December 13, 2013

Analytics, Aquifers, Faults, and Lightning Databases

H. Roice Nelson, Jr. and Kathy S. Haggar, Dynamic Measurement LLC

Abstract: In discussing aquifer characteristics of Iron County Utah and East and West Baton Rouge Parishes Louisiana we recognized similar measurement and monitoring issues and solutions. Iron County Utah is at the southern end of the Great Basin in the Rocky Mountains. In this desert environment water is scarce and important. Mountain stream was diverted starting in the 1850's and used to irrigate farms around Cedar City. As drilling technology developed, water wells were drilled and agriculture, primarily growing alfalfa, spread across Iron County. Population increase has made water availability and use a political issue. Nitrates used to fertilize alfalfa have contaminated aquifers. Water wells have drawn down and collapsed aquifers. Central Iron County Water Conservancy District, formed in 1997, implements long term water use plans. East Baton Rouge Parish is located on the east bank the Mississippi River in the center of the Gulf Coast Basin where there is extensive rainfall. Aquifer derived fresh water is contaminated by salt dissolution from the St. Gabriel salt dome downthrown to the Baton Rouge Fault. This active growth fault system impacts salinity dispersion. Aquifer definition, measurement, and monitoring are of significant concern to scientists and to the local population. Computer workstations and analytics provide a way to integrate legacy and recent data used to measure and monitor aquifer integrity. These mature technologies also allow integration of a new geophysical data type, lightning strike locations and attributes, which has the potential to help map faults and aquifer extent. Lightning data has been collected for years for insurance, meteorological, and safety reasons. In 2008 Dynamic Measurement LLC (DML) was formed after recognizing lightning strike locations are not random, but are controlled by telluric or earth currents. Since then DML has developed and patented methodologies for data mining these large databases to map faults, predict seeps, define anisotropy, optimally design 3-D seismic surveys, and explore for natural resources, like distinguishing between conductive brines and resistive aquifers. The talk will review the basic geophysical technologies behind lightning data mining and review examples demonstrating the potential for mapping faults and aquifers in places like Iron County Utah and East and West Baton Rouge Parishes in Louisiana.

Biography: Roice is an experienced interpretation geoscientist who has spent his career working in the international petroleum industry, mostly as a seismic interpreter at Pan American, Amoco, Mobil, University of Houston, Landmark Graphics, HyperMedia Corporation, Continuum Resources Corporation, Geophysical Development Corporation, and as a consultant. He has proven success in using, creating, and building new tools and processes for the hydrocarbon exploration industry. As founder of Landmark Graphics, Roice designed the interpretation software, was the only in-house geophysical end-user for several years, and created a university program which placed advanced interactive interpretation systems in many universities worldwide to support research and teaching. He has taught courses on interactive interpretation and new technologies for UH, IHRDC, Landmark, and others worldwide. Roice also has a consulting company (W3D) and an exploration company (DRC) to develop and utilize industry and proprietary tools and processes to explore for, develop, and produce hydrocarbons. In 2008, Roice co-founded Dynamic Measurement, LLC (DML), which has developed, licensed, and patented new methodologies to existing databases of lightning strike locations and attributes to map faults, define anisotropy, identify seeps, and explore for natural resources.

November 8, 2013

Design and Engineering considerations for the installation of a coupler-well to mitigate saltwater encroachment in the Baton Rouge area

P.R. (Randy) Hollis, P.E. and Roy A. Waggenspack, P.E., Owen & White Engineering, Consulting Engineers

