

Seminole Integrated Wind-Water Demonstration System

Progress Report for June 2013

Submitted to

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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, the State Energy Conservation Office, Llano Estacado Underground Water Conservation District, Texas Tech University National Wind Institute (NWI) and Water Resources Center (WRC), 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 March 2013, the construction contracts as the site were completed, such that the TDRA and TWDB contracts could financially end. Continuous operation and monitoring of the system began in June 2013 and will extend for a year into 2014, 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 6430 located in Gaines County in the Southern High Plains. The results will be applicable to many other arid and semi-arid regions.

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 and WRC and NWI researchers continued. Continuous operation of the well, wind, turbine, and RO system began with a successful 24-hr operation test starting on April 18, and the system ran successfully until May 2 when the well pump motor failed. The pump motor was successfully replaced on June 14, and continuous operation of the system began again on June 17.

2.2 Site Construction All construction activities were previously completed.

2.3 Wind Turbine and Site Preparation The wind turbine became operational on March 6. After consultation with WTC and the City of Seminole staff, the WRC is working with Real-Time Automation of Hobbs, NM, to install a data-logging system to remotely track the electricity generation from the wind turbine and allow delivery of those data to the City's SCADA system and also through the internet.

2.4 RO System Upon reactivation on June 17 by the City of Seminole staff, the RO system returned to its previous operational conditions over the next 24 hr with little adjustment. The system delivers 40 gpm of permeate and 14 gpm concentrate, for a recovery of 74 percent. Feed water and permeate water samples were collected on June 24 by the WRC staff for analyses at TraceAnalysis in Lubbock. The results to date are shown in Table 1. Major cation analyses are also underway and will be added to the table when available. Note that the total dissolved solids are reduced by almost 95 percent in the permeate. The WRC is also working with Real-Time Automation for automatic data collection to monitor the digital data collected by the RO system.

Table 1. Feed and Permeate Water Analyses for June 24, 2013 Water Sample

Analyte	Concentration		Units	Reporting Limit
	Feed Water	Permeate		
Chloride	2910	178	mg/L	2.5
Fluoride	<5	<0.5	mg/L	0.5
Nitrite-N	<0.4	<0.04	mg/L	0.04
Nitrate-N	<0.4	0.1	mg/L	0.04
Sulfate	1780	4	mg/L	2.5
Total Dissolved Solids	8235	436	mg/L	2.5
pH	7.7	6.4	s.u.	2
Total Silica	8.7	<0.5	mg/L	0.5
Total Aluminum	<0.05	<0.05	mg/L	0.05
Total Arsenic	<0.01	<0.01	mg/L	0.01
Total Copper	<0.005	<0.005	mg/L	0.005
Total Iron	0.6	1.3	mg/L	0.01
Total Manganese	0.4	<0.005	mg/L	0.005
Total Uranium	<0.03	<0.03	mg/L	0.03
Total Zinc	<0.01	<0.01	mg/L	0.01

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It is noted that the total iron concentration, while small, was higher in the permeate than in the feed water. That result will be double-checked and monitored for its possible impact on the RO operational settings. The City staff continue to monitor the RO system five days per week and manage the antiscalant and acid feeds.

2.5 Santa Rosa Well On May 2, the well pump motor stopped, with a ground fault recorded on the VFD controller. The one-year warranty on the pump and motor had expired. Anderson Welding, Pump, and Machine Service was brought in to pull and service the well pump motor. The replacement motor was installed on June 14 and operates adequately. Real-Time Automation will also set up data collection from the well's VFD to the City's SCADA system. The AquaTroll pressure transducer/temperature/salinity monitoring device became inactive during the well repair, so it was removed from the site on June 24 for return to the manufacturer for repair. The depth to water in the pumping well was measured that day with both an eline and a sonic water level meter operated by Charles George of the Llano Estacado Underground Water Conservation District, and both devices set the depth to water at 286 ft below the ground surface.

2.6 Local Outreach The kickoff workshop and media event is still being planned to explain the project for the local public and other interested parties. The WRC and WiSE staff contacted all contributing organizations for their availability as the final date is confirmed. The preliminary interactions with all parties identified the week of August 19-23 as a potential window for the event. The date will hopefully be settled very soon after the publication of this progress report.

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