Targeting Critical Areas and Scheduling Implementation

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Treat the Right Problems with the Right Solutions in the Right Places

How do we get there?
Objective

To remediate a significant amount of water quality degradation from nonpoint sources using existing policy, knowledge, and methods through the incorporation of the "human dimension" in a rigorous and scientifically valid fashion.
A Recently Maintained Channel
Bank Failure in an Illinois Ditch
For each natural resource component in your watershed, identify the stressors acting to degrade or impair that component. Then, identify the sources that contribute to the stressors.

1. **Natural Resource Component**
   - Fishery

2. **Stressor**
   - Sediment
   - Nutrients
   - Hydrologic Dynamics

3. **Source**
   - Eroding road-stream crossing
   - Streambank erosion
   - Livestock in stream
   - Failing septic systems
   - Land Conversion

1. **Natural Resource Component**

2. **Stressor**

3. **Source**
Impacts on Water Quality

Nutrients
Pathogens
Sediment
Toxic Contaminants
Debris
Thermal Stress

Increased quantity
Decreased quality
Relationship of Impervious Cover to Stream Health

- Watershed Impervious Cover
- Stream Health

Protected | Impacted | Degraded
## Potential Sources

<table>
<thead>
<tr>
<th>Potential Sources</th>
<th>Bacteria</th>
<th>Nutrients</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Septic Systems</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td><strong>Wildlife</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deer</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Feral Hogs</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td><strong>Cropland</strong></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td><strong>Livestock</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sheep and Goats</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Horses</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Cattle</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td><strong>Oil and Gas Production</strong></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td><strong>Urban Runoff</strong></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td><strong>Wastewater Treatment Facilities</strong></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
Average Daily Potential 
*E. coli* Load from

**SELECT**
47 samples were collected for chlorophyll and $\delta^{15}$N on October 11, 2006

Highest levels of $\delta^{15}$N corresponded with lowest levels of chlorophyll and vice versa.

"These results are suggestive of different nitrogen sources upriver and down."

"The low $\delta^{15}$N values are consistent with a sewage derived signal."

"However... [it] may also be consistent with significant processing of nitrogen [by algae]."
Scales of Management

Scale
- Sub-Field
- Field
- Farm
- Watershed

Decisions
- Operational
  - Day-to-Day Implementation
- Tactical
  - Seasonal Use/Non-Use
- Strategic
  - Multi-Year Planning
- Not Considered
Getting it right

- Critical areas
- Delivery System (who, what)
Critical Area Types

- Restoration:
- Protection:
Management Zones Based on Watershed Boundary
Management Zones Based on Proximity to Water Body
Management Zones Based on an Integrated Pollutant Source and Transport Approach
Solving Water Problems

Use biophysical measures to identify vulnerable locations within problem area.

Assess salient behaviors in these locations to determine where disproportionality may be occurring.

Gain understanding why inappropriate behaviors are occurring in these locations.

Design intervention effort based on this understanding.
Why Assess Behaviors?

Behavior relative to the environment varies significantly – from saint to sinner.

* If we want to **advance science**, then we need to assess the full spectrum.

* If we want to **manage programs**, then we need to assess receptive audiences within the program area.

* If we want to **solve water problems**, then we begin with those making disproportionate contributions.
A Definition

The human dimension of water resource management can be defined as the effort to classify, explain, predict and influence salient behaviors proportionate to their impact on water quality and quantity.
Approaches to NPS Pollution

Social Systems

Biophysical Systems

This is Unacceptable!

Water Quality Degradation
How to Address This Dilemma

1. Base planning efforts on the fact that land user behaviors vary significantly, even when engaging in the same type of land use.

2. Use biophysical models and science to determine what land user behaviors need to be assessed.

3. Focus on disproportionality in your initial efforts.
Disproportionality

The degree of asymmetry emerging between a specific behavior, or a set of behaviors, and the resiliency or buffering capacity of the biophysical setting (i.e., space and time) where these actions occur.
Disproportionality

Egregious behaviors in a well-buffered setting may have an insignificant impact on degradation processes.

“Normal” behaviors in a vulnerable setting may have a significant impact on degradation processes.

Disproportionality emerges out of scale-specific interactions between human and biophysical attributes.
Disproportionality

**Biophysical Management**

- **Low Impact**
  - hydrologically-connected (e.g., upland location)
  - minimal application of inputs
  - greater residue cover (e.g., ridge or no tillage)
  - greater organic matter
  - fine-to-medium textured soils

- **Lesser Impact**
  - medium-to-coarse textured soils
  - low organic matter

- **Greater Impact**
  - hydrologically-connected (e.g., upland location)
  - over-application of inputs
  - minimal residue cover
  - medium-to-coarse textured soils
  - greater organic matter
  - over-application + broadcasting
  - minimal residue cover
  - delayed incorporation of manure

- **Lesser Impact**
  - hydrologically-connected medium-to-coarse textured soils
  - low organic matter
  - over-application + broadcasting
  - minimal residue cover
  - delayed incorporation of manure
What Should be the Focus of NPS Management?

