

Allan R. Standen, P. G 1227
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Specialization

More than 35 years of experience with groundwater resource evaluations, facility and field operations, database management, environmental assessments, mining and mineral exploration, and geographic information systems (GIS).

During the last ten years, Mr. Standen has constructed a statewide GIS groundwater (TWDB and TDLR) geodatabase of over 400,000 wells to improve consulting response time and reduce costs for his clients. He has specialized in constructing stratigraphic and/or lithologic (formation and/or aquifer top and base) datasets by integrating oil and gas geophysical logs, scout tickets, cable tool driller and water well driller's reports into county scale hydro-stratigraphy for 3-D models of the subsurface hydrogeology. Mr. Standen has spent many years behind water well and mineral exploration drilling rigs supervising drilling and field operations. He provided the geological framework for the development of the Amarillo and CRMWD well fields, both producing approximately 20 to 25 million gallons per day. He presently works with numerous Texas groundwater districts assisting them in with their respective groundwater management and monitoring needs.

Academic Degrees

M.A., Geology, University of Texas at Austin, 1987

B.S., Geological Sciences, Kent State University, 1976

Professional Registration

Professional Geoscientist No. 1227, Texas

Professional Experience

Allan R. Standen LLC, President & owner July 2011 to present

Daniel B. Stephens & Associates, Inc., Austin, Texas, 2003 to July, 2011
Texas Water Resources Technical Director

LBG-Guyton Associates, Austin, Texas, 1998-2003, Hydrogeologist

International Technology Corporation, Austin, Texas, 1994-1998, Hydrogeologist/Geologist

Bureau of Economic Geology, University of Texas, Austin, Texas, 1981-1994
Research Assistant, Texas minerals and strategic metals studies (part-time from 1981-1987)
Manager/Curator Core Research Center (1987-1991), Research Scientist II (1991-1994)

Precious Metal Minerals Exploration, part and full time, 1979-1984, Chevron Minerals and Bear Creek Mining, Colorado, Utah and Nevada and Mobil Oil Uranium Mineral Exploration, 1976-1979, New Mexico, Texas and Nevada.

Military Service

Military Service, Navy, 1967 to 1971, Diesel and Nuclear submarines, Honorable discharge

Professional Memberships and Activities

Austin Geological Society

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National Groundwater Association
Society of Mining Engineering

