D. Boyle, C. Garner, and A. Knust, 2008. Preliminary Model of a Coupled Groundwater-Surface Water System, Mason Valley, Nevada

- MODFLOW and More: Ground Water and Public Policy. International Ground Water Modeling Center. Colorado School of Mines, Golden, CO USA.
30. Carroll, R., G. Pohll, S. Earman, and R. Hershey, 2007. A comparison of groundwater fluxes computed with MODFLOW and a stable isotope mixing model: Application to the eastern Nevada Test Site and vicinity American Geophysical Union Fall Meeting. San Francisco.
  31. Botros, F. Hassan, and G. Pohll, 2007. Block-effective Dispersivity in Heterogeneous Media: Effects of Porosity and Distribution Coefficient Variability International Symposium on Technology and Society: Risk, Uncertainty, Vulnerability. IEEE. Las Vegas, Nevada.
  32. Makowski, A., G. Pohll, and C. Kropf, 2007. Modeling Nitrate Transport in Spanish Springs Valley, Washoe County, Nevada Nitrate Workshop. Nevada Water Resources Association. Carson City, Nevada.
  33. Chapman, J., G. Pohll, A. Hassan, and K. Pohlmann, 2007. Using Uncertainty to Guide Characterization, Closure, and Long-term Management of an Underground Nuclear Test Site International Symposium on Technology and Society: Risk, Uncertainty, Vulnerability. IEEE. Las Vegas, Nevada.

### **Miscellaneous Publications**

1. Pohll, G., R. Carroll, D.M. Reeves, R. Parashar, B. Muhunthan, S. Thiyagarajah, T. Badger, S. Lowell, K. Willoughby, 2012. Design Guidelines for Horizontal Drains used for Slope Stabilization, DRI Report.
2. Pohll, G., and J. Chapman, 2010. Value of Information Analysis, Project Gnome Site, New Mexico. DRI Publication Number: 45227.
3. Boyle, D., G. Pohll, S. Bassett, T. Minor, C. Garner, R. Carroll, D. McGraw, A. Knust, and C. Barth, 2009.. Development of a Decision Support Tool in Support of Water Right Acquisitions in the Walker River Basin.
4. Reimus, P., R. Hershey, D. Decker, E. Garcia, S. Earman, J. Ryu, B. Roback, G. Pohll, and L. Papelis, 2009. Laboratory Experiments of <sup>14</sup>C Uptake and Release on Calcite and Dolomite to Support Groundwater Radionuclide Transport Modeling for the Nevada Test Site Underground Test Area Program.
5. Laczniak, R. A. Flint, M. Moreo, L. Knochenmus, K. Lundmark, G. Pohll, R. Carroll, J. Smith, T. Welborn, V. Heilweil, M. Pavelko, R. Hershey, J. Thomas, S. Earman, B. Lyles, B. F.; 2007. Ground-water budgets, in Welch, A. H., Bright, D. J., and Knochenmus, L. A., eds., Water resources of the Basin and Range carbonate-rock aquifer system, White Pine County, Nevada, and adjacent areas in Nevada and Utah.

6. Pohll, G., and A. Makowski, 2007. Red Rock Valley Red Rock Valley – Groundwater Modeling.
7. Epstein, B., G. Pohll, D. Bansah, A. Makowski, 2007. Regional Groundwater Model Development for the Fernley/Wadsworth Hydrologic Basins, Nevada. DRI Publication Number: 41229.
8. Carroll, R., R. Hershey, and G. Pohll, 2006. Numerical simulation of groundwater withdrawal from proposed pumping near the southeastern Nevada Test Site. DRI Publication Number: 45217.
9. Gilliam, A., R. Carroll, G. Pohll, R. Hershey, 2006. Numerical simulation of groundwater withdrawal within the Mercury Valley administrative groundwater basin, Nevada. DRI Publication Number: 45214.
10. Lane, J., P. Joesten, G. Pohll, and T. Mihevc, 2001. Analysis of Borehole-Radar Reflection Logs from Selected Boreholes at the Project Shoal Area, Churchill County, Nevada, U.S. Geological Survey, Water Resources Investigations Report: WRI 01-4014, 23p.
11. Pohll, G., and Warwick, J., 2000. Stochastic Analysis of a Coupled Surface/Subsurface Hydrologic Model, In: Terrain Analysis - Principles and Applications, Edited by: Wilson, J., and Galland, J., John Wiley and Sons, Inc., New York, NY.