Focus on Solving Problems

Focus on Managing Programs
Three Dimensions

The following three dimensions need to be treated as an integrated package. That is, one cannot focus on one or two to the exclusion of the others.

3 Dimensions

1. Assessment
2. Disproportionality
3. Inappropriate Behavior
Assessment

Assessment is the process of classifying behaviors into categories that are meaningful to underlying theories or models.

• Meaningful assessment is underutilized in our current water program efforts.

* Too much of the current “human dimensions” is based on political expediency/social marketing or, from a scientific perspective, is “fluff” at best.
Land use behaviors in vulnerable areas are critical in assessment.
Disproportionality

Any assessment in a water quality or quantity program needs to try and account for disproportionality as it should become the focus of any intervention effort that is intended to solve problems.
Inappropriate Behaviors

What is the explanation for inappropriate behavior in vulnerable or susceptible biophysical settings?

1. Technological “leakage”
2. Tradition/Community norms
3. Market Rationality
4. Ignorance
5. Scale Incongruence
6. Others?
Starting points where spreader gate opened and PTO engaged across 24 month period

An Example
Science Challenges

- **Non-linearity**: Relationship between action and effect varies.
- **Indirect effects**: Impact of action depends on many factors.
- **Uncertainty**: Future changes and actions difficult to predict or measure.

Incorporating the human dimension into natural resource management will not be easy, but “good science” never is.
Temporal Scales of Management

Variation in climate and hydrologic patterns induce changes in the spatial and temporal attributes of manure distribution decisions.
Same Behavior, Different Time

Hypothetical Hydrological Runoff

frozen pre-plant crop post-harvest frozen

Manure Storage Systems Daily Haul Systems
Next Steps

- Develop delivery system
Delivery System
administrative goals driving environmental protection

• Critical areas not being addressed – not going out to the critical area
• Partial treatment of problems – scope and BMPS
• Not all problems being addressed
• Landowner capacity not developed
Example of Diverse Biophysical Resources

The vulnerability of field #10 can nullify or negate the “conservation gains” from the other 9 fields.

Assume “behavior” measure is constant

Environmental Vulnerability
Table 23. Landowner survey: Interest in letting volunteer groups install practices (N = 606).

<table>
<thead>
<tr>
<th>INTEREST</th>
<th>PERCENT RESPONDING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Let a volunteer group install a grassland/prairie</td>
<td>Yes: 8, Maybe: 19, No: 52, No response/don’t know: 22</td>
</tr>
<tr>
<td>Let a volunteer group install a wetland</td>
<td>Yes: 5, Maybe: 14, No: 58, No response/don’t know: 23</td>
</tr>
<tr>
<td>Let a volunteer group install a riparian buffer</td>
<td>Yes: 8, Maybe: 19, No: 50, No response/don’t know: 23</td>
</tr>
<tr>
<td>Let land be used for research demonstrations</td>
<td>Yes: 9, Maybe: 28, No: 45, No response/don’t know: 17</td>
</tr>
</tbody>
</table>
### Table 21. Landowner survey: Willingness to install best management practices (N = 606).

<table>
<thead>
<tr>
<th>BEST MANAGEMENT PRACTICES</th>
<th>PERCENT RESPONDING</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cropland</strong></td>
<td>Willing to install, with both technical and financial assistance</td>
</tr>
<tr>
<td>Habitat improvement</td>
<td>23</td>
</tr>
<tr>
<td>Nutrient management</td>
<td>15</td>
</tr>
<tr>
<td>Conservation easements</td>
<td>13</td>
</tr>
<tr>
<td>Wetland installation</td>
<td>12</td>
</tr>
<tr>
<td>Reduced-tillage program</td>
<td>10</td>
</tr>
<tr>
<td><strong>Grassland</strong></td>
<td></td>
</tr>
<tr>
<td>Habitat improvement</td>
<td>17</td>
</tr>
<tr>
<td>Pest management</td>
<td>14</td>
</tr>
<tr>
<td>Native grass planting</td>
<td>12</td>
</tr>
<tr>
<td>Nutrient management</td>
<td>13</td>
</tr>
<tr>
<td>Conservation easements</td>
<td>10</td>
</tr>
<tr>
<td>Burning grassland</td>
<td>6</td>
</tr>
<tr>
<td><strong>Woodland</strong></td>
<td></td>
</tr>
<tr>
<td>Habitat improvement</td>
<td>15</td>
</tr>
<tr>
<td>Timber stand improvement</td>
<td>13</td>
</tr>
<tr>
<td>Tree planting</td>
<td>13</td>
</tr>
<tr>
<td>Pest management</td>
<td>11</td>
</tr>
<tr>
<td>Conservation easements</td>
<td>8</td>
</tr>
<tr>
<td>Timber harvest</td>
<td>4</td>
</tr>
<tr>
<td>Burning</td>
<td>4</td>
</tr>
<tr>
<td><strong>Streamside</strong></td>
<td></td>
</tr>
<tr>
<td>Plant a buffer with trees and/or shrubs</td>
<td>19</td>
</tr>
<tr>
<td>Route field tile drainage to a treatment wetland</td>
<td>18</td>
</tr>
</tbody>
</table>
Table 26. Landowner survey: Self-reported obstacles to implementing conservation practices (N = 317).