Representative Professional Assignments

- ◆ ***3-D Interactive Hydro-stratigraphic Models for the University of Texas (University Lands) including portions of twelve West Texas counties***, Project area was approximately 1.2 million acres and involves building a interactive 3-D geological model of all aquifers and major oil and gas producing formations down to a depth of 20,000 feet within the University Lands leases in Crockett, Irion, Pecos, Reagan, Schleicher and Upton counties, west Texas (Permian Basin). Reviewed over 10,000 driller's reports and geophysical logs to select formation tops and water production zones to build surfaces and aquifer thicknesses. Through a screening process, subsurface information from over 1,100 wells was used to build the 3d hydro-stratigraphic model.
- ◆ ***3-D Interactive Hydro-stratigraphic Model for Pecos County Texas (Middle Pecos Groundwater District)*** Project area was over 5,000 square miles and involve integrating the subsurface geology from 1,100 oil, gas and water well driller's reports and geophysical logs. Built 3-D surfaces for five aquifers (Pecos Valley Alluvium, Edwards-Trinity Plateau, Dockum, Rustler and Capitan Reef Complex) and oil and gas surfaces down to 23,000 feet (top of Ellenburger) in the Delaware Basin. Interactive 3-D model allows clients to create cross-sections, measure thicknesses or distances to tops of formations and query individual wells for specific information.
- ◆ ***Hydro-stratigraphic Framework for Crockett County GCD***, Compiled over 800 cable tool driller's reports (BEG), geophysical logs (BEG) and water well driller's reports (TWDB, TDLR and TCEQ) to interpret subsurface geology. Using GIS, constructed a county wide stratigraphic framework of the Edwards, Trinity, and Dockum aquifers and the top surfaces of the Yates, San Andres and Ellenburger. Created net thickness isopachs of Edwards Limestone and net sand maps for Trinity and Dockum aquifers. Created a detailed recent water level surface using water level measurements from the TWDB and supplemented with water levels from recent water well drilling reports (TDLR). Provided client with hard and digital copies of data compiled in study, all GIS shapefiles created and Excel spreadsheets to aid District groundwater decisions.
- ◆ ***Clay Mine, Brown County (client is confidential)*** Supervised the drilling and geophysical logging of 14 core holes, logged (geological descriptions) the core holes, supervised curation of core and sampling for chemical analyses. Built GIS datasets for volumetric estimates of ore reserves and provided report for client to market clay mine.
- ◆ ***3-D Interactive Hydro-stratigraphic Model for Bell County Texas (Clearwater Groundwater District)*** Compiled over 550 oil, gas and water driller's reports and geophysical logs to a construct 3-D aquifer model down to a depth of 3,000 feet. Included Cretaceous Edwards and Trinity (Hensell and Hosston) aquifers. Deliverable product allowed the client to construct cross-sections, measure depths and formation thicknesses and the query wells used to construct model in real time.
- ◆ ***Hydro-stratigraphic Framework for Santa Rita GCD (Reagan County)***, Compiled over 400 cable tool driller's reports (BEG), geophysical logs (BEG) and water well driller's reports (TWDB, TDLR and TCEQ) to interpret subsurface geology. Using GIS, constructed a county wide stratigraphic framework of the Edwards, Trinity, and Dockum aquifers. Created net thickness isopachs of Edwards Limestone and net sand maps for Trinity and Dockum aquifers. Created a detailed recent water level surface using water level measurements from the TWDB and supplemented with water levels from recent water well drilling reports (TDLR). Provided client with hard and digital copies of data compiled in study, all GIS shapefiles created and Excel spreadsheets to aid District groundwater decisions.
- ◆ ***Hydro-stratigraphic Framework Cross-sections for Intera Geosciences and Engineering (client, Upper Trinity GCD)***: Compiled over 600 cable tool driller's reports, scout tickets, geophysical logs and water

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well driller's reports which were used to construct 13 cross-sections (strike (2) and dip (11)) of the Pennsylvanian, Permian and Cretaceous stratigraphy for Montague, Wise, Parker and Hood counties.

