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# water spouts

No. 255

May 2011

## Upcoming 2011 NDSU Field Days

<b>Streeter</b> Central Grasslands Research Extension Center	June 29	(701) 424-3606
<b>Hettinger</b> Research Extension Center	July 12	(701) 567-4323
<b>Dickinson</b> Research Extension Center	July 13	(701) 483-2348
<b>Williston</b> Research Extension Center	July 14	(701) 774-4315
<b>Casselton</b> Agronomy Seed Farm	July 18	(701) 347-4743
<b>Carrington</b> Research Extension Center	July 19	(701) 652-2951
<b>Minot</b> North Central Research Extension Center	July 20	(701) 857-7677
<b>Langdon</b> Research Extension Center	July 21	(701) 256-2582
<b>Oakes</b> Irrigation Research Site	July 26	(701) 742-2189
<b>Nesson Valley Irrigation Site</b>	July 28	(701) 774-613

and dams; and generally made the upcoming irrigation season look good. However, with the late planting season, we need some normal to above-normal heat units in the next few months to increase the potential for timely crop development.

## Summer Water Tours

### North Dakota Water Education Foundation

This summer the North Dakota Water Education Foundation (NDWEF) will offer six water tours. The first tour will start on June 22 and the last will be on Sept. 13. These tours provide a firsthand look at North Dakota's critical water issues. Registration is \$15 per person and includes tour transportation, meals, refreshments, informational materials and a one-year subscription to North Dakota Water magazine. Here are the first two tours of the summer.

### Devils Lake Solutions:

#### Upper Basin Water Management – June 22

This tour begins and ends in Devils Lake. With above-average snow amounts and normal spring rain events, the outlook for the spring and summer in the Devils Lake Basin is potentially disastrous. If the lake level reaches 1,455 feet above sea level (a 50 percent chance, according to the National Weather Service) more than 38,000 acres of additional land will be flooded and the lake will cover almost 218,000 acres. This tour will include upper basin storage, a major component to dealing with the flooding dilemma of a continuously rising lake. The tour will show how inundated roads and fields affect crop yields and quality of life in the area.

#### Bismarck-Mandan's Missouri River – July 14

This half-day tour begins and ends in Bismarck. Explore the Missouri River and learn about critical issues such as bank stabilization, fishing, recreation, irrigation, water use and management, endangered species and water quality. Included is a tour of the South Central Regional Water treatment plant and headquarters, recreation and historic sites, the Harmon Lake recreation area and Riverbound Farms, a small farm focused on organic vegetables and meat production.

To register online, go to [www.ndwater.com](http://www.ndwater.com) or send a check to NDWEF, P.O. Box 2254, Bismarck, ND 58502. Please indicate which tour you want to attend and include the number of people. For more information on the tours, call or email the foundation.

**North Dakota Water Education Foundation,**

(701) 223-8332, Fax: (701) 223-4645

[ndwaterusers@btinet.net](mailto:ndwaterusers@btinet.net)

## Another Growing Season Begins With Plenty of Moisture

You probably have noticed we did not have an April issue of *Water Spouts*. Flooding and cool weather, combined with a late planting season, contributed to delaying this publication. The entire state of North Dakota seems to have received a significant amount of precipitation since last fall. The Williston area received a record amount of snow, and the amount exceeded what was received in the eastern part of North Dakota. All this precipitation may cause problems, but it is good for the upcoming irrigation season.

From an irrigation perspective, the extra water from precipitation events has a silver lining. The excess moisture has recharged the soil, including the subsoil below 2 feet, to near field capacity; recharged aquifers; filled dugouts

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County Commissions, NDSU and U.S. Department of Agriculture Cooperating. This publication will be made available in alternative formats for people with disabilities upon request, (701) 231-7881.

# The Cost to Pump Water Keeps Increasing

Electricity and diesel fuel are the most common energy sources for pumping irrigation water in North Dakota. Currently, the price of farm-delivered diesel fuel is around \$4 per gallon, and the price may not drop by the end of the irrigation season. If you use a diesel-powered pump for irrigation, converting to an electric-powered pump could save you money.

Figures 1 and 2 show the costs of pumping 1 acre-inch of water with a high-, medium- and low-pressure pumping plant for a wide range of fuel costs. An acre-inch is 27,500 gallons of water, which is the amount of water required to cover one acre to a depth of 1 inch. To apply an inch of water to the land under a standard quarter section center pivot requires about 128 acre-inches of water. These graphs were developed for center pivot sprinkler systems that obtain water from wells. The energy to power the center pivot (whether electric or hydraulic) has been included in the pumping costs.