## **SERVICE ACTIVITIES**

- Chair - Washoe County Well Mitigation Board
- Member of the Department of Energy Groundwater Modeling Review Team
- External reviewer for the following journals:
  - Water Resources Research
  - Journal of Hydrology
  - Ground Water
  - Journal of the American Water Resources Association
  - Hydrogeology Journal
- Served on numerous committees within DRI and UNR

## **EXTRAMURAL FUNDING**

Nevada Water Resources Data, Modeling, and Visualization (DMV) Center (\$1,600,000), Co-PI, Sponsor: Department of Energy – The goal of this project is to develop a decision support framework using digital modeling, 3D visualization and data acquisition (sensor webs and aerial sensing) to address watershed-scale hydrologic issues within the Lake Tahoe basin. This framework is seen as a tool for enabling and compiling our understanding of processes that control the availability and

distribution of water within the Lake Tahoe basin. The framework is intended to support the analysis of the complex interactions between processes that affect supply, giving rise to controllable abundance but also capable of triggering scarcity or deluge. The developed framework, consisting of infrastructure and tools, will enable DRI to establish a center of excellence in water resource management and analysis of hydrologic issues, particularly within the Lake Tahoe basin.

Martis Valley Watershed Model (\$300,000), Co-PI, Sponsor: Bureau of Reclamation, - Development of integrated watershed-ground water model of Martis Valley, Ca to understand the potential effects of climate change on groundwater and surface water supplies.

Application of the METRIC Approach to Western Nevada (\$3,500,000), Co-PI, Sponsor: Bureau of Reclamation – Calculation of evapotranspiration in western Nevada and associated uncertainty.

Development of Tools to Estimate Truckee River Conveyance Losses (\$350,000), Co-PI, Sponsor: Bureau of Reclamation – Development of a numerical algorithm to calculate transportation losses on the Truckee River in support of the existing TROA water accounting system.

Decision Support Tool in Support of Walker Lake Restoration (\$1,200,000), Co-PI, Sponsor: Bureau of Reclamation – Development of a watershed-scale hydrologic model and decision support tool to aid in the acquisition of water rights in the Walker Basin.

Monitoring Reservoir Evaporation and Invasive Species in the Southwestern U.S.(\$200,000), PI, Sponsor: Bureau of Reclamation, - Development of innovative tools for the measurement of evaporative losses from reservoirs and evapotranspiration losses from invasive species such as Tamarix.

Design Guidelines for Horizontal Drains used for Slope Stabilization (\$400,000), PI, Sponsor: Washington State Department of Transportation – Development of a design manual to aid geotechnical engineers in lowering water levels to increase slope stability.

Las Vegas Wash Perchlorate Transport Model (\$50,000), Co-PI with local consulting firm, Sponsor: Nevada Division of Environmental Protection – Development of a coupled surface/groundwater flow and transport model to estimate perchlorate loading to the Las Vegas Wash.

Comprehensive Evaluation of the Geothermal Resource Potential within the Pyramid Lake Paiute Reservation (\$4,900,000), PI, Sponsor: Department of Energy, Geothermal Technologies Program – Integration of state-of-the-art exploration technologies with geologic framework and reservoir modeling to determine the efficacy of future geothermal production at the Astor Pass Site within the Pyramid Lake Paiute Reservation.

Data Decision Analysis: Central Nevada Test Area (\$250,000), PI, Sponsor: Department of Energy - Quantify the current model output uncertainty for the Central Nevada Test Area (CNTA) groundwater model and to determine the most cost-beneficial characterization activities for reducing uncertainty.

Groundwater Impacts Associated with the Southern Nevada Water Authority Pipeline (\$250,000), PI, Sponsor: Department of Energy – Development of a groundwater model to determine drawdown impacts from Southern Nevada Water Authority proposed pumping.

ENEL Stillwater Geothermal Plant Expansion Environmental Impact Assessment Support (\$100,000), Co-PI, Sponsor: ENEL – Aid ENEL’s environmental team to determine the potential environmental impacts associated with their geothermal plant expansion in Stillwater, Nevada.

Truckee Canal Seepage Analysis in the Fernley/Wadsworth Area (\$200,000), PI, Sponsor: Bureau of Reclamation – Estimation of seepage losses from the Truckee Canal using thermal methods

Evaluation of Groundwater Supplies in the Fernley Area, Nevada (\$180,000), PI, Sponsor: Bureau of Reclamation – Update a basin-wide hydrologic model to help locate new water supplies for the City of Fernley

Value of Information Analysis Project Gnome Site, New Mexico (\$250,000), PI, Sponsor: Department of Energy – Cost-benefit analysis for groundwater characterization activities to reduce model uncertainty.

Development of a Groundwater Model for the Pahrump, Nevada (\$300,000), Co-PI, Sponsor: Inyo County – Development of a groundwater flow model to assess groundwater resources in the Pahrump Valley.