Abstract: Baton Rouge Water Company (BRWC) relies on wells that pump water from the 1,500-Foot sand aquifer (1,500-Foot sand) beneath Baton Rouge, which is a major source of fresh groundwater for the Baton Rouge area. Historic pumping from the aquifer has caused leakage of saline water across the Baton Rouge Fault and into the aquifer. Saline water was first detected in the 1,500-Foot sand north of the fault in 1965. Since then, a saltwater plume has migrated into the aquifer between the fault and three BRWC pumping stations with wells screened in the 1,500-Foot sand: the Government Street Station, the North 4th Street Station, and the Lula Avenue Station. Recent increases in the background chloride concentration observed at the Lula Station are of particular concern. Chloride concentrations in Lula wells have increased from a background concentration of approximately 3 milligrams per liter (mg/L) to as high as 180 mg/L. The Lula Station is an integral source of supply for the water utility, pumping an average of 10.9 million gallons per day (mgd) between 2000 and 2009, from five wells screened in the 1,500-Foot sand. Given the current understanding of saltwater encroachment in the 1,500-Foot sand, it is anticipated that chloride levels in the Lula wells will continue to rise and could soon be approaching the USEPA drinking-water standard of 250 mg/L. The primary objective of BRWC is to control and mitigate saltwater encroachment in the 1,500-Foot sand between the fault and BRWC wells so that drinking-water standards can be met into the foreseeable future. Recently, to meet this need BRWC installed a coupler-well system south of Lula Street pumping station. The coupler-well system was designed by engineers at Layne Hydrogeologic and Owen & White, Consulting Engineers. The installation site is south of the Lula Street pumping station to mitigate the encroachment of saltwater towards the station.

Biography: P. R. (Randy) Hollis, P.E. – President of Owen & White, Consulting Engineers. Randy received a B. S. in Civil Engineering from Mississippi State University in 1978 and a M. S. in Sanitary Engineering from Virginia Polytechnic Institute in 1979. Randy has been with Owen and White, Inc. since 1983 and has been president since 1988. He directs all corporate business activities involving organization, management, finance, marketing, engineering, personnel and supporting services. He also provides overview of all design activities for water and wastewater facilities.
Biography: Roy A. Waggenspack, P.E. – Vice President of Owen & White, Consulting Engineers. Roy received a B.S. in Civil Engineering from Louisiana State University in 1976 and has been with Owen and White, Inc. since that time. He directs field and office functions associated with engineering studies, design, drafting, specification writing, procurement, schedule and construction services. He consults

with clients on funds management, project changes, federal and state participation and construction contractor performance. He also coordinates start-up procedures, preparation of manuals and consults with clients on post start-up activities.

October 11, 2013

Reconstruction of Geological Architecture and Groundwater Model Development for Understanding Saltwater Intrusion in the Baton Rouge area, southeastern Louisiana

Dr. Frank Tsai

Abstract: Groundwater resources are vital for Louisiana's economic and demographic developments. Many freshwater aquifers underneath Baton Rouge are being contaminated by saltwater intrusion due to excessive groundwater withdrawals. This study developed high-resolution three-dimensional saltwater intrusion models to better understand salinization in the "1,200-foot", the "1,500-foot", the "1,700-foot", and the “2,000-foot” sands in the Baton Rouge area. The model area includes the east-west trending Baton Rouge fault and the Denham Springs-Scotlandville fault, which restrict flow to the heavily pumped area between two faults. To develop the three-dimensional models, we first reconstructed the geological architecture of the Baton Rouge aquifer system using 288 electrical well logs. Then, we converted the geological architecture into MODFLOW computational grid. A model of 45 layers was constructed to include the "1,200-foot", the "1,500-foot", and the "1,700-foot" sands. For the “2,000-foot” sand model, the MODFLOW grid is consisted of 29 layers. To overcome the computational difficulty, we implemented the Covariance Matrix Adaptation Evolution Strategy (CMA-ES) to a cluster of the LSU supercomputers for calibrating the flow and transport models. It was found that the complex geological architecture and sand displacements at the Baton Rouge fault mainly control the saltwater encroachment location. The simulation results showed that saltwater will eventually stop at Lula wells in the “1,500-foot” sand and stop at Entergy wells in the “2,000-foot” sand in the industrial district.

