

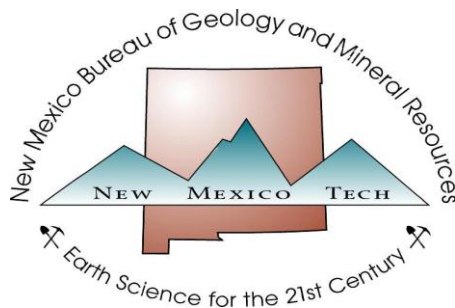
# **12th ANNUAL ESPAÑOLA BASIN WORKSHOP THE LOWER SANTA FE RIVER AND THE VISION FOR WATER SUSTAINABILITY IN SANTA FE COUNTY, NEW MEXICO**

**Open-file Report 557**

By

**Charles Nylander, editor**

**New Mexico Bureau Geology & Mineral Resources**  
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October 2013

# **Program With Abstracts**

***The Lower Santa Fe River and the Vision for Water Sustainability  
in Santa Fe County***

**12<sup>th</sup> Annual Española Basin Technical Advisory Group (EBTAG)  
Workshop & Field Trip**

***May 20-21, 2013***

***Santa Fe Community College, Santa Fe, New Mexico***

**Charles Nylander, *editor***

**12<sup>th</sup> Annual Española Basin Technical Advisory Group (EBTAG)**  
**Workshop & Field Trip**  
*May 20-21, 2013*  
*Santa Fe Community College, Santa Fe, New Mexico*

**Theme:** *"The Lower Santa Fe River and the Vision for Water Sustainability in Santa Fe County"*

**Optional Field Trip:** "Hydrogeology of Groundwater-Fed Wetlands in the La Cienega Area" (see below)

**Schedule of Events:**

<b>From</b>	<b>To</b>	<b>Agenda</b>
7:45 a.m. -	8:30 a.m.	<b>Registration:</b> (\$10 due at the door, cash only; pick up badges, programs and sign-in; poster set-up/viewing)
8:30 a.m. -	8:45 a.m.	<b>Meeting begins with Welcome and Introductory remarks:</b> <i>"What is EBTAG and why do we have an Annual EBTAG Workshop?"</i> — Charlie Nylander, Chair, EBTAG
8:45 a.m. -	9:10 a.m.	<b><i>"An Orientation to Water Resource Studies in the Lower Santa Fe River"</i></b> — Jan-Willem Jansens, Ecotone
9:10 a.m. -	9:30 a.m.	<b><i>"Wetland Mapping in the Lower Santa Fe"</i></b> — Jim Dick, U.S. Fish and Wildlife Service
9:30 a.m. -	9:50 a.m.	<b><i>"Geology of the La Cienega Area, Santa Fe County, New Mexico"</i></b> — Dan Koning, N.M. Bureau of Geology and Mineral Resources
9:50 a.m. -	10:20 a.m.	<b><i>"Groundwater-Fed Wetlands in the La Cienega Area, Santa Fe County, New Mexico"</i></b> — Peggy Johnson, N.M. Bureau of Geology and Mineral Resources
10:20 a.m. -	10:40 a.m.	— <b>Coffee Break</b> —
10:40 a.m. -	11:00 a.m.	<b><i>"Student Monitoring for Water Quality in the Lower Santa Fe River, Santa Fe County, New Mexico"</i></b> — Will Barnes
11:00 a.m. -	11:30 a.m.	<b><i>"Managing and Planning for the Reclaimed Wastewater in Santa Fe"</i></b> — Claudia Borchert, City of Santa Fe Water Division
11:30 a.m. -	12:30 p.m.	<b><i>"Water Sustainability in the Espanola Basin" (a new 30 minute educational video film)</i></b> — Charlie Nylander, Watermatters, LLC
12:00 p.m. -	1:15 p.m.	— <b>Lunch Break</b> — (food available for purchase in the cafeteria down the hall)
1:15 p.m. -	1:40 p.m.	<b><i>"Water Use and Conservation Potential for Domestic Wells in the Santa Fe Area"</i></b> — Amy Lewis, Amy C. Lewis Hydrology and Water Planning
1:40 p.m. -	2:10 p.m.	<b><i>"Water Resource Management in the Santa Fe Area-Review of Selected City and County Policies and Agreements"</i></b> — Charlie Nylander, Watermatters, LLC
2:10 p.m. -	2:40 p.m.	<b><i>"Santa Fe County Rural Water Policy"</i></b> — Adam Leigland, Public Works Director, Santa Fe County
2:40 p.m. -	3:15 p.m.	<b><i>"Facilitated Group Discussion with Workshop-Related Discussion Topics"</i></b> — Charlie Nylander, EBTAG Chair
3:15 p.m. -	5:15 p.m.	— <b>Poster Session</b> — <b><i>"Hydrogeologic Tools for Source Water Protection"</i></b> — Dennis McQuillan, Peggy Johnson, Miriam Wamsley, David Torres, and Emily Geery

