

# **Seminole Integrated Wind-Water Demonstration System**

## **Progress Report for August 2011**

### **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, 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 recently extended to March 2013.

**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 are 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.

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, and capitol purchases moved forward. The major

current site event is the Santa Rosa well construction, which began in June and continued in July, followed by pump testing and water quality sampling in August.

**2.2 Site Layout and Balance of System Design** West Texas Consultants (WTC) continued work on the infrastructure for the demonstration project, including concentrate management through discharge to the City’s wastewater treatment plant, which will require a sewer line and lift station to move the flow, and the building and associated amenities at the site. Ken Rainwater, Chad Tompkins of WTC, and representatives of Parkhill, Smith and Cooper (PSC) are communicating often to confirm these details and those associated with the wind turbine site preparation.

**2.3 Wind Turbine Procurement and Site Preparation** The turbine nacelle and blades were previously received in Seminole. WTC completed the geotechnical work for the foundation design and submitted it to the City in late June. The lattice tower was ordered from the manufacturer, with delivery expected by November, with erection to follow immediately.

**2.4 RO System Procurement** The RO system and spare parts from Crane Environmental were received in Seminole in late December. The equipment will remain in storage at the City warehouse until the RO building is built, later in 2011. PSC will work with the City and WRC to get Texas Commission for Environmental Quality (TCEQ) approval for the demonstration project after the water sample results are determined from the Santa Rosa well. PSC is interacting directly with WTC for logistical details for the final sizing and placement of the RO building and associated piping and water storage issues.

**2.5 Santa Rosa Well Procurement** West Texas Water Well Service (WTWWS), from Midland, Texas, performed well development and pump testing in early August. The initial depth to water on August 4 was 743 ft in the 1800-ft deep well with its 7-in casing, perforated from 540-650 ft, 890-920 ft, and 1610-1770 ft. The pump test began on August 4 at 8:00 a.m, with the

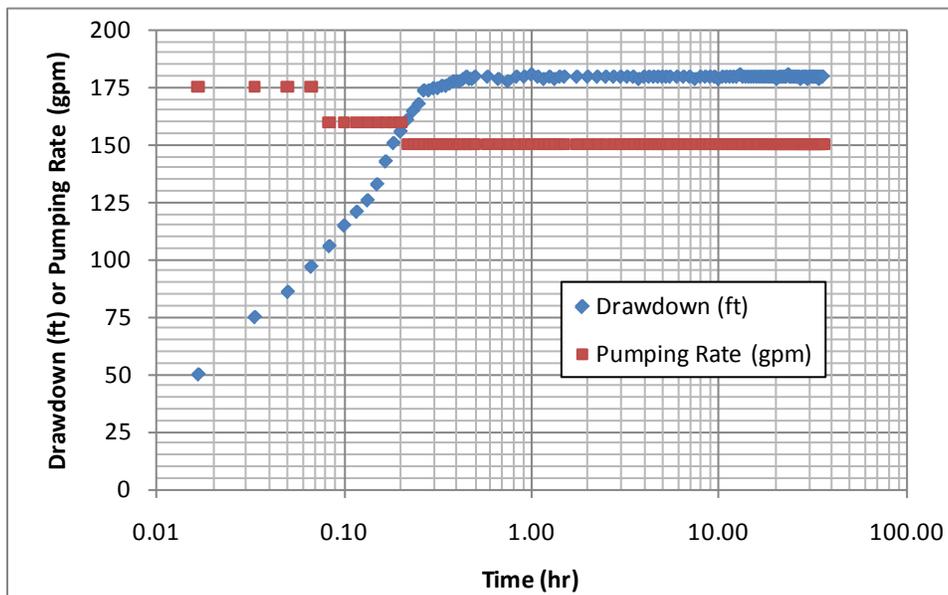


Figure 1. Drawdown and pumping rate during the 36-hr pumping test on August 4-5, 2011

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pump intake set at 1600 ft. Figure 1 shows the records of pumping rate and drawdown in the pumping well vs. time for the next 36 hr. The pumping rate was 175 gpm for 4 min, then 160 gpm for 8 min, and then stabilized at 150 gpm for the next 35 hr and 48 min. The drawdown stabilized at approximately 180 ft in less than 30 min and remained at that value for the rest of the test duration. After 36 hr of pumping, the pump was turned off, and the well recovered to a stable depth to water of approximately 746 ft within 30 min. These results were very encouraging, as the stable pumping rate of 150 gpm was three times the target of 50 gpm planned for the demonstration project. The position of the water column in the well will allow selection of a pump with its intake less than 1000 ft from the ground surface, which should fall within the range of commercially available water well pumps. The budget for the well included a 50-gpm pump with its intake planned near the bottom of the well, at a nominal 1800-ft depth, which would require a more expensive and unique pump configuration. Pump selection will be completed in September.

A water sample was collected by WTWWS on August 5 and sent to Xenco Laboratories in Odessa for preliminary analyses. The results are provided in Table 1. “ND” represents non-detection of the analyte, meaning it was not found above the lab’s reporting limit. The primary interest in the preliminary analyses was the total dissolved solids (TDS) content, shown as 7130 mg/L. More complete analyses will follow to meet TCEQ guidance and fully inform the membrane selection and pretreatment requirements for the RO system.

Table 1. Preliminary Water Quality Analyses

Group	Analytes	Units	Reporting Limit	Sample Value
Inorganic Anions	Chloride	mg/L	4.00	3420
	Fluoride	mg/L	0.20	1.95
	Nitrate as N	mg/L	0.05	ND
	Nitrite as N	mg/L	0.05	ND
	Sulfate	mg/L	4.00	2200
Metals	Aluminum	mg/L	0.05	0.135
	Arsenic	mg/L	0.01	0.0107
	Copper	mg/L	0.01	0.0267
	Iron	mg/L	0.10	1.00
	Manganese	mg/L	0.05	0.395
	Zinc	mg/L	0.10	ND
Other	Total Dissolved Solids	mg/L	5.00	7130
	pH	SU	2.00	7.89

At this time, it is not clear which of the three perforated zones is providing water to the well or at what rate. WTWWS was asked to estimate the cost of a packer testing procedure to isolate the three zones sequentially for collection of water samples and possible productivity testing. Based on WTWWS findings, a packer test could cost from \$40,000 to \$60,000 depending on exact

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logistic requirements. The packer test was not in the budgeted scope of work, but it is a worthwhile consideration for the City of Seminole to obtain as much information as possible from this well, which is also of interest to the Llano Estacado Underground Water District. Further discussion about this issue continues, and it would be possible for the City to perform such a test either [1] before placement of the pump for this demonstration project or [2] after completion of the demonstration project.

Dr. Judy Reeves of Cirrus Associates completed the geologic report based on her observation of the well drilling. A copy of her report is included as a separate attachment with this progress report. Her findings were previously applied in the selection of the perforated zones.

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