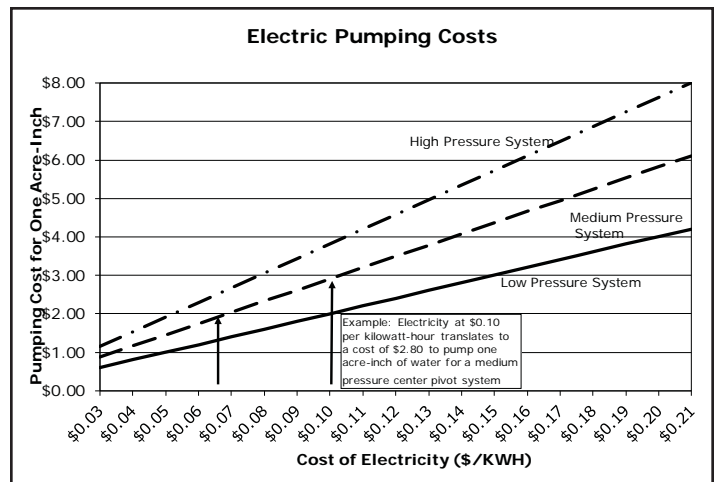
The high-pressure system assumes a 50-foot lift in the well and 100 pounds per square inch (psi) of pressure at the pump. The medium-pressure system assumes a 50-foot lift in the well and 70 psi of pressure at the pump. The low-pressure system assumes a 50-foot lift in the well and 40 psi at the pump.

The statewide average irrigation cost for off-peak electric power is about 6.5 cents per kilowatt-hour (kwh) in North Dakota when adjusted to include the energy charge, the demand charge and/or annual charges. As shown by the arrow on Figure 1, the cost to pump water at this price for a medium-pressure pumping plant is about \$1.85 per acre-inch of pumped water.

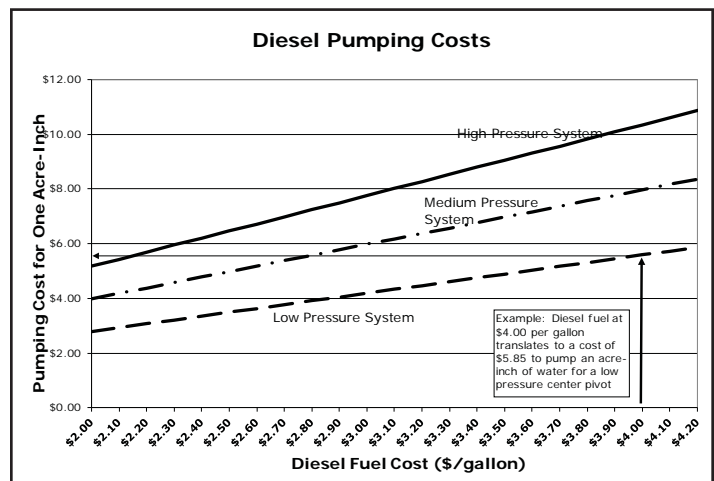
The statewide average irrigation cost for regular-rate power is about 10 cents per kwh when adjusted to include the energy charge, the demand charge and/or annual charges. As shown on Figure 1, this corresponds to a pumping cost for a medium-pressure irrigation system of \$2.80 per acre-inch of pumped water.

The current price for farm-delivered diesel fuel is about \$4 per gallon. As shown on Figure 2, this results in a pumping cost for a low-pressure pumping plant of \$5.85 per acre-inch of pumped water. At this fuel price, the cost to pump 1 acre-inch to a medium-pressure center pivot is about \$8.20. Comparing this with electric pumping costs for a medium-pressure center pivot using off-peak electric power rates, the difference is \$6.35 per acre-inch of pumping costs (\$8.20 minus \$1.85). Compared with regular electric power rates, the cost difference is \$5.40 per acre-inch.

For the last 10 years, the annual statewide average of pumped water per acre of irrigated land has been about 10 acre-inches. Using this amount, the additional pumping cost using diesel on a per-acre basis is \$54 and \$63, compared with regular and off-peak electricity, respectively. For a typical center pivot irrigating about 128 acres, the annual difference in pumping



**Figure 1.** Electric pumping costs for a high-, medium- and low-pressure irrigation pumping plant. The two arrows show the pumping costs for 6.5- and 10-cent-per-kwh electricity on a medium-pressure pumping plant are \$1.85 and \$2.80 per acre-inch, respectively.



**Figure 2.** Diesel pumping costs for a high-, medium- and low-pressure irrigation pumping plant. The arrow shows that with farm-delivered diesel fuel at \$4 per gallon, pumping an acre-inch of water through a low-pressure irrigation system will cost \$5.85. If the arrow is extended up to the medium-pressure system, the cost of pumping is \$8.20 per acre-inch.

cost between diesel and electric would be about \$6,912 at regular power rates and \$8,064 with off-peak electric rates. These huge differences in pumping costs make changing from diesel engines to electric motors economical.

## Diesel or Electric Power?

Due to the large motor sizes (25 to 100 horsepower), three-phase electricity is the preferred power source for pumping irrigation water. The reason many irrigators originally installed diesel engines instead of electric motors was the cost of access to three-phase power. The cost of access

to three-phase power still may be too high, even with the large energy cost differential between electric and diesel.

Based on a survey of electric cooperatives and investor-owned electric suppliers, extending a three-phase power line one mile to an irrigation pump site varies from \$40,000 to \$60,000. Many electric suppliers have programs to help reduce the cost of installing three-phase line, including cost-share and multiyear power use contracts.

