A Presentation of the
Minnesota
11th Annual
Drainage Research Forum
Iowa

with partners:
IOWA STATE UNIVERSITY
University Extension
South Dakota Cooperative Extension Service

November 23, 2010   Owatonna, MN
Iowa Bioreactor Demonstration Project

TODD SUTPHIN & KEEGAN KULT
IOWA SOYBEAN ASSOCIATION
ENVIRONMENTAL PROGRAMS AND SERVICES

MINNESOTA/IOWA DRAINAGE RESEARCH FORUM
NOVEMBER 23, 2010
OWATONNA, MINNESOTA
ISA Environmental Program

- Provide leadership for agriculture; have impact.
  - Environment
  - Policy
  - Profitability
- Seeking and capturing performance; tools/techniques to help farmers address issues.
- Apply science to gain understanding, impact and profit
- Crosses multiple geographic scales
- Valuing cooperative partnerships and collaborations
- Provide value to membership and Iowa farmers.
Partnerships

• ISA works with a variety of partners in each watershed
• Each partner provides necessary expertise or support
• ISA’s role is project coordination, watershed planning, farmer outreach/interface, and technical assistance
Agriculture’s Clean Water Alliance

Mission: To reduce the nutrient loss – specifically nitrate – from farm fields and to keep the nutrients from entering the Raccoon River and Des Moines River and its tributaries.

- 13 fertilizer dealers in the Raccoon/Des Moines River watersheds.
- Sell and apply most of the nitrogen used on 5 million acres of cropland in the watershed.
- Leading private sector sponsor of water quality monitoring
- Code of Practice
- Bioreactor demonstration study
Objectives of ACWA

- Position ACWA as a credible source of data regarding nutrients entering the Raccoon and Des Moines River.
- Establish ACWA as a bridge between science and its application on the land.
- Apply “best management practices” to encourage
  - Sound economics
  - Strong environmental stewardship
Bioreactor Demo and Evaluation

- End of the tile treatment process
- ACWA initiated project; 2008
- Partnering with Sand County Foundation
- Worked with ISU on initial design; and Iowa NRCS and ISU on interim standard
- Currently 6 sites installed; 7th pending
Watershed Planning

- A comprehensive plan for the watershed
  - Farmer involvement; locally-led
  - Inventories available data
  - Identifies water quality concerns
  - Outlines resources and partners available
  - Provides guidance on steps needed to address the concerns

- Set of integrated solutions; no silver bullet

- Infield/Edge of Field

- MRBI practice list

- Implementation
ACWA/Sand County Foundation Bioreactor Installations
Site Selection

• Tile size typically 6 – 8”
• Nearby tiles?
• Filter strip width
• Water table issues?
• Sandy or rocky bottom
Design Considerations

- Perpendicular or parallel to the stream
- Site located within land that is enrolled in a conservation program?
- Future plans for the sight, is filter strip width going to be adjusted in future?
- Drainage district
Installation Process

1. Place control structures
2. Excavate pit
3. Fill with wood chips
4. Roll geo-fabric over wood chips
5. Cover pit with soil, minimum 18 – 24 inches
6. Re-seed area
Place Control Structures

- Set upper and lower
- Pull stop logs before placing
- Use non-perf for 5 – 10 ft. at upper control
• Plastic lining

• If in-line match grade of tile

Excavate the pit
Fill with wood chips

- 100 cubic yards/semi load
- Minimum 2.5 – 3 ft. depths
- Deeper at upper end
- Order 20% more than needed
Diversion Structure
(Upper)

Flow Control Structure
(Lower)

Saturated

Unsaturated
Roll out geo-fabric

Allows water to move through, but prevents soil from settling into the wood chips.
• Minimum 18”
• Mound to account for possible settling
• Consider what to do with spoil