- ◆ ***Uranium exploration in Texas, (client is confidential)*** Evaluated potential for uranium resources throughout the state using TWDB groundwater chemistry and knowledge of Texas clastic aquifers.
- ◆ ***Hydro-stratigraphic Analysis of the Ward County well fields, CRMWD:*** Constructed detailed GIS hydro-stratigraphy of the Pecos Alluvium and the Dockum aquifers within the Ward and Winkler CRMWD well field. Used over 200 driller's and cable tool reports and geophysical logs to delineate stratigraphic surfaces and net sands. Information was used to construct a groundwater model to design well field.
- ◆ ***3-D Hydro-stratigraphic Analysis of the City of Fort Stockton's water rights, City of Fort Stockton, Pecos County:*** Project manager to construct 3-D hydro-stratigraphic model of southwestern Pecos County. Investigated water quality and historical water level fluctuations in the study area. Compiled over 350 geophysical logs, cable tool driller's reports and water well driller's reports to construct detailed subsurface stratigraphic model of the Edwards, Trinity and Dockum aquifers.
- ◆ ***3-D Hydrostratigraphic models of counties for Hemphill County GCD, Mesa GCD (Dawson County), High Plains GCD (Parmer County), Sutton County GCD, Permian GCD (Martin and Howard Counties), Wes-Tex GCD (Nolan County), Lone Wolf GCD (Mitchell County) and Fayette County GCD:*** Project manager and/or technical lead on the construction of 3-D hydrostratigraphy (Mining Visualization System (MVS) software) involving between 250 to approximately 700 driller's and cable tool reports, water well driller's reports and geophysical logs per county. The projects involved delineating stratigraphic/formational surfaces, quantifying gross and net saturated sand sequences, and creating 3-D visualizations of historical water level fluctuations.
- ◆ ***Water Rights Sales or Land Swaps, City of Amarillo,*** Project manager, Analysis involved using GIS to quantify volumetrics of the gross and net sand saturated thicknesses of water rights of the Ogallala and Santa Rita aquifers within Dallam and Hartley counties and Ogallala in Roberts County. Provided client with time-series of historical water level declines.
- ◆ ***Design of Groundwater Monitoring Programs for Central Texas GCD (Burnet County), Hickory GCD (areas of Concho, Lampasas, Kimble, Mason, McCulloch and Menard counties), Hemphill County GCD and Kenedy County GCD:*** Project manager, projects involved the selection of monitor wells based on selection criteria including historical water level availability and record extent, aquifer, aquifer condition (unconfined or confined), availability of historical water quality data, well accessibility, well status (pumping, inactive) and well type (windmill, domestic, etc.). Selected monitor wells were intended to be used for monitoring status of Desired Future Condition (DFC).
- ◆ ***Development of Structure and Stratigraphy of the Capitan Reef Aquifer, West Texas, Texas Water Development Board contracted report:*** Project Manager and Principal Investigator of active project for the construction of a GIS structural and stratigraphic framework of the Capitan Reef Aquifer located within a six county area in far west Texas. Supervised the correlation of Permian stratigraphy involving geophysical logs, scout tickets and driller's reports.
- ◆ ***Potter County Well Field, City of Amarillo, Texas:*** Project Manager of the construction of a GIS hydro-stratigraphic analysis of the Ogallala Aquifer and to assist in a well field design of a 20 million gallon per day well field. Provided oversight for drilling and well development operations.
- ◆ ***Development of Structure of the Llano Uplift Aquifer, Central Texas, Texas Water Development Board contracted report:*** Project Manager and Principal Investigator for evaluation of the structure and stratigraphy of the Llano Uplift region (18-county area), with particular emphasis on key hydrogeologic units. Created GIS structural elevation maps of four aquifer (Marble Falls, Ellenburger-San Saba, Welge-Lion Mountain, and Hickory) top and base surfaces. The groundwater is naturally radioactive. Also developed net sand isopachs of the Welge-Lion Mountain and Hickory aquifers. The project involved

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Representative Professional Assignments Continued

extensive geophysical log interpretation through alternating depositional facies for the characterization of deep aquifer units.

