# Seminole Integrated Wind-Water Demonstration System

## Progress Report for February 2013

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# 1.0 INTRODUCTION AND OVERVIEW

**1.1 Scope and Content** This progress report is submitted jointly to the Texas Department of Rural Affairs (TDRA) and to the Texas Water Development Board (TWDB). TDRA formerly was called the Office of Rural and Community Affairs (ORCA). The report is submitted as part of TDRA contract number 728082 and TWDB contract number 0804830832. In addition to project funding from the TDRA and the TWDB, major participants include the City of Seminole, Texas Tech University and the US Department of Energy through Texas Tech University. The project was initiated in April 2009, and the completion date was originally set at March 2013. As of early February, 2013, the construction contracts as the site have been completed, such that the TDRA and TWDB contracts could financially end. Continuous operation and monitoring of the system will extend for a year beyond March, 2013, so that the seasonal behavior of the wind turbine energy generation can be observed and documented while the well and RO system also perform.

**1.2 Project Description** This project addresses the continuing depletion of the Ogallala aquifer, the current principal source of potable groundwater for much of west Texas and northward through Kansas. The approach is to access, lift, and purify brackish, much deeper water-bearing formations in the Santa Rosa of the Dockum group. On the basis of preliminary evidence, these formations were believed to occur in Gaines County at depths ranging from 1500 to 2000 ft. There may also be water-bearing strata between 600 and 800 ft. Our drilling and geophysical investigation found potentially productive zones at 540-650 ft, 890-920 ft, and 1610-1770 ft. The purification will be accomplished using reverse osmosis (RO). The electrical energy required for the well lift pumps and those of the RO system will be supplied principally by a grid-connected wind turbine. The purified water is to be utilized as part of the municipal water supply of Seminole, Texas, a community with a population of about 7,000. Seminole is located in Gaines County in the southern panhandle of West Texas bordering New Mexico. The results are expected to be applicable to many other arid and semi-arid regions as well.

The project encompasses the following broad tasks:

1) The siting, permitting, drilling and characterization of a well drilled into the Santa Rosa, including site acquisition, pre-drilling hydro-geological investigations, permitting, logging, well completion and test,
2) The design and construction of required infrastructure, including well completion, site preparation, foundations and civil works to support the wind turbine, RO system and other system elements,
3) Installation and commissioning of a wind turbine including the foundation, electrical infrastructure, and liaison with the local utility,
4) The procurement, installation and commissioning of a commercial reverse osmosis system, including necessary permits, civil structures, electrical work and piping,
5) The design, permitting and construction of an evaporation pond or other means for dealing with the concentrate from the RO system,
6) Operation and characterization of the integrated wind-water purification system for a period of 12 months, and
7) Documentation and reporting of project results and performance.

## 2.0 SUMMARY OF ACTIVITIES THIS PERIOD

**2.1 Overview** Collaboration between the City of Seminole, WRC and WiSE researchers, and engineering/management consultants continued. All major construction activities have been completed, and startup of the RO system occurred in early October. All electrical connections for the wind turbine are complete, and Entegrity Wind's maintenance contractor is performing final maintenance for impending startup. The variable frequency drive for the well and sand separator were installed, and the well is now ready for continuous operation.

**2.2 Site Construction** West Texas Consultants (WTC) reported Tejas Partners' construction work as completed previously. The building that houses the RO system has lights and grid-based electricity. On-site plumbing and the lift station for the water leaving the building are complete, and grid-based power is also available for the well.

**2.3 Wind Turbine and Site Preparation** The installation of the tower, nacelle, and blades was completed on March 13, 2012, and ancillary electrical connections were made over the next several months. Entegrity Wind's installation contractors performed some final maintenance on the wind turbine during late February, and start-up of the turbine was set for early March.