**Optional Field Trip** from 8:00 a.m. to noon

**Leaders:** Dan Koning and Peggy Johnson, N.M. Bureau of Geology and Mineral Resources

*Attendees should assemble at the eastern parking lot of the museum (to the left when entering) at 8:00-8:30 a.m. and the field trip begins at 8:30 a.m (no pets allowed). The trip will involve 1-2 miles of walking, generally on dirt roads with minor scrambling on rocky or brushy slopes. Hiking shoes, hat, and water are required. The field trip ends at noon when attendees return to the parking lot. Participants should plan to drive back into town to eat lunch.*

# AN ORIENTATION TO WATER RESOURCE STUDIES IN THE LOWER SANTA FE RIVER

**Jan-Willem Jansens**

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A series of surface and groundwater studies in the La Cienega Area of the Lower Santa Fe River in Santa Fe County were conducted in response to a concern that wetlands in the area have been degraded due to a variety of human-caused stressors and ecological changes. A confluence of surface and groundwater flows in the study area has supported the existence of extensive wetland areas and several historical, acequia irrigation-based agricultural communities, wildlife corridors, and open space amenities. The studies aimed to improve the understanding of groundwater resources that sustain wetlands and springs in the area, and included mapping of 680.3 acres of wetland habitat, along with stream flow monitoring and investigations of local geology, groundwater levels, and groundwater chemistry. Independently, local students and non-profit groups also conducted studies in the Lower Santa Fe River area. While springs and seeps contribute to streamflow in the area, direct measurement of spring and seep flows is difficult because the area of discharge is diffuse. Future monitoring and additional study of streamflow in the study area is needed to better understand streamflow variations over time. Springs and wetlands in the La Cienega area are supported by a complex, three-dimensional groundwater system wherein groundwater discharge from multiple flow pathways in the Santa Fe Group regional aquifer sustains the wetland environment. The location of the wetlands is controlled by the geologic setting. The La Cienega wetlands water budget is dominated by groundwater inflow and surface water outflow, with seasonal water level and water storage fluctuations controlled by changes in evapotranspiration between growing and dormant periods. Wetland zones and stream valleys are areas of both discharging and recharging groundwater, which indicate that local hydrologic processes, such as bank storage during storm events and local recycling of discharged groundwater and surface flows, play an important role in wetland function. Chemistry, isotope, and age characteristics of groundwater verify that mixtures of multiple groundwater sources with distinct chemistries and residence times feed wetland zones east and west of Cienega Creek.

## **Keywords:**

surface water flow, groundwater discharge, wetlands, wetland mapping, La Cienega Area, Lower Santa Fe River

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# WETLAND MAPPING IN THE LA CIENEGA AREA OF THE LOWER SANTA FE RIVER

**Jim Dick**

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The U.S. Fish and Wildlife Service's (Service) National Wetlands Inventory Program (NWI) is responsible for the collecting and distributing data and information concerning wetland and riparian habitats of the United States. Geographic information on types and locations of various wetland and riparian habitats provide invaluable information for resource managers and planners dealing with protecting our natural resources while providing for human development and growth.

Though relatively small, the La Cienega Area of the Lower Santa Fe River, in Santa Fe County, is a unique area geographically and culturally. The area has a long history of human settlement, primarily because of the seep and spring wetlands that have been feeding the local drainages for centuries. Currently, as the city and county of Santa Fe expand, demand has increased for these waters, burdening local aquifers and surface waters, while degrading existing wetlands.

Developing a spatial database of wetland types, locations, and basic hydrologic functions is essential to any wetland protection, enhancement, and/or re-establishment program. The wetlands data and information collected from aerial imagery and field surveys, will serve as a baseline for long-term monitoring of these wetland systems.