Cover with soil
• FSA requires re-seeding

• Re-growth is usually shorter

Re-seed the area
<table>
<thead>
<tr>
<th>Site</th>
<th>Structures</th>
<th>Contractor</th>
<th>Wood Chips</th>
<th>Supplies</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greene</td>
<td>2,750</td>
<td>5,250</td>
<td>1,245†</td>
<td>500</td>
<td>9,745</td>
</tr>
<tr>
<td>Hamilton</td>
<td>1,640</td>
<td>--‡</td>
<td>2,400</td>
<td>350</td>
<td>4,390</td>
</tr>
<tr>
<td>Hancock</td>
<td>1,970</td>
<td>1,800</td>
<td>3,350</td>
<td>560</td>
<td>7,680</td>
</tr>
<tr>
<td>Webster</td>
<td>1,270</td>
<td>1,890</td>
<td>3,000</td>
<td>780</td>
<td>6,940</td>
</tr>
<tr>
<td>Carroll</td>
<td>1,640</td>
<td>5,030</td>
<td>4,650</td>
<td>500</td>
<td>11,820</td>
</tr>
<tr>
<td>Greene 2</td>
<td>1,480</td>
<td>2,710</td>
<td>2,520</td>
<td>400</td>
<td>7,110</td>
</tr>
</tbody>
</table>

† Half of wood chips were donated
‡ Contractor services donated by Willie Ubben Jr.
* Estimation from contractor, not final number
Bioreactor Monitoring

- Weekly to bi-weekly samples
- Nitrate, DO, and temperature
- Sulfates, TN, and TOC
- Flow measurements
Hamilton County Bioreactor

Nitrate-N, mg/L

- Nitrate IN, mg/L
- Nitrate OUT, mg/L
- MCL

- Jul
- Oct
- Apr
- Jul
- Jan 2010

0
5
10
15
20
25
Hamilton County Nitrate-N Concentrations

Nitrate-N, mg/L

In

Out

0
5
10
15
20
25
Greene County Bioreactor

Nitrate-N, mg/L

Incoming, Nitrate, mg/L
Outgoing, Nitrate, mg/L
Maximum Contaminant Level

- **Incoming, Nitrate, mg/L**
- **Outgoing, Nitrate, mg/L**
- **Maximum Contaminant Level**
Greene County Nitrate-N Concentrations

<table>
<thead>
<tr>
<th>In</th>
<th>Out</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrate-N, mg/L</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>
## Cost Effectiveness

<table>
<thead>
<tr>
<th>Practice</th>
<th>US $ (kg-N(^{-1}))</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bioreactor</td>
<td>2.39 -15.17</td>
<td>Schipper et al. (2010)</td>
</tr>
<tr>
<td>Soil Testing &amp; Side Dressing N fertilizer</td>
<td>1.15</td>
<td>Saleh et al. (2007)</td>
</tr>
<tr>
<td>Drainage water mgmt.</td>
<td>2.71</td>
<td>Jaynes and Thorp (2008)</td>
</tr>
<tr>
<td>Wetlands</td>
<td>3.26</td>
<td>Hyberg (2007)</td>
</tr>
<tr>
<td>Fall cover crops</td>
<td>11.06</td>
<td>Saleh et al. (2007)</td>
</tr>
</tbody>
</table>

Table from Schipper et al. 2010
Management

- Diversion Control Structure (Upper)
  - Lower before field operations
  - Raise after spring operations, and after harvest

- Flow Control Structure (Lower)
  - Raise during periods of low temperature
  - Lower once water temperatures rise
  - Remove all stop logs during periods of no flow

- Monitoring performance
Iowa Interim Standard

- Design for 10 year life span
- Avoid Equipment travel over the bioreactor
- Designed to treat base flow using DC of 0.125 in/d or a minimum of 20% of peak flow
- Periodic monitoring
Incentives

- No benefit to producer
- Increases rankings for competitive programs such as MRBI
- Tax credit?
Concerns

- Life span
  - How to replace wood chips

- Missing peak flows

- Larger tile lines

- TA for installation
Thank You

Special thank you to our collaborators and supporters –

- USDA Natural Resources Conservation Service
- Des Moines Water Works
- Sand County Foundation
- Agriculture’s Clean Water Alliance.

For more information please contact:

**Todd Sutphin**
State Watershed Coordinator  
Iowa Soybean Association  
Environmental Program  
515 251-8640 office  
515 334-1052 desk  
tsutphin@iasoybeans.com

**Keegan Kult**
Watershed Mgmt Specialist  
Iowa Soybean Association  
Environmental Program  
515 251-8640 office  
515 334-1036 desk  
kkult@iasoybeans.com