- ◆ ***Brackish Water Study, TWDB, State of Texas:*** Compiled data from statewide GIS evaluation of all Texas major and minor aquifers for brackish-water geographic distribution within Region F. Assisted in evaluation of vertical and geographic distribution of brackish water within aquifers.
- ◆ ***Igneous Aquifer Study, TWDB, Jeff Davis, Presidio and Brewster Counties, Texas:*** Collected field water-level data. Compiled and evaluated TWDB and local well data, geology, digital elevation models (DEMs), and precipitation data in GIS to evaluate local water resources. Evaluated regional groundwater flow directions.
- ◆ ***Lipan Aquifer Groundwater Availability Model, Tom Green County, Texas:*** Evaluated over 500 drillers' and lithologic logs extracting information necessary to create structural paleosurface maps, isopachs and stratigraphy of aquifer sands and underlying Permian formations. Created a spatially oriented data set to construct a groundwater model.
- ◆ ***Natural Gas Pipeline Cleanup, Tenneco Pipeline Company, Texas, Mississippi, Tennessee, and Ohio:*** Conducted interstate cleanup of polychlorinated biphenyl (PCB), mercury, and benzene, toluene, ethylbenzene, and xylene (BTEX) contamination from Tenneco interstate natural gas pipeline.
- ◆ ***Delineation of Salmon and Sterling Site Contamination, Department of Energy, Salmon Nuclear Test Site, Mississippi:*** Investigated radioactive groundwater contamination adjacent to a previous nuclear test site.
- ◆ ***Bullion Project, Department of Energy, Nuclear Test Site, Nevada:*** Investigated radioactive groundwater contamination adjacent to a previous nuclear test site.
- ◆ ***Groundwater Model of the Nuclear Test Site, Department of Energy, Nevada Test Site (NTS), Las Vegas, Nevada:*** Compiled and analyzed groundwater data for NTS. Created conceptual model to estimate evapotranspiration for MODFLOW groundwater model.
- ◆ ***Groundwater Contamination of Burn Sites, Department of Energy, Pantex Plant, Amarillo, Texas:*** Supervised field work for investigation of groundwater contamination at the Pantex site.
- ◆ ***Industrial mineral consulting for barite and attapulgite deposits in Texas and Georgia respectively for Milwhite Mining Company.***
- ◆ ***Evaluation of the Proposed Sierra Blanca Low-Level Radioactive Waste Site, Texas Bureau of Economic Geology:*** Supervised all field work to assisted in geologic and hydrologic characterization of the proposed low-level radioactive waste site in west Texas.
- ◆ ***Precious metals exploration, Chevron Minerals and Bear Creek Mining:*** Conducted field gold and silver exploration in Colorado, Arizona, Utah and Nevada.
- ◆ ***Precious metals exploration, Chevron Minerals and Bear Creek Mining:*** Conducted field gold and silver exploration in Colorado, Arizona, Utah and Nevada.
- ◆ ***Mineral and Mining Studies in State of Texas, Texas Bureau of Economic Geology:*** Conducted studies of uranium mineralization in the Oakville Formation, strategic mineral and metal studies and mineral deposits of west Texas. Supervisor was Dr. Bill Galloway.
- ◆ ***Mobil Oil Minerals, Uranium Exploration, Texas, New Mexico and Nevada:*** Conducted uranium roll-front exploration in the south Texas gulf coast, Grants Uranium District in New Mexico and northern Nevada.

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Publications

Standen, A. R., 2012, "Exploration of West Texas Groundwater to Supply Frac Fluids for the Bone Spring Play" Gulf Coast Association of Geological Societies and Gulf Coast Section of SEPM, 62 Annual Convention,

Standen, A. R. and Kirby, P., 2010, 3-D Model of Fayette County Hydrostratigraphy, Gulf Coast Association of Geological Societies (GCAGS), San Antonio, Texas
<http://www.gcags2010.com/Abstract.PDFs/Abstracts/2010.standen.and.kirby.pdf>

Standen, A. R., Finch, S., Williams, R., and Lee-Brand, B., 2009, Capitan Reef Complex Structure and Stratigraphy, Texas Water Development Board (TWDB) contracted report, 0804830794, 71 p.
http://www.twdb.state.tx.us/RWPG/rpgm_rpts/0804830794CapitanReef/0804830794CapitanReef.asp

Standen, A. R., Ruggiero, R., Ashworth, J., Tybor, P. and Roeling, B., 2008, Llano Uplift Structure and Stratigraphy, TWDB contracted report, 0604830614, 78 p.
http://www.twdb.state.tx.us/RWPG/rpgm_rpts/0604830614_LlanoUpliftAquifers.pdf

Standen, A. R., and J.A. Kane, 2005, The Spatial Distribution of Radiological Contaminants in the Aquifers Overlying the Llano Uplift, Central Texas. National Groundwater Association Meeting, Arsenic and Radioactive Contamination, Charleston, South Carolina, 12 p.
http://www.ngwa.org/bdc/http_www_ngwa_org/GWOL%20Data_1.aspx?RecordID=652378

Standen, A. R., and J.A. Kane, 2005, The Spatial Distribution of Radiological Contaminants in the Hickory and other aquifers overlying the Llano Uplift, Central Texas. Austin Geological Society, Volume 1, p 71-87. http://austingeosoc.org/AGS_Bulletin-2004-2005.pdf

Standen, A.R. and D.R. Opdyke, 2004, Contamination migration, characteristics, and responses for the Edwards-Trinity Plateau Aquifer. Aquifers of the Edwards Plateau, Texas Water Development Board, Report 360, p. 211-234.
http://www.twdb.state.tx.us/publications/reports/numbered_reports/doc/R360/Ch11.pdf

Standen, A. R., and J.A. Kane. 2005. The Spatial Distribution of Radiological Contaminants in the Aquifers Overlying the Llano Uplift, Central Texas. National Groundwater Association Meeting, Arsenic and Radioactive Contamination, Charleston, South Carolina, 12 p. Also was published within and Austin Geological Society (AGS) publication 2007.