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# GEOLOGY OF THE LA CIENEGA AREA, SANTA FE COUNTY, NEW MEXICO

Daniel J. Koning<sup>1</sup> and Peggy S. Johnson<sup>1</sup>

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Because the local geology controls locations of springs and wetlands in the La Cienega area, we summarize the rock units found here and their stratigraphic relations. The older bedrock includes the Galisteo and Espinazo Formations (ca. 55-37 and 36-28 Ma, respectively). The Galisteo Formation consists of reddish, typically cemented sandstone, pebbly sandstone, and mudstone. The Espinazo Formation is composed of light gray, well-cemented sandstone and conglomerate interbedded with minor latite + andesite flows. Overlying these older units is a package of sedimentary strata (layered rock) called the Tesuque Formation (25-8 Ma), which was deposited in a subsiding basin during Rio Grande rift extension. These strata are less cemented than the older bedrock and are generally moderately to well consolidated. Deformation associated with basin subsidence caused the Tesuque Formation here to be tilted 5-8° to the east-northeast. In the La Cienega area, the Tesuque Formation contains two, partly interfingering, stratigraphic components. Lithosome E, on the west, consists of volcanoclastic sediment comprised largely of brown, gravelly sandstone, sandstone, and clayey-silty sandstone. It is interbedded with at least four volcanic flows of the Cieneguilla basanite (26-25 Ma). Lithosome S, on the east, is composed of arkosic sediment, mainly sandstone with subordinate mudstone and lesser conglomerate, eroded from the granite-cored Sangre de Cristo Mountains. Lithosome S progrades westward over lithosome E.

A younger, relatively non-tilted, sediment package called the Ancha Formation was laid down between 3 and 1.5 Ma, after a long period of uplift and erosion that produced up to 150 ft of local paleotopographic relief. The Ancha Formation is coarser, less consolidated, and less cemented than the underlying Tesuque Formation. These properties explain why Ancha Formation hydraulic conductivity values are one to four orders of magnitude higher than older strata. The Ancha Formation, whose lower contact is a scoured angular unconformity, thickens over paleovalleys created by pre-Ancha erosion. The paleovalleys are hydrologically important because they may hold thick accumulations of saturated Ancha sediment. We mapped two noteworthy paleovalleys, one of which parallels the modern Santa Fe River 1-2 mi to the southeast and another which trends west-northwest from Eldorado.

The Ancha Formation can be subdivided into two interfingering stratigraphic components. The first is associated with a southwest-flowing, ancestral Santa Fe River and is relatively coarse-grained in a downstream direction. Santa Fe River deposits are as much as 220 ft thick 1 mi south-southwest of Agua Fria, but thin westward to 60-100 ft under the Caja del Rio Plateau. North and south of the ancestral Santa Fe River deposits are alluvial slope deposits associated with smaller, west-flowing, ephemeral streams. The northern alluvial slope deposits pinch out northward and northeastwards against the Santa Fe uplands. The southern alluvial slope deposits are generally 60-150 ft thick but thicken to 200-295 ft about 5 mi east of La Cienega. The lower 30-130 ft of the southern alluvial slope deposits is generally coarse-grained (sand and gravel). In overlying strata, sandy gravel dominates near the Sangre de Cristo Mountain front but gross texture fines westward to clayey-silty fine sand.

# GROUNDWATER-FED WETLANDS IN THE LA CIENEGA AREA, SANTA FE COUNTY, NEW MEXICO

Peggy S. Johnson<sup>1</sup>, Daniel J. Koning<sup>1</sup> and Stacy Timmons<sup>1</sup>

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Groundwater-fed wetlands that form large cienega complexes in semi-arid landscapes are among the most diminished and threatened ecosystems in the Southwest. Groundwater-fed wetlands on saturated slopes and adjacent to streams cover 384 acres in the La Cienega area and are threatened by dwindling, disrupted, or erratic water flows. A collaborative, multi-agency (NMED, NMOSE, NM Bureau of Geology, Santa Fe County, U.S. Fish & Wildlife Service) study of the wetlands, completed in December 2012, reveals that a complex interaction between geology, groundwater, and surface flows controls the location and condition of the wetlands.

Groundwater discharging from the Ancha Formation of the Santa Fe Group aquifer feeds the cienegas. As the aquifer thins and pinches out over underlying, lower permeability units, groundwater is forced to the surface to discharge in spring-wetland zones and adjacent streams. Storage of groundwater in the Ancha is controlled by three factors: (1) permeability contrasts between the Ancha and sub-Ancha formations; (2) topography of the erosion surface at the base of the Ancha; and (3) recharge and inflow to the Ancha.

Paleo-valleys eroded into the surface of the Tesuque Formation and filled with coarse Ancha deposits create altitude-dependent drains that gather groundwater, concentrate flow, and direct discharge to spring-wetland zones. The El Dorado paleo-valley controls locations for large spring-wetland zones on the eastern slopes and tributaries of Cienega Creek (Guicu Creek, Canorita de las Bacas, Leonora Curtin Preserve). Sunrise Springs and wetlands along the western slopes of Arroyo Hondo are controlled by the ancestral Santa Fe River paleo-valley. Unique chemistry, isotope, and age (<sup>14</sup>C and <sup>3</sup>H) characteristics of wetlands east and west of Cienega Creek verify that groundwater sources for the cienegas include mixtures of deep regional flow through the Tesuque Formation and local flow along unique pathways in the shallow Ancha aquifer.