Redrock Valley Water Resource Evaluation (\$120,000), PI, Sponsor: Redrock Valley Ranch, LLC – Analysis of available water supplies within Red Rock Valley, NV. The analysis was used to for a subsequent water right application and testimony at a Nevada State Engineer hearing.

Steady-state Water Budget Accounting Model for Water Resources of the Basin and Range Carbonate Aquifer System in White Pine County, Nevada, and adjacent areas in Nevada and Utah (\$250,000), Co-PI, U.S. Geological Survey - Groundwater budgets for a twelve basin carbonate aquifer study area in White Pine County, Nevada, and adjacent areas in Nevada and Utah were evaluated using a steady state groundwater mass-balance accounting model.

Contaminant Boundary Assessment for the Project Shoal Underground Test Area (\$400,000), Co-PI, Sponsor: Department of Energy – Development of a groundwater flow and transport model to calculate the contaminant boundary for Corrective Action Unit \$447.

Spanish Springs – Nitrate Contamination Assessment (\$275,000), PI, Sponsor: Washoe County Department of Water Resources – Development of a groundwater flow and transport model to test the efficacy of potential nitrate remediation alternatives.

Application of the METRIC Approach to Western Nevada (\$1,500,000), Co-PI, Funded, Sponsor: Bureau of Reclamation – Calculation of evapotranspiration in western Nevada and associated uncertainty.

Decision Support Tool in Support of Walker Lake Restoration (\$1,200,000), Co-PI, Sponsor: Bureau of Reclamation – Development of a decision support tool to aid in the acquisition of water rights in the Walker Basin.

## **RESEARCH INTERESTS**

### Watershed Analysis and Modeling

As one of my main research interests, I have developed numerous computer models to simulate the interactions of surface and groundwater systems at the watershed scale. My Ph.D. research involved the simulation of overland flow and vadose zone infiltration to study the potential for enhanced recharge within nuclear subsidence craters and the Nevada Test Site. I developed a coupled model to study the interaction between semi-permanent wetlands and shallow groundwater in North Dakota. I am also involved in an ongoing project with the U.S. Geological Survey to couple existing watershed models (PRMS) to the most widely used groundwater model MODFLOW. The integrated model is called GSFLOW and was recently released to the public. I am using this model to better understand watershed-scale hydrologic processes in the Lake Tahoe and Truckee River watersheds.

### Climate Change Impacts on Hydrology

The mechanisms causing observed historical, and projected, hydrologic change in high-elevation catchments is poorly understood, especially regarding surface and groundwater interactions. I recently began investigating these issues in the Lake Tahoe basin. My data analysis and modeling indicates that summer time streamflow is declining. A thorough understanding of the linkage between changes in snowmelt timing and surface and groundwater (SW-GW) interactions will help address a major question in hydroclimate research, that is, how do changes in snowmelt and streamflow timing impact groundwater resources and groundwater derived surface-water resources? To simulate climate impacts on SW-GW interaction we rely on the integrated SW-GW interactions model, GSFLOW, and evaluate the interplay between changing groundwater conditions and baseflow during the 21st century for the snow-dominated watersheds of the eastern Sierra Nevada tributary to Lake Tahoe and Truckee Meadows hydrographic areas of California and Nevada.

### Thermal Analysis

Thermal analysis has been used as a simple method to determine natural recharge to groundwater systems and to determine stream/aquifer interactions. I have been involved in numerous studies around the U.S. that utilize temperature methods to quantify seepage losses from streams and canal systems. I developed a finite element coupled thermal/fluid model this is used with common inversion programs to calculate seepage loss.

### Drainage Assessment

I recently received funding to create a design manual for geotechnical engineers for horizontal drain installation for slope stability. The project is funded through a multi-state consortium to provide a single reference source that can be used to estimate water levels under drained conditions, and to provide a clear methodology for drainage design. The project will lead to an ASCE Manual of Practice as a guide for geotechnical engineers across the nation.

### MODFLOW Development

During a recent sabbatical I had the opportunity to work with software developers at the U.S. Geological Survey. The purpose of my sabbatical research was to develop a numerical solution for the well known MODFLOW “wet/dry” problem. I helped develop a new algorithm which allows flow along diagonal grid points near a free-surface boundary. Geometric relationships were used to estimate the average hydraulic conductivity for diagonal cells. The results are to be released shortly by the USGS. The new version of MODFLOW will solve a multi-decade problem and will allow hydrogeologists to solve many more types of problems without numerical instabilities.

