# Potential runoff of stacked poultry manure – 2

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**Figure 1. Creating a headland stack**

Discovery Farms has investigated the potential for nutrients to move from headland stacks into waters of the state (surface or groundwater). A headland stack is a pile of manure stored on bare soil at the edge of a crop field until the field is ready for manure application. Headland stacks remain in place for weeks or months, or up to one year. Stacking, while not unique to poultry manure, is common in the industry because of this manure's high dry matter content. Stacking is also common on farms that haul daily or clean livestock lots, or on farms with stackable manure.

The goal of the study was to evaluate the potential for nitrogen and/or phosphorus to run off a stack of poultry manure. Discussions with producers and state agency personnel led us to expand the study to evaluate why crops do not grow for a period of time after removing the piles. This objective is addressed in a separate paper.

A site meeting state requirements of soil type, slope, soil test levels and location for stacked poultry manure was selected. The manure and bedding were stacked and constructed to resemble a "typical" headland stack (height, width and length) and left in place for one year (Figure 1). Most stacks do not remain in fields for a year, but the study was looking at worst possible conditions. The site was soil-tested prior to placing the manure and contained 3.3 percent organic matter, 30 ppm $P_2O_5$, and 114 ppm $K_2O$; the previous crop was soybeans.

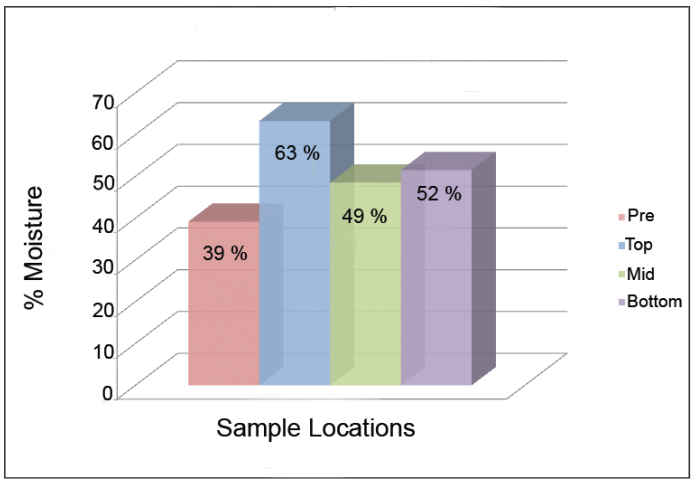
## Methods

One hundred tons (6 feet high X 12 feet wide X 100 feet long) was stacked in November 2003. To channel runoff water to the monitoring equipment, a retaining wall was erected around the perimeter using 3/4 inch exterior grade plywood, trenched 6 inches into the ground (Figure 2). Approximately 4 to 6 inches of bare soil separated the manure from the plywood border. The soil inside the plywood perimeter was compacted to prevent water infiltration along the soil/wood interface. The exposed soil was shaped to improve flow towards the end of the enclosure, which was formed into a funnel and attached to a trapezoidal flume. The equipment was checked and calibrated on a routine basis throughout the study period to ensure reliability. The headland stack and monitoring equipment remained in place throughout the entire 12-month period.

In November 2004, the stack was removed and applied on the surrounding land. During removal, manure samples were taken for moisture analysis from the upper, middle and bottom one-third of the center profile. This was done to improve the understanding of water movement through the pile. Soil under the pile was sampled prior and after removal at two locations: the center, where depth was greatest and the outside edge, about 1 foot into the stack. Soil samples were analyzed for total nitrogen, nitrate, ammonium, phosphorus, potassium, manganese and other soluble salts.

Soil sampling was conducted to track increases in soil tests, which might indicate that water was moving through the pile and into the soil profile

**Figure 2. Retaining wall**




**Graph 1. Moisture content in manure stack**

versus running off through the flume. How manure and the soil surface interact might allow predictions into potential groundwater impacts and possible remediation techniques. These tests were a precursor to groundwater monitoring conducted in the third phase of the study, following the conclusion of this project.

## Results

The annual rainfall at the site was well within the "normal" range and could be considered slightly higher than normal. There was a wide range of conditions with less than normal precipitation in March, June and August and greater than normal precipitation in May and September. **The key finding of this study is that over the 12-month period, this typical headland stack produced no runoff events.** Earlier work may help explain the lack of runoff. Poultry manure holds a lot of water: a 100-ton stack would require 16.3 inches of sustained rainfall to achieve full saturation. Observations of the stack during intense rainfall revealed that water was absorbed into, not shed from, the stack. Moisture levels in the pile (Graph 1) show that the moisture was highest near the surface and become drier deeper in the pile. The interior was dry enough to be used by small rodents to over-winter. A stack of poultry manure generates substantial heat because of composting, which evaporates moisture and, to some degree, offsets moisture added through rainfall events. Another factor reducing runoff was that a thick mat of vegetation (lambsquarter, redroot pigweed, giant ragweed and giant foxtail), had grown around the edge of the pile. This vegetation further facilitated the infiltration of rain and decreased the possibility of runoff.

Nitrogen and phosphorus concentrations were the highest in the top layer of the soil (0-6 inches). Nitrate concentrations were the highest around the edge of the stack where manure was not piled very deep and water likely infiltrated and saturated on the edge of the pile. Ammonium levels were higher directly underneath the center of the headland stack as opposed to around the edges. The soil underneath the center of the stack had relatively high levels of ammonium (NH4+), which can convert to nitrate (NO3-), and may have groundwater quality implications. To understand potential groundwater concerns, we sampled for a broader range of nitrogen compounds. We conducted another phase of the study to evaluate potential risks to groundwater.

## Conclusion

- ❒ Headland stacks of poultry manure pose a very slight risk to surface waters if they are sited away from areas of concentrated flow and severe slopes and are constructed to minimize shallow depths of manure. This conclusion is supported by the abundant plant growth surrounding the stacks. If stacks shed significant levels of rain, there would be channels void of plant growth. This is not the case.
- ❒ Poultry manure should be stacked as high as possible to reduce the potential for water to saturate the pile and allow water to runoff or leach through.
- ❒ Poultry manure can release plant-toxic levels of soluble salts.
- ❒ To minimize the risk to surface water from headland stacked poultry manure, the emphasis should remain on choosing proper stack locations.

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*This brief is a summary of a five-year project evaluating the potential impacts of headland-stacked poultry manure. This project resulted in four factsheets, which are summarized in four additional Discovery Farms briefs. The series includes:* Characterization of poultry manure – 1; Potential runoff of headland-stacked poultry manure – 2; Stockpiling manure and soluble salts: Site remediation for crop production – 3; and Effect of headland stacking of poultry manure on groundwater – 4. *All briefs, as well as four more detailed factsheets, are available from the UW Discovery Farms office, PO Box 429, Pigeon Falls, WI 54760, and 715-983-5668 or at our website: http://www.uwdiscoveryfarms.org.*