Seasonal water levels in 38 shallow wells show an increase in winter levels of +0.77 ft (average) in wetland zones. A hydrograph and thermograph of continuous measurements from October 2011 to October 2012 in a wetland well show inverse, synchronized changes in water level and temperature in November and April. These changes correspond to transitions between growing and dormant seasons and illustrate the hydrologic response of shallow groundwater to seasonal changes in evapotranspiration. Water levels measured in 22 wells between 2004 and 2012 show water-level declines of 5.03 to -0.10 ft for the 8-year period in aquifers east (up-gradient) of the wetlands. Forty-year hydrographs from area wells also show a persistent trend of declining levels, with rates of change from -0.11 to -0.25 ft/yr. Wells with high-frequency measurements show the cumulative effects of seasonal water-level variations (winter highs, summer lows) and recharge events (spring 2005) superimposed on the effects of pumping and long-term withdrawals. Our results strongly suggest that long-term reduction in aquifer storage in the Ancha Formation poses a significant threat to the existence and viability of wetlands.

# MANAGING AND PLANNING FOR THE RECLAIMED WASTEWATER IN SANTA FE

**Claudia I. Borchert**

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Reclaimed wastewater from the City of Santa Fe's (City) wastewater treatment plants has contributed to water supply needs in the region since treatment of sanitary waste began. Today reclaimed wastewater meets x % of the City's water supply needs. Over past decades reclaimed wastewater use has increased, while production has decreased by 29%. Two percent of the reclaimed wastewater produced is sold, generating less than \$200,000 annually; the value of the resource, based on the current rate of \$3.03 per 1,000 gallons, is over six million dollars. The annual demand for reclaimed wastewater, including potential future options, is 40% greater than its availability. The City developed the Reclaimed Wastewater Resource Plan to prioritize current RW uses and identifies strategies and implementing actions to optimize current and future use of the resource. Based on the City's average RW production of 1,887 million gallons/yr (5,790 af/yr) over the past five years, the Plan assumes that 1,825 mg/yr (5,600 af/yr) and 152 mg/mo (467 af/mo) of RW is available at a steady daily and monthly rate for a 40-year planning period. Using criteria established by the governing body of the City, the alternatives were scored and ranked. The budgets of the options were compared to available supply and then allocated based on ranking. This Plan identified that all but two of the 'current' RW options can be met with the available RW at this time; the exception is that there are insufficient flows to fully meet the target downstream Santa Fe River flows 3 mg/d, target flows in June and the Santa Fe Equestrian Center request in May, June and July. In the near future (approximately 2018), the shortfall in RW will be even greater: the Santa Fe River downstream, the Santa Fe Equestrian Center, and the option to pump reclaimed wastewater upstream to Santa Fe River do not have adequate supply during the summer months. By the 2020s, when the infrastructure and permits to use reclaimed wastewater for potable supply may be ready, no supply is available for the SF Equestrian Center or the Santa Fe River upstream, and there continues to be insufficient flows to meet the 3 mg/d target for Santa Fe River downstream in June. By the 2020s, using the reclaimed wastewater that is not needed during the irrigation season, the Plan estimates that approximately 717 mg/yr (2,200 af/yr) of RW will be available for potable supply.



# WATER USE AND CONSERVATION POTENTIAL FOR DOMESTIC WELLS IN THE SANTA FE AREA

Amy C. Lewis

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Preliminary results of a Bureau of Reclamation and the Española Basin Regional Issues Forum funded GIS-based water resource inventory of the Española Basin (to support development and implementation of water management and conservation strategies) reveals the actual water use by domestic wells and the potential for water savings. Self-supplied domestic wells are wells serving one to several households permitted under the NM Statute 72-12-1. Approximately 8,200 wells such wells are permitted and contain information in OSE WATERS database in the Española Basin. Of these wells, about 500 wells are metered and about 70 of the wells identify the specific houses served. Based on our analysis of the meter records, annual water pumping ranges from 0.03 to 1.6 acre-feet per year (ac-ft/yr) per house with a median of 0.26 ac-ft/yr per home. Using the 2010 census for the average household size per block group to estimate the population for each house, the median per capita demand is 0.12 ac-ft/yr (110 gallons per capita per day). The amount of water that *would be needed* for each of these homes was estimated by digitizing the landscaping using aerial photography and calculating water needed for a conserving and non-conserving household. The results showed that if conservation techniques were applied (inside and out) and buffalo grass were used for the same area of landscaping, the water use would be 0.07 ac-ft/yr per person and if non-conserving techniques were applied the median use would be 0.17 ac-ft/yr. An estimated 43,000 people are supplied by domestic wells in the Española Basin, thus with an average savings of 0.05 ac-ft/yr per person, savings for this water sector could be about 1,900 ac-ft/yr.