#### Contaminant Transport

I have a lot of experience creating site-specific groundwater models to investigate the migration of contaminants in groundwater systems. Some of the investigations that I have been involved with include modeling radionuclide movement from nuclear tests, MTBE migration from underground storage tanks, total dissolved solids, pesticides, nitrate, perchloroethylene, and perchlorate plumes. In an effort to study the leaching of perchlorate beneath the Las Vegas Wash, I developed a coupled groundwater and channel model to predict future perchlorate concentrations entering Lake Mead. The results were used by stakeholders within the Colorado River Basin to make decisions regarding downstream users.

#### Geochemistry

I developed a computer program for the DRI geochemistry group that calculates concentration changes for batch experiments under the assumption of an infinite number of rate coefficients. The user specifies the type of distribution and then solves for the moments such that there is general agreement between the simulated and experimental concentrations.

#### Fracture Flow Analysis

Simulation of fracture flow systems is difficult due to our inability to properly characterize the hydraulic features of individual fractures. Typically site-specific data includes the location and orientation of fractures as determined from borehole data. To take advantage of this information I developed a stochastic fracture generation program, which generates a three-dimensional model of fractures while conditioning at borehole locations. The model is used in combination with a groundwater flow model and inversion algorithm to produce realistic flow patterns. This model has become the first publicly available software package to solve hydrogeologic problems within fractured aquifers.

#### Value of Information Analysis

I developed a novel approach to determine the value of information for groundwater characterization for a site contaminated with radionuclides. The analysis framework incorporates data collection costs, the losses due to contaminated water, and consequences of making improper decisions to determine the most cost-beneficial characterization activities. The analysis technique integrated statistical protocols used by managers within the Department of Energy such that the results were consistent with

previously determined regulatory guidelines. The analysis framework was applied to the Project Gnome site located in southeast New Mexico.

#### Automatic Grid Refinement

I developed an automated procedure to automatically create a refined finite difference grid for an existing groundwater flow model. The program utilizes information from an existing model such that the new model with a higher resolution grid honors the original model's parameterization. The program was tested and implemented on the Death Valley Regional Flow System Model to ascertain drawdown under proposed pumping scenarios by the Southern Nevada Water Authority.

#### Contaminant Boundary Analysis

Regulatory agencies are moving toward a risk-based assessment of contaminated groundwater sites. In particular, the Department of Energy is required to provide a risk assessment for all of their underground nuclear tests and associated radionuclide migration. I developed a computer program that processes the results of a stochastic groundwater flow and transport model to develop three-dimensional maps of cancer risk over a 1000-year period into the future. These maps are then used by regulatory agencies to restrict future pumping from within the contaminant boundary.

#### Water Supply Analysis

I have been involved with two groundwater modeling studies to locate additional groundwater supplies and to predict the impact of increased pumping. I worked with the City of Fernley to develop a regional groundwater model that was used to determine new pumping locations based on simulated water level declines and TDS plume encroachment. At the Nevada Test Site, I used an existing model to determine the impacts of increased pumping on water levels and adjacent spring flows. I have been involved in a number of groundwater modeling studies to determine the efficacy of interbasin transfers.

#### Regional Recharge Analysis

According to the Nevada Division of Water Resources, perennial yield is the maximum amount of natural discharge that can be withdrawn and consumed each year for an indefinite period without bringing about undesired results. The Nevada State Engineer uses perennial yield estimates to determine if all water in a system is allocated or if some is available for a requested use. These estimates are highly uncertain due to errors in the recharge estimates and underlying model. I lead a project, which incorporated other independent estimates of natural recharge to calculate the uncertainty associated with the State Engineer perennial yield estimates using recent advances in numerical statistics.

### **CONSULTING EXPERIENCE**

I have approximately 10 years experience providing consultation and expert witness testimony for local water purveyors, and toxic tort litigation.

## **LEADERSHIP EXPERIENCE**

### Director – Graduate Program of Hydrologic Science (UNR)

- Created long term management and curriculum plan
- Interacted with UNR department chairs and upper administration.
- Held regularly scheduled faculty/student meetings
- Managed budgets (\$350,000)
- Supervised administrative staff
- Prepared annual reports for UNR administration
- Handled student/advisor issues as needed
- Conducted entrance and exit interviews with students
- Updated all program documents and created a student handbook
- Interacted with student leaders and students overall
- Wrote the Director's corner in the program newsletter
- Organized teaching assignments
- Created, organized, updated, and managed program databases

### Deputy Director – Division of Hydrologic Science, Desert Research Institute

- Supervise 15 faculty, staff, and research assistants
- Conduct annual evaluations for Rank II faculty within the division (10 faculty)
- Serve in the capacity of director in his absence
- Serve on the division research advisory council
- Responsible for mentoring junior faculty within division's Reno office.