Standen, A.R. and D.R. Opdyke. 2004. Contamination migration, characteristics, and responses for the Edwards-Trinity Plateau Aquifer. Aquifers of the Edwards Plateau, Texas Water Development Board, Report 360, p. 211-234.

Beach, J.A. and A. Standen. 2000. Ground-Water Availability Model of the Lipan Aquifer. Presented at the Southwest Focus Ground Water Conference sponsored by the National Ground Water Association, May 17-18, 2000, Austin Texas.

Paine, J.G., A.R. Standen, et al. 1993. Shallow Seismic Studies of a Playa Basin Near Amarillo, Texas. *In* Symposium—The Application of Geophysics to Engineering and Environmental Problems, Environmental and Engineering Geophysical Society, p. 495-500.

Price, J.A., C.D. Henry, and A.R. Standen. 1983. Annotated Bibliography of Mineral Deposits in Trans Pecos Texas, Mineral Resource Circular No. 73, Texas Bureau of Economic Geology, p.108

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Presentations

Dunlap, D, Andrews, J., Standen, A., Averett, A., and Murphy, S. 2013, “A Three Dimensional Geologic Model and Geo-referenced Database for Texas (3-D-T), West Texas Geological Society Annual Symposium, September 2013, Midland, Texas.

Standen, A. R., 2012, “Exploration of West Texas Groundwater to Supply Frac Fluids for the Bone Spring Play and Delaware Basin”, West Texas Geological Society Annual Symposium, September 2012, Midland, Texas

Standen, A. R. and Kirby, P., 2010, 3-D Model of Fayette County Hydrostratigraphy, Gulf Coast Association of Geological Societies (GCAGS), San Antonio, Texas
<http://www.gcags2010.com/Technical.Program/Technical.Program.html#Water>

Standen, A. R. 2010, Sutherland, M. and Kirby, P., 3-D Hydrostratigraphic Models of Countywide Groundwater Resources in the Texas Panhandle, National Groundwater Association (NGWA) Ground Water Summit, Denver, Colorado, <http://ngwa.confex.com/ngwa/2010gws/webprogram/Paper7149.html>

Standen, A. R., 2009, Three Dimensional Stratigraphic Ground Water Model of the Llano Uplift Aquifers in Central Texas, NGWA Ground Water Summit, Tucson, Arizona
http://www.ngwa.org/bdc/http_www_ngwa_org/GWOL%20Data_1.aspx?RecordID=726670

Standen, A. R., 2007, Perfect Storm Analyses of the Frio and Dry Frio Rivers to Identify Potential Additional Recharge, NGWA Ground Water Summit, Albuquerque, New Mexico,
http://www.ngwa.org/bdc/http_www_ngwa_org/GWOL%20Data_1.aspx?RecordID=654623

Standen, A.R. 2006. Identification of Inland Oil and Gas Reservoirs for Injection Well Disposal of Desalination Reject Water. Texas Water Conservation Association Annual Conference, February 2006.
http://www.ngwa.org/bdc/http_www_ngwa_org/GWOL%20Data_1.aspx?RecordID=653780

Standen, A. R., and J.A. Kane. 2005, The Spatial Distribution of Radiological Contaminants in the Aquifers Overlying the Llano Uplift, Central Texas. National Groundwater Association Meeting, Arsenic and Radioactive Contamination, Charleston, South Carolina.
http://www.ngwa.org/bdc/http_www_ngwa_org/GWOL%20Data_1.aspx?RecordID=654203

Standen, A.R. 2004. Contamination Migration, Characteristics and Responses for the Edwards-Trinity Plateau Aquifer. Texas Water Development Board, Aquifers of Edwards Plateau Conference, February 2004.