Biography: Frank Tsai is an associate professor of the Department of Civil & Environmental Engineering, Louisiana State University. He joined LSU as a faculty member in 2003. Frank Tsai received his Ph.D. degree from the Department of Civil Engineering, University of California, Los Angeles in 2002 and continued on at UCLA for one year as a post doctorate fellow. He has published 35 peer-reviewed journal articles and graduated 4 M.S. and 4 Ph.D. students. He is serving as an associate editor for ASCE Journal of Hydrologic Engineering and ASCE Journal of Water Resources Planning and Management and is on the editorial board of two additional journals. His current research is groundwater flow and transport modeling in aquifer systems, which includes geological architecture modeling, inverse problems, uncertainty analysis, experimental designs, and high performance computing. His research is funded by the National Science Foundation, the U.S. Geological Survey, and the Louisiana Board of Regents. Five Ph.D. students are currently working with him on this subject.

September 13, 2013

Subsidence and Sea-Level Rise: The Impact on the Southeastern Louisiana Coast

Tim Osborn

Abstract: Louisiana's coastal Master Plan addresses restoring and conserving a landscape that is subsiding at rates faster than realized when the plan was developed-a rate faster than other coastal areas around the world. The presentation will discuss current measurements of subsidence in coastal Louisiana within a context of accelerating sea level rise and what this means for the future of the southeastern Louisiana coast.

Biography: Tim Osborn is the Navigation Manager for NOAA's Central-Gulf Region (Mississippi, Alabama, Louisiana and Florida Panhandle) Coast Survey, Lafayette Office. His 18-year career with NOAA includes experience and responsibility in coastal ports and navigation, tide and water levels and geodetic programs and projects. While at NOAA, Mr. Osborn has worked in cooperation with local and state organizations to develop the Northern Gulf Operational Forecast System (NGOFS) that forecasts water levels, salinity, and other parameters along the coastal states of Alabama, Mississippi, Louisiana and Texas. Part of this effort has been to help increase coastal observation stations and to modernize vertical and horizontal reference networks along the Gulf coast. Mr. Osborn holds a B.S. degree in Marine Biology from Florida State University and graduate degrees from Louisiana State University.

May 10, 2013

Salt Dome Gas Storage and Brine Production Facilities: Geological, Environmental and Safety Issues

Mr. Bill Schramm and Mr. Dutch Donlon

Abstract: Louisiana hosts numerous salt domes both on land and off shore. Many of these domes have been evaluated for oil and gas potential as well as sources for salt/brine/sulfur and provide underground storage for a variety of petroleum based products. Critical events arising from the use of salt domes for brine production and storage purposes include the 1980 collapse of the salt mine on Jefferson Island and the closure of the Strategic Petroleum Reserve at Weeks Island due to sinkhole development. More recent events including the collapse of a brine cavern on the Napoleonville dome and the proposed cavern storage of natural gas adjacent to an active salt mine at Cote Blanche. This presentation examines operations and concerns at Napoleonville and Cote Blanche and the Eminence Storage Field near Seminary, Mississippi. The Napoleonville dome is used for brine production and storage of both natural gas and liquid petroleum gas. Underground mining of salt at Cote Blanche presents different concerns with proposed cavern construction and storage situated adjacent to mining operations. These

operations emphasize the importance of understanding all aspects of safety and technical feasibility of using salt caverns for these purposes. Most critical is the need for accurate geological understanding of salt boundary and anomalous zones locations.

Biography: William H. Schramm is a 20 year veteran of the Louisiana Department of Environmental Quality. As a Geologist III he has worked closely with industry, consultants and private citizens to investigate and/or remediated over 3000 contaminated sites. His main focus is on groundwater issues throughout Louisiana. Since 2005 he has been an Adjunct Instructor on the staff of the Department of Geology at the University of Louisiana-Lafayette and served on numerous Graduate Thesis Committees. Mr. Schramm holds a BA and MS in Geology and a Teaching Certification for K-12 in Science and Earth Science. He is a member and past Director, twice past Vice-President/President of the Baton Rouge Geological Society. He also serves on the Board of Directors of the Louisiana Environmental Health Association, and ComForCare Senior Services. Mr. Schramm serves as Delegate to the AAPG, representing the Baton Rouge Geological Society AAPG members. He has participated in numerous conferences, conventions and seminars as organizer, committee chair, session chair, judge, presenter and author/coauthor with over 35 papers or abstracts in publication. His off time is spent raising foster children, doing carpentry and trying to find time to travel with his wife Mary.