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# **WATER RESOURCE MANAGEMENT IN THE SANTA FE AREA-REVIEW OF SELECTED CITY AND COUNTY POLICIES AND AGREEMENTS**

**Charles L. Nylander**

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Since January 2005, several water resource management policies and agreements have been negotiated between the City of Santa Fe, Santa Fe County, and Las Campanas that are pertinent to water sustainability in the Santa Fe area. Excerpts from the following agreements have been selected to provide an overview of the foundation documents underpinning water sustainability and management in the Santa Fe area. They include the: Water Resources Agreement between the City of Santa Fe and Santa Fe County, January 2005; Joint Powers Agreement between the City of Santa Fe and the County of Santa Fe Governing the Buckman Direct Diversion Project, March 2005; Facility Operations and Procedures Agreement for the Buckman Direct Diversion Project between the City of Santa Fe, Santa Fe County and Las Campanas LP, October 2006; Project Management and Fiscal Services Agreement Buckman Direct Diversion Project, November 2007; Bulk Water Service Agreement, October 2009; and the Raw Water Supply Agreement, November 2011. Selected text from these agreements develops a better understanding of water resource management in the Santa Fe area, and demonstrates the value of collaborations and partnerships that strive to develop a shared interest in the cost of water infrastructure, water conservation, and prudent water resource management, so as to develop a regional, sustainable water supply for city and county water customers that ensures protection of public health and the environment.

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# SANTA FE COUNTY RURAL WATER POLICY

**Adam Leigland**

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Rural water systems across New Mexico (of which mutual domestic water consumer associations are the best known but by no means only example) are under increasing threat from a variety of sources. Water supplies are dwindling; requirements for regulatory compliance and technical and financial management are growing more stringent; financial resources are on the wane; and demographic trends are straining governance. Meanwhile, Santa Fe County takes water seriously, and has numerous plans to guide its action in that arena, including the Conjunctive Management Plan and a chapter in the Sustainable Growth Management Plan. Unfortunately, plans, no matter how well-crafted, often languish for lack of linkage to implementation programs. Santa Fe County has over 35 rural water systems within its boundaries, and the Board of County Commissioners has recently adopted a policy that, in addition to meeting County goals as articulated in the aforementioned plans, represents an example of linking planning to execution, and attempts to address the threats to rural water systems. This policy was the result of extensive (but now always amicable) public involvement, and has the support of the Rural Water Association, the Office of the State Engineer, the Rural Community Assistance Corporation, and the New Mexico Environment Department. The policy addresses the challenges of planning in a diverse region with numerous stakeholders competing for limited resources.

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# HYDROGEOLOGIC TOOLS FOR SOURCE WATER PROTECTION

**Dennis McQuillan<sup>1</sup>, Peggy Johnson<sup>2</sup>, Miriam Wamsley<sup>3</sup>, David Torres<sup>4</sup> and Emily Geery<sup>4</sup>**

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<sup>4</sup>New Mexico Environment Department

Water users in New Mexico are facing extraordinary and unprecedented challenges in protecting the quality and sustainability of their water sources. These challenges arise from the combined effects of natural and anthropogenic contamination, groundwater depletion and severe drought. The information needed to protect existing water sources, to locate and develop new water sources, and to assess aquifer vulnerability in permitting or spill abatement situations is widely scattered and has not been assembled in a single, easily accessible, location. U.S. Congress provided for source water protection in the 1996 Safe Drinking Water Act amendments and required that the states use, “all reasonably available hydrogeologic information on the sources of the supply of drinking water in the state and the water flow, recharge, and discharge...”

The New Mexico Environment Department, the New Mexico Bureau of Geology, and the New Mexico Department of Health are collaborating to produce an Internet-based Atlas that will provide access to the tremendous amount of hydrogeologic information in the state. The Atlas will build on existing resources within the collaborating organizations, and will produce the following online tools:

- bibliography for hydrogeologic information;
- groundwater geochemistry archive; and
- geographic information system (GIS) that contains data layers showing groundwater geochemistry, anthropogenic and natural sources of contamination, aquifer vulnerability, and areas of groundwater depletion and subsidence.