Single-phase electricity can be used for pumping irrigation water, but it must be converted to three-phase power. To do this requires the purchase of phase converters or a variable-frequency drive. In addition, you still will have line extension charges for the single-phase power. Some electric suppliers are very leery of using single-phase power lines for irrigation pumping loads at certain locations on the distribution system, so visiting with them to discuss your plans is very important.

In addition to the line extension charges, you have to factor in the cost of an electric motor, electric shutoff and control panels, along with labor. Additional costs could involve phase conversion equipment, transformers and underground line installation. These could add \$12,000 to \$20,000 to the cost. Of course, the diesel engine, fuel tank and other parts will have some salvage value.

Other factors to consider are the reliability of electricity, not having to maintain the diesel engine (changing oil and filter every 150 hours) and whether you can live with controlled (off-peak) electric service. If you are considering changing from diesel to electric, plan to visit your electric supplier and irrigation dealer.

If connecting to electricity is too expensive, here are some options to reduce pumping energy requirements. First, reduce pressure requirements. Check with your irrigation dealer to see if you can install a lower-pressure sprinkler package. For example, at a pumping rate of 800 gallons per minute, a 10-psi reduction at the pump will reduce pumping power by 6.5 horsepower. This would save about one-third of a gallon of diesel per hour.

Second, improve the efficiency of the diesel engine. If your engine is more than 15 years old, upgrading to a newer model can improve fuel use by 10 to 25 percent. Third, maintain your well. Partially plugged well screens increase drawdown, which increases pumping energy requirements. Fourth, plug all leaks in the pipeline and on the pivot. Leaks put water where you don't want it.

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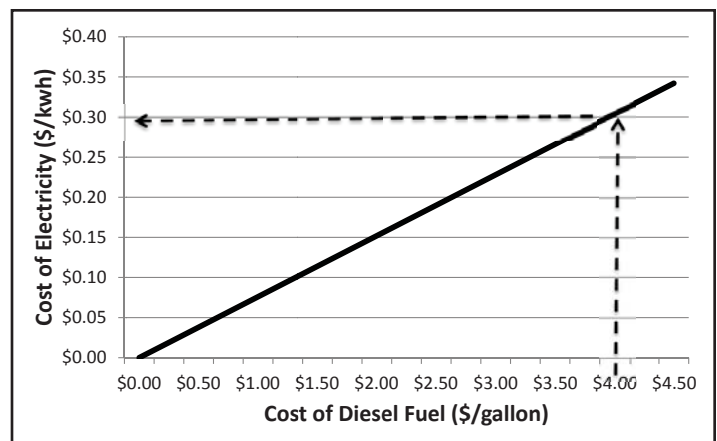
## Electric and Diesel Fuel Cost Comparison

The graph in Figure 1 directly compares the cost of electricity in kilowatt-hours (kwh) to diesel fuel in gallons. The graph only compares energy costs. It was developed assuming good efficiencies for both diesel and electric motors. A 10 percent charge was added to the diesel cost to cover the additional costs of lubricants, filters and other routine service.

Remember, when comparing energy costs, add all the costs of energy. For electricity, this includes annual charges (meter charges), demand and/or motor horsepower (or kilowatt) charges and any other costs for electrical service. Total all electrical costs and divide by the total kwh usage to arrive at average cost per kwh.

The average regular electric rate for a typical irrigation system in North Dakota is about 10 cents per kwh. This corresponds to a diesel fuel cost of \$1.33/gallon. The average controlled (sometimes called off-peak) electric rate is 6.5 cents per kwh, which corresponds to 86 cents per gallon for diesel. This is the break-even rate between the two fuel sources.

Each electric supplier has a different set of rates. To compare your costs, look at the total electrical bill from last year for an irrigation system and divide the dollar amount by the total kilowatt-hours used for the growing season to obtain the dollars per kwh.



**Figure 1.** Irrigation pumping cost comparison. The arrow shows when diesel fuel cost is \$4 per gallon the equivalent electric pumping cost is 30 cents per kwh.

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## **Starting the Irrigation System: A Checklist**

- ✓ Open and check electric control panels for rodents or damage before starting the irrigation system.
- ✓ Check all motor openings to see if they are screened properly, again to keep out rodents.
- ✓ Measure and record the static water level in all wells.
- ✓ Visually inspect the piping system, especially above-ground pipes.
- ✓ Check all air-release valves to make sure they are working.
- ✓ **Fill pipelines slowly; make sure all the air is out of the system.**
- ✓ Replace any broken or old pressure gauges.
- ✓ Check the sprinkler system for damage.
- ✓ Make sure all portable aluminum or PVC pipe sections have gaskets installed.
- ✓ Check gearboxes on center pivot towers for water accumulation. Drain water and replace with oil.
- ✓ Check the tire pressure on center pivots.
- ✓ With the center pivot running, visually check each sprinkler head to make sure it is working properly.