Biography: Mr. Donlon received a B.S. in Geology from the University of Southwestern Louisiana in 1985. After working four years in petroleum exploration in Lafayette, Louisiana, he began his career in environmental geology in 1989 with the Louisiana Department of Environmental Quality where he has been employed for the past 24 years. His areas of expertise are groundwater hydrology and contaminant hydrogeology.

April 12, 2013

The Baton Rouge Aquifer System: Stratigraphic Architecture and Sources of Saline Contamination

Dr. Jeffery S. Hanor

Abstract: The recent increase in interest in problems of salinization of the Baton Rouge aquifer system has led to an attempt to characterize in more detail the stratigraphy and depositional setting of these siliciclastic aquifer sediments and to identify the sources of saline water contamination. The aquifer system consists of interbedded zones of fluvial sand-rich and mudstone-rich sediments which dip to the south. Recent research by Elizabeth Chamberlain (2012) supports the hypothesis that the sand-dominated aquifers are made up of amalgamated sand bodies deposited during sea level low-stands and that the mudstone-dominated confining zones were deposited during times of high aggradation in

response to rises in sea level. Superimposed on these external (allogenic) forcing processes were autogenic events such as avulsion and flooding which further complicated aquifer architecture.

The two principal hypotheses regarding the sources of saline contamination in Baton Rouge are: 1) the saline waters have migrated up the Baton Rouge fault from depth, and 2) the saline waters have migrated laterally northward at shallow depths from the south. Callie Anderson (2012) has mapped spatial variations in groundwater salinity south of the fault and has demonstrated that one source of saline waters is the St. Gabriel salt dome south of Baton Rouge. Some of the salt water is migrating northward along the base of the Mississippi River alluvial aquifer in response to variable-density forces. Lateral flow of saline water to the northeast from the Bayou Choctaw dome appears to be an additional source of contamination at somewhat greater depths.

Biography: Jeff Hanor received his bachelors' degree in Geology from Carleton College and his Ph.D. from Harvard. He was an NSF Postdoctoral Fellow and Assistant Research Oceanographer at the Scripps Institution of Oceanography before joining LSU in the fall of 1970. Hanor is a Fellow of the Geological Society of America and served as the GSA Hydrogeology Division Birdsall-Dreiss Distinguished Lecturer in 1998. An informal account of some his groundwater studies in Louisiana can be found in the journal Ground Water, v. 49, p. 611-615 (2011).

March 8, 2013

Legal Aspects of Coastal Change

Kelly M. Haggar, Attorney

Abstract: Coastal change is unlikely to require new law but properly dealing with its effects and planning our response to them will require more than just a good understanding of present law. Statutes rest on fundamental - but often unstated - societal assumptions favoring some outcomes and denying others. For example, Western societies presume land should remain in commerce and always be productive. Virtually all of the major cases and controversies concerning water and/or coastal issues arising in Louisiana in recent years - levee and flood wall failures during Katrina, land loss from E & P (exploration and production) canals, diversions affecting oyster beds, homeowners insurance covering flood losses - have been resolved by applying existing law. These range from laws only decades old (the Flood Act of 1928) to modern text based upon Roman law going back over 2,000 years. The BP spill is governed by a pair of current laws, the Oil Pollution Act of 1990 and the 1977 amendments to the Clean Water Act. Unfortunately, much of the general public either does not understand the basic principles of land use and tort or perhaps simply wishes for different outcomes despite existing laws. The pending regulatory scheme for carbon emissions is particularly tied to coastal land loss through the Anthropogenic Climate Change ("global warming") thesis. In fact, the thicket of administrative law is even denser and more complex that basic statutes, yet it, too, is based on law decades old, the Administrative Practices Act of

