Our Common Ground

Iowa Department of Natural Resources

Iowa Geological and Water Survey
Resource Information Fact Sheet 2011-3

Groundwater Availability Modeling of the Des Moines River Aquifer

Increased demands for groundwater by agriculture, industries, and municipalities have raised concerns about the future availability of groundwater in Iowa. In 2007, the Iowa Legislature began funding a comprehensive Water Resources Management program, which would be implemented by the Iowa Department of Natural Resources. A key aspect of the program is to evaluate and quantify the groundwater resources across the state using computer simulation models. These models help answer questions such as: "How much water can be pumped from an aquifer over 10, 20, or 100 years?" or "Will my well go dry?"

A hydrogeologic study was initiated in 2010 to more fully understand the shallow groundwater resources in the West Fork of the Des Moines River alluvial aquifer (Des Moines River aquifer), located in north-central Iowa. The primary objective of this study was to evaluate the potential impact of a new Iowa Lakes Regional Water wellfield near Osgood (Osgood wellfield) on the nearby irrigation wells (Figure 1). A groundwater

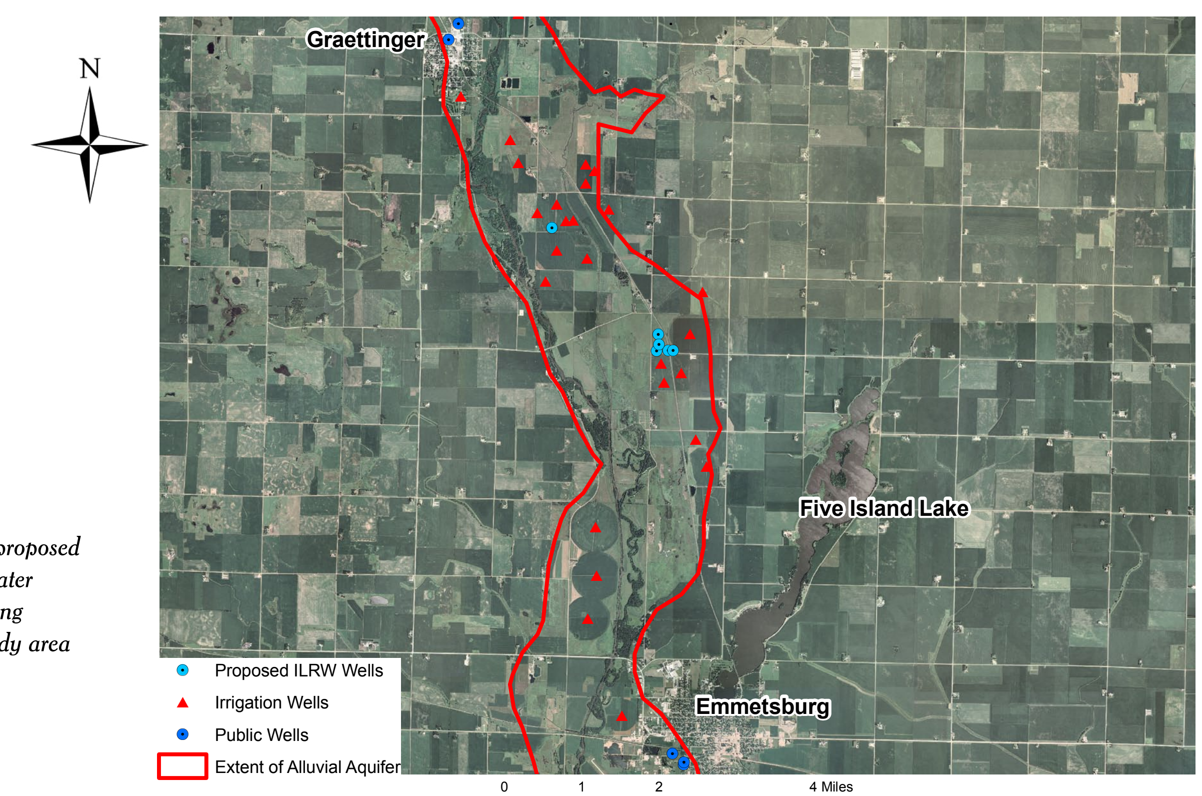

Figure 1. Locations of proposed Iowa Lakes Regional Water (ILRW) wells and existing irrigation wells in the study area (Palo Alto County).

shown in Table 1.

Based on the mass balance calculations in Visual MODFLOW, the percentage of water production supplied by the Des Moines River and Jack Creek (induced recharge) increased from 10.9 percent during normal rainfall conditions to 58.4 percent during a severe drought. The increase in induced recharge prevents much higher drawdowns in both the irrigation wells and the Osgood wellfield wells. Without the recharge from the Des Moines River and Jack Creek, a severe drought would significantly reduce the water production in the area wells.