**2.4 RO System** The RO system was moved to the RO building in May 2012. Startup of the RO system with Keith Summerford of Crane Environmental and PSC took place on October 2 through 5, 2012. The RO system currently operates with grid-based power. City of Seminole staff members are currently operating the well and RO system for about 30 minutes to one hour three to five times per week to keep the membranes moist. Figure 1 below demonstrates the variations in depth to water and total dissolved solids (TDS) concentration recorded by the downhole Aqua Troll from February 8 to 28. It is interesting to see that the TDS at the pump varied from about 2000 mg/L when the pump has been off for a day or so to over 10,000 mg/L not long after the well pump is turned on. This behavior demonstrates mixing of water from at least two producing zones within the well. It is most likely that the deepest water producing zone has the highest TDS concentration, and this water appears to move upward in the well after the water level has been taken downward when the pump is operating. Summerford plans to return to Seminole in late March for the final site inspection before long-term continuous operation. Summerford requested a new analysis of a raw water sample for pH, hardness, iron, and TDS to double-check the anti-scalant choice, and that sample will be collected in early March and

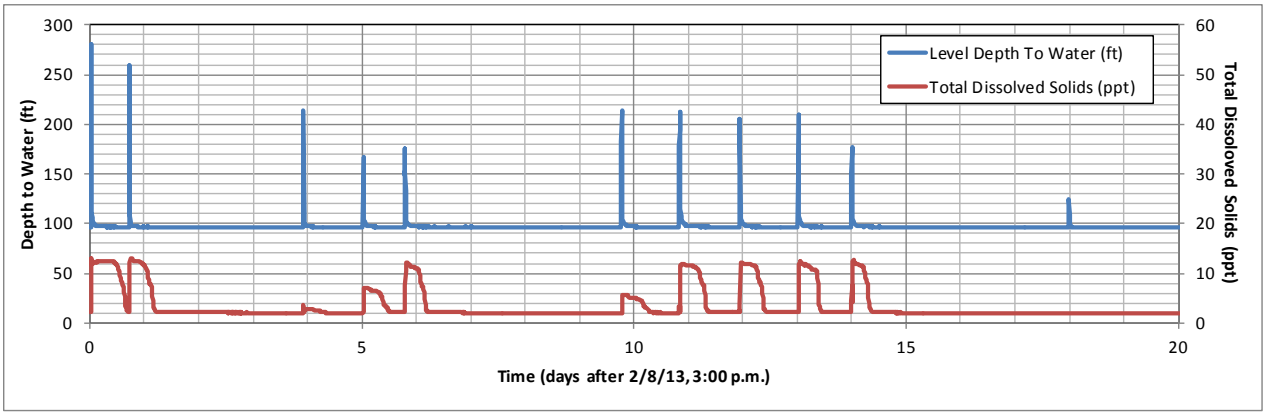


Figure 1. Depth to water and total dissolved solids variations from February 8 to 28, 2013

analyzed at the TTUWRC Environmental Science Laboratory. If the analyses confirm that the anti-scalant solution is still appropriate, we could begin continuous operation of the RO system prior to Summerford's visit.

**2.5 Santa Rosa Well** As noted previously, the recent static water level in the well has remained at approximately 96 ft below ground surface, much higher than the 750 ft below ground surface shortly after the initial well construction and pump test. Under the current conditions, the pump set at 900 ft below ground surface is subject to much higher intake pressures than the initial conditions, so the discharge from the pump is a much higher pressure than the design conditions for the variable speed booster pump between the well pump and the RO system. The variable frequency drive (VFD) was installed to control the well pump motor speed to provide properly pressurized flow to the new sand separator and then to the RO system. The VFD also led to removal of the booster pump with its own VFD that had previously been between the well pump and the RO system. David Anderson and his staff of Anderson Welding Pump & Machine, Inc., installed the VFD and sand separator, and the well is now ready for continuous operation. The Llano Estacado Underground Water Conservation District provided the local funds to for this timely purchase.

**2.6 Local Outreach** The kickoff workshop and media event is still being planned to explain the different aspects of the project for the local public and other interested parties. The WRC and WiSE staff will be contacting all contributing organizations for their interest and availability as the final date is confirmed. Ken Rainwater submitted an invited manuscript about the project to the Journal of Contemporary Water Research and Education for publication later in 2013. Co-authors were Phil Nash, Lianfa Song, and John Schroeder.

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