1946. Law as an institution has never attempted to "control nature" per se but it most assuredly attempts to specify and control who gains and who loses - and why - when a river changes course, when new land forms at the beach, and when a dispute breaks out as to "what is a beach?" and "who owns it?" I believe a general overview of the major cases and an explanation of why they turned out as they did will better enable coastal planners to find - and stay within - the realistic limits of what can and cannot be accomplished within the framework of our existing laws. Moreover, if American society does determine a new direction in coastal programs is needed, a fuller understanding of current law will likely allow better choices to be consciously made in lieu of muddling through, or, worse repeated exercises of trial and error.

Biography: Following graduation from LSU in 1973 with his BS in Political Science, Mr. Haggar joined the US Air Force in 1974. Mr. Haggar was a B-52 pilot for 8 years and served for 10 years in Flight Safety at three levels for the Pentagon Squadron Office School, Air Command and Staff College, Air War College. He earned a Master of Public Administration in 1987 from the University of Oklahoma and his Juris Doctor and Bachelor of Civil Law from the LSU School of Law in 2005. He was admitted to the Louisiana Bar in 2005. Mr. Haggar worked in the area of wetlands permitting and environmental consulting with Riparian, Inc. from 1998 - 2011. He began his own law practice in Baton Rouge in 2012.

February 8, 2013

River Diversions: Geologic Boundary Conditions and Other Considerations

Prof. Harry Roberts, Louisiana State University

Abstract: Most researchers and coastal managers now agree that diversion of Mississippi River water and sediment is the best methodology for preserving and reclaiming Louisiana's coastal plain. However, it has become clear in recent years that our ability to create a sustainable coastal plain is resource limited. Dams in the Mississippi River drainage basin trap ~ 50% of the total sediment load. This decrease in sediment available to offset land loss coupled to a substantial increase in the rate of sea level rise (1 mm/yr over 7 kyrs of Mississippi Delta history and now ~ 3 mm/yr) presents a challenging view of the future for coastal Louisiana. Accommodation space, primarily a product of subsidence and rising sea level, is being created faster than we can address it with Mississippi River sediment. It is estimated that under a "no sediment introduction" scenario that 10,000 - 13,500 km2 of present coastal plain land will be submerged by the year 2100. Sustaining the existing coastal plain surface till 2100 would require an estimated 18-24 billion tons of sediment, more than can be drawn from the Mississippi River. Several "basic truths" emerge when confronted with these facts. First, we cannot save the entire coastal plain. Second, Mississippi River sediment is a precious commodity and we need to apply it where it will be most effective. Third, every decade of delay will increase accommodation requiring ~ 1 billon tons of sediment to fill. The Wax-Lake Delta in Atchafalaya Bay is used as a model for river diversions to

help solve Louisiana's land loss problem. Over 50% of suspended sediment available to the lower Mississippi and Atchafalaya Rivers is now delivered to the coast through the Wax Lake and Lower Atchafalaya River Outlets. Approximately 42% of this suspended sediment is currently transported through the Wax Lake Delta. Although sand-rich substrates in a deltaic landscape are important to initiating marsh growth, finer-grained sediments are the norm for maintaining healthy marshlands by substrate accretion and nutrient delivery. In Atchafalaya Bay, the Wax Lake and Atchafalaya deltas are composed primarily of sand (65-75%), but the fate of the finer fraction of the suspended load is only qualitatively known. The majority of the fine fraction is transported offshore to build a seaward prograding wedge of prodelta muds. Both delta growth and offshore mud accretion are linked to the annual flood cycle. However, short term water level set-up and set-down driven by cold front passages during the flood season modulates both offshore and onshore transport of suspended sediments. A more quantitative understanding of sediment transport in the Wax Lake Delta and adjacent coastal plain marshlands related to flood/cold front-driven processes seems critical to predicting the responses of river diversions and where to place them to obtain the maximum benefit of land-building as well as maintenance of surrounding marshlands.