Based on the model results, adequate water resources are available to meet the Iowa Lakes Regional Water System's proposed permitted withdrawals in the Des Moines River aquifer. Cooperation would be necessary from both Iowa Lakes Regional Water and the irrigators to maintain water supplies during a severe drought. Adjustments in pumping cycles and rotating active and inactive wells may be necessary. The irrigation wells may need to pump during the night when water demand is lower for the Osgood wellfield, or Iowa Lakes Regional Water may want to pump additional water from the northern wellfield to reduce the pumping stress on the southern wellfield.

The groundwater flow model can be used as a planning tool for future severe droughts. The model can also be used to evaluate the maximum sustainable withdrawal from the area and to potentially limit new water use permits in order to prevent over-allocation of the groundwater resources in the Des Moines River aquifer.

South Wellfield			
	Normal Rainfall	6 Inches of Recharge	4 Inches of Recharge
Well Owner	Drawdown (ft)	Drawdown (ft)	Drawdown (ft)
Dale Opheim	4.1	5.1	5.8
Herke Farms Well 3	4.1	5	5.6
Herke Farms Well 2	3.3	4.3	5
Herke Farms Well 1	2.7	3.6	4.2
North Wellfield			
	Normal Rainfall	6 Inches of Recharge	4 Inches of Recharge
Well Owner	Drawdown (ft)	Drawdown (ft)	Drawdown (ft)
Doug Herke 3	0.2 to 0.6	0.4 to 0.7	0.4 to 0.7
Soper Farms	0.2	0.4	0.7

***Table 1.** Simulated drawdown for various drought scenarios near Iowa Lakes Regional Water wellfields.*

Acknowledgements

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References

Schlumberger Water Services, 2010, Visual MODFLOW Professional, Version 2010.1.

Thompson, C.A., 1984, Hydrogeology and water quality of the Upper Des Moines River alluvial aquifer, Iowa Geological Survey, Open File Report 84–5, 170 p.

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model of the Des Moines River aquifer was created using Visual MODFLOW version 2010.1 (Schlumberger Water Services, 2010). The model predicts future well interference, declines in water levels, and maximum sustainable pumping rates.

Des Moines River Aquifer

The Des Moines River aquifer consists of sand and gravel deposited by the modern river system and is highly variable in both thickness and grain size. Cobble and boulder zones are found near Graettinger and in isolated areas throughout the aquifer. Tremendous well yields are produced in these cobble zones (Thompson, 1984). The sand and gravel thickness of the Des Moines River aquifer (Figure 2) is based on existing data from 82 striplogs and drillers' logs. The sand and gravel is overlain by fine-grained sediments consisting of silt and silty sand, that range in thickness from 2 to 6 feet. The Des Moines River aquifer is underlain by glacial till throughout the study area.

The thickness of the Des Moines River aquifer varies from 6 to over 50 feet, but averages approximately 20 feet (Thompson, 1984). The deposits are not uniform or homogeneous, but vary from coarse sand and gravel to cobbles and boulders. The yields that can be expected in wells screened in these sediments depend on the thickness of alluvium, the grain size or texture, and interconnectedness of the various sand and gravel units.

The groundwater flow model for the proposed Osgood wellfield involved six proposed public wells with an annual permitted water use of 539 million gallons per year. The Osgood wellfield is divided into a northern wellfield (proposed Well 6) and a southern wellfield (proposed wells 1 through 5). A total of 14 irrigation water use permits (24 known irrigation wells) and two existing public water use permits (City of Emmetsburg and City of Graettinger) are located in the model area with permitted water use totaling 1.15 billion gallons per year. A worst-case historical drought, based on the 1958 drought (15.2 inches of precipitation and 4 inches of recharge), was simulated and the impact of the new Osgood wellfield on the nearby irrigation wells was evaluated. Maximum additional drawdowns in the irrigation wells caused by the pumping of the Osgood wellfield ranged from 4.2 feet to 5.8 feet in the southern wellfield (Figure 3), to 0.4 to 0.7 feet in the northern wellfield (Figure 4). The change in additional drawdown versus recharge is

