The Northwest Research Farm (NWRF) is located near Sutherland, Iowa. Drainage research on the impacts of 4R N-management on crop production and nitrate-nitrogen (nitrate-N) loss began in 2015. Treatments include three N-management treatments and one treatment with no N-fertilizer (Table 1). The site includes 32 individually subsurface drained plots (Figure 1). Tile lines were installed in 2013 at a depth of 3.5 feet spaced 80 feet apart. The center tile line from each plot is pumped and monitored continuously for drainage volume with a flow meter (Figure 2 and 3). A flow-proportional sample is passively collected and subsamples are taken for nitrate-N, total-phosphorus (P) and total-reactive-phosphorus analysis. Soils are predominantly Marcus, Primghar and Galva, all silty clay loams. The 30-year average annual precipitation at NWRF is 30.7 inches.

At NWRF, 4R N-management practices are examined for their impact on drainage N and P loss and crop yield:

**Crops:** Corn-soybean

**Management Practices:** Fall N-application with inhibitor, spring application, split N-application and no N-fertilizer application

### Table 1. Treatments at the Northwest Research Farm drainage facility.

<table>
<thead>
<tr>
<th>Treatment Number</th>
<th>Tillage</th>
<th>Nitrogen Application Time</th>
<th>Nitrogen Application Rate (lb N/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Conventional tillage</td>
<td>Fall (anhydrous ammonia (NH₃) with nitrapyrin inhibitor)*</td>
<td>135</td>
</tr>
<tr>
<td>2</td>
<td>Conventional tillage</td>
<td>Spring (anhydrous NH₃)</td>
<td>135</td>
</tr>
<tr>
<td>3</td>
<td>Conventional tillage</td>
<td>Split N, with 40 lb/acre of urea 2x2 starter at planting plus remainder in-season agrotain treated urea</td>
<td>135</td>
</tr>
<tr>
<td>4</td>
<td>Conventional tillage</td>
<td>None</td>
<td>0</td>
</tr>
</tbody>
</table>

Preliminary findings, 2015-2016:

- In 2015, there was a 40 bu/ac corn yield increase with the application of N-fertilizer (treatments 1-3) compared to with no N-fertilizer. In 2016, this yield increase was greater than 50 bu/ac.

- No significant differences in corn yield were found between the three N-application methods.

- Soybean yield was similar for all four treatments in 2015. In 2014, all plots were cropped with soybeans and received no N-application. In 2016, however, soybean yield was about 3 bu/ac greater with a spring anhydrous NH₃ application (to the previous corn crop) compared to a split N-application (to the previous corn crop).

- There were no significant differences in drainage flow-weighted nitrate-N concentration between soybean plots in 2015 (Figure 4). This was expected as there were no N-applications in 2014.

- In corn plots with no N-fertilizer application, annual flow-weighted nitrate-N concentration was significantly lower in 2015. In 2016, however, there were no significant differences in flow-weighted nitrate-N concentrations between N-application and no N-application.

- In the soybean phase of 2016, the treatment without N-fertilizer application (to 2015 corn) was significantly lower than treatments with spring anhydrous NH₃ and fall anhydrous NH₃ with inhibitor (both to the 2015 corn crop).

- For both years and crop phases, the nitrate-N concentration was statistically the same for the control (no N-fertilizer) and the split N-application.

- There were no significant differences in total-P and total-reactive-P concentrations in drainage found between the four treatments.