Biography: Harry H. Roberts is the former director of Coastal Studies Institute (for 11 years) at LSU, an emeritus member of the Department of Oceanography and Coastal Sciences (School of the Coast and Environment), and a Boyd Professor. He has had a career in marine geology that spans more than 40 years and has worked in many foreign countries as well as in the United States. Recently, his research has focused on three themes: (a) modern deltaic sedimentation and processes, (b) shelf-edge deltas, and (c) surficial geology of the northern Gulf's continental slope.

January 11, 2013

Geophysical Monitoring of Artificial Earthen Levees

Prof. Juan Lorenzo, Louisiana State University

Abstract: A growing societal need exists for scientific involvement in the study of flood protection systems, addressable by near-surface seismic methods. Both deep- and near-surface hydro-geologic processes can contribute to the structural failure of artificial flood protection embankments, dikes, or artificial levees. Recently, seismic geophysical methods have attempted to develop a proxy for engineering shear strength, by mapping changes in the transmission velocity of shear waves through artificial levees. In the absence of electromagnetic methods VP/VS ratios can be used as good indicators of variations in the fluid (water, and air or gas) saturation. A distressed section of an artificial earthen levee, suitable for seismic investigation, lies ~15 km S of the city of New Orleans, Louisiana. A 100-m section of the crest shows continuous cracks which are as much as 10 cm wide, and 30 cm deep at their northern end. Between September 2007 and February 2008 we collected horizontally polarized shear and compressional wave data in pseudo-walk-away tests focusing on the natural soils (upper 30 m) of

the protected (west) flank of the earthen levee 30 m away from the crest. Two profiles lie parallel and on either flank of the damaged levee crest and, for reference, two profiles sample undamaged portions of the protected levee flank. Cone-Penetration Tests (CPT) are spaced at 300 m intervals along the levee crest. In the first 30 m (~100 feet) of sediment below the lower delta plain of the Greater New Orleans area, a complex and dynamic interaction of freshwater and marine sedimentary environments has juxtaposed a diverse set of facies. From the integration of VP and VS velocity maps (from body and Love Waves), surface facies maps, and laboratory-derived physical properties we interpret greater soil saturation on the protected side of the levee, adjacent to crestal cracks. Subsurface fluvial-deltaic facies are too variable to be predictable from physical properties at widely-spaced CPT sites alone. Future preventive, monitoring of flood-protection barriers stand to benefit from integration of geophysical profiles, calibrated to geotechnical information at point locations and integrated with geological and topographic information.

Biography: Juan Lorenzo became a geologist through the University of Barcelona in 1983. His interest in geophysics was kindled after a summer internship in Italy with Western Geophysical in 1982. The following year he came to the US as a Fulbright student where he concentrated on Marine Seismology for his graduate degrees at the Lamont-Doherty Observatory of Columbia University. For his Ph.D. he worked on the structure and mechanics of continental transform margins. He has participated in seven marine geophysical and drilling cruises in all the major oceans except the Arctic and has led two land-based seismic field surveys lasting several months to central and northern Chile: in 2001 and in 2007-8. From 1993 until 1999 while at LSU he used marine seismic images to study the flexure and failure of northern Australia during collision with Indonesia. Since 1999 he turned to land-based seismic studies to look at shallow faulting in the Gulf Coast (0-500 m), microearthquake activity induced by hydraulic fracturing and soil saturation in a physical seismic modeling tank and in the field beneath New Orleans levees. Field work on the geophysical monitoring of levees forms part of a collaboration with the University of New Orleans and is funded by South-East Louisiana Flood Protection Authorities-West and East. Student scholarships for the work are supported by New Orleans Geological Society, Inc. and Memorial Foundation, Southeastern Geophysical Society and American Petroleum Institute Delta Chapter.