<table>
<thead>
<tr>
<th>OBSTACLE</th>
<th>Number of comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of money/costs</td>
<td>124</td>
</tr>
<tr>
<td>Maintaining productivity</td>
<td>37</td>
</tr>
<tr>
<td>Lack of government funding/incentives</td>
<td>30</td>
</tr>
<tr>
<td>Lack of time</td>
<td>17</td>
</tr>
<tr>
<td>Problems with cost-share</td>
<td>14</td>
</tr>
<tr>
<td>Lack of knowledge</td>
<td>12</td>
</tr>
<tr>
<td>Government regulations/interference</td>
<td>12</td>
</tr>
<tr>
<td>Lack of technical assistance</td>
<td>12</td>
</tr>
<tr>
<td>Lack of equipment</td>
<td>9</td>
</tr>
<tr>
<td>Drainage</td>
<td>9</td>
</tr>
<tr>
<td>Absentee landowner won’t approve</td>
<td>8</td>
</tr>
<tr>
<td>Uncooperative neighbors</td>
<td>6</td>
</tr>
<tr>
<td>Erosion</td>
<td>6</td>
</tr>
<tr>
<td>Lack of labor</td>
<td>4</td>
</tr>
<tr>
<td>Flooding</td>
<td>4</td>
</tr>
<tr>
<td>Taxes</td>
<td>4</td>
</tr>
<tr>
<td>Red tape with government assistance</td>
<td>3</td>
</tr>
<tr>
<td>Wildlife damage</td>
<td>2</td>
</tr>
<tr>
<td>Tillage</td>
<td>2</td>
</tr>
<tr>
<td>Weeds</td>
<td>1</td>
</tr>
<tr>
<td>Tenant won't do</td>
<td>1</td>
</tr>
</tbody>
</table>
La Moine River Ecosystem Partnership
Willing Landowners and Critical Areas

Legend
- Critical Areas
- Streams
- Watershed Boundary
- Willing Landowners

Karyn McDermaid, University of Illinois
Jeff Boeckler, Illinois Department of Natural Resources
2005
Defining the Problem

- **Identify Challenges and Opportunities**
  - Obstacles that prevent positive change
  - Condition that can make positive effect
<table>
<thead>
<tr>
<th>Natural Resource Component</th>
<th>Goal</th>
<th>Objective</th>
<th>Objective</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fishery</td>
<td>Restore the cold water fishery</td>
<td>Reduce the amount of sediment by <em>amount</em> by <em>date</em></td>
<td>Reduce the amount of nutrients by <em>amount</em> by <em>date</em></td>
<td>Reduce hydrologic impacts by <em>amount</em> by <em>date</em></td>
</tr>
</tbody>
</table>
# Lake Sarah Watershed Management Plan Turbidity Objective

<table>
<thead>
<tr>
<th>Objective</th>
<th>Activity</th>
<th>Action</th>
<th>Responsibility</th>
<th>Time Frame</th>
<th>Cost Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce turbidity in lake by 15% by June 2004</td>
<td>Install riparian buffers</td>
<td>Involve local landowners</td>
<td>Partner group</td>
<td>July 2001 – July 2002</td>
<td>XXXX</td>
</tr>
</tbody>
</table>
How Do We Begin To Solve Water Problems?

We need to admit that we do not have all the answers, but need to design our programs so to give us the opportunity to learn. Understanding why traditional local implementation effort failed could be the key to success for future programs. **Adaptive Management**
Conclusion

We have the capacity and knowledge to address the “human dimension” of water problems in a robust and valid fashion.
Who Is This?

Charles Darwin; “Origin of Species”

Who survives? --- not the strongest, not the most intelligent, but those who adapt to change the best.