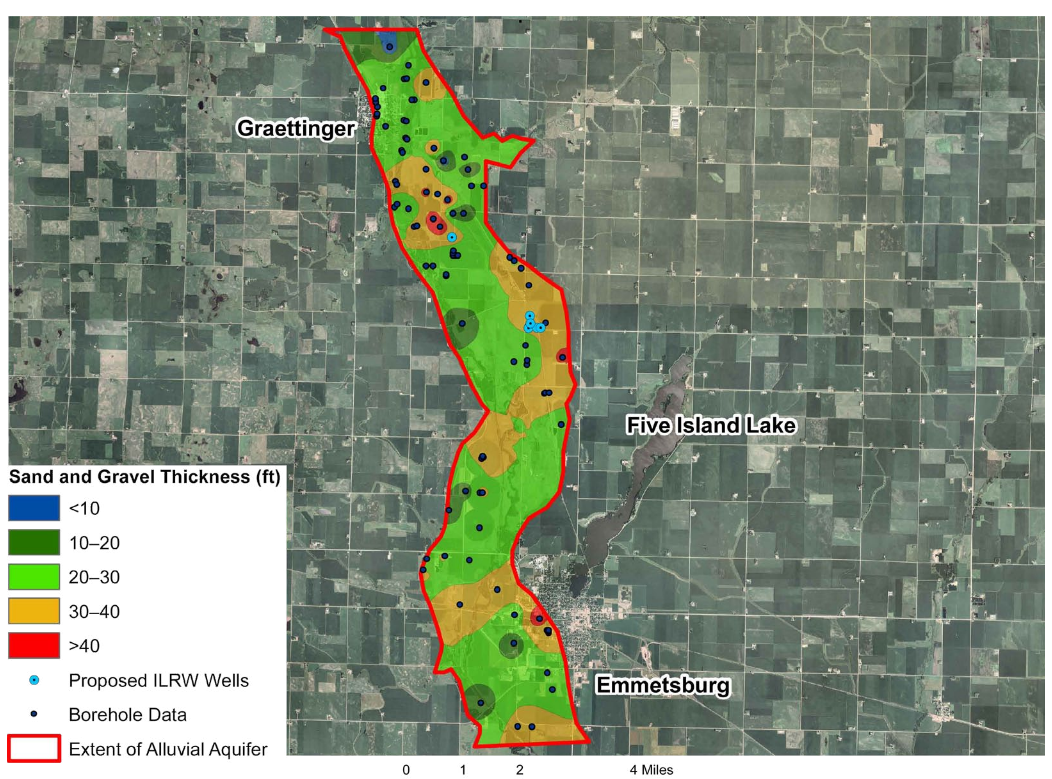

Figure 2. Isopach (thickness) map of the Des Moines River aquifer and its tributaries (Palo Alto County).

Figure 3. Simulated drawdown map for Iowa Lakes Regional Water south wellfield for a severe drought (4 inches of recharge per year).

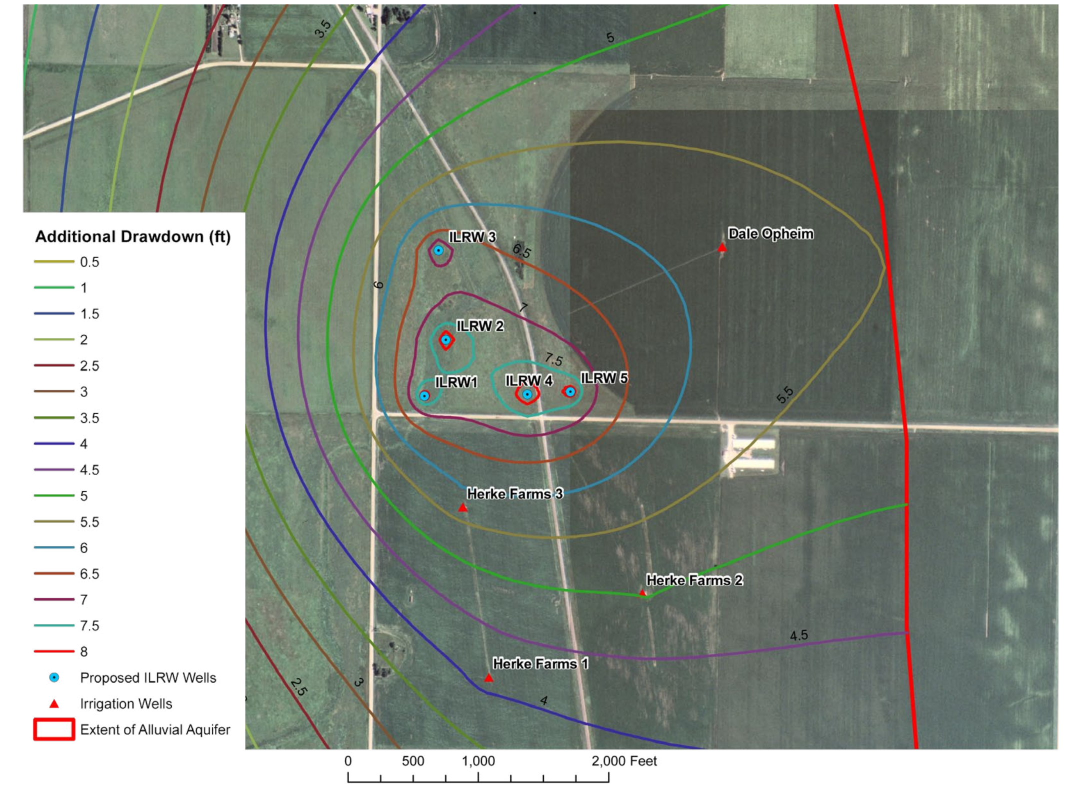

Figure 4. Simulated drawdown map for Iowa Lakes Regional Water north wellfield for a severe drought (4 inches of recharge per year).