A watershed approach to the future of lakes and waterways

Eric Booth
Assistant Research Scientist
egbooth@wisc.edu

Jenny Seifert
Science Writer/Outreach Coordinator
jseifert2@wisc.edu

WSC.LIMNOLOGY.WISC.EDU

UNIVERSITY OF WISCONSIN MADISON
Water Sustainability and Climate
In the Yahara Watershed

NSF
What does water quality mean?
What does water quality mean?

“The health of our waters is the principle measure of how we live on the land.”

– Luna Leopold
WATERSHED = Area that contributes water to a common point or body of water
Traditional in-lake/near-lake approach

**CHEMICAL TREATMENT OF MILFOIL**

![Image of people treating lake with chemicals]

*The Spokesman Review*

**SHORELAND RESTORATION**

![Image of restored shoreline]

*WLWCA*

**PREVENTION OF AIS INVASION**

![Prevent the spread of invasive species poster]

*WDNR*

- Varying levels of success
- Often treating symptoms, not causes
Varying success, little progress

from Gillon et al. 2016
Watershed approach = holistic approach

- Watersheds are complex systems that change according to internal and external drivers
- Watersheds produce multiple benefits for society
Challenges of holistic approach

- High uncertainty, drivers of change
  - Many drivers are obscure
- Internal drivers
  - Farm economics/family situation
  - Urban development pressures
- External drivers
  - Demand for food products, bioenergy
    - Price of milk, corn, dietary trends
    - State and federal policy
  - Climate change
    - Increasing frequency of heavy rainfall
These challenges span generations

Major Changes in the Yahara Watershed
1800-present
Lake health from a watershed scope:
Our soil phosphorus legacy
Challenges of holistic approach

• Public engagement and decision making
• Starting conversations with unfamiliar groups can be a barrier
  – Especially if “blaming” is implied
• Loss of direct control over decisions
  – Hard enough getting lakeshore owners to agree on a plan...try a whole watershed
We expect a lot from our watersheds.
Can we have clean lakes and ice cream, too?
Scenarios and a watershed approach

- Provocative, plausible stories about the future with contrasting social and environmental conditions.
- Explore questions of “What if?”

Based on Carpenter et al. 2005
Scenarios help us consider changes and choices

- They facilitate multi-scale, long-term thinking.
- They help us learn ways to address change and build resilience.

based on Carpenter et al. 2005
Our choices matter.

“While the future is uncertain and much of it is beyond our control, we can control many aspects of it. We choose our future: we create it by what we do or fail to do.”

– Wendy Schultz, futurist
Principle 1: We can make choices that will affect future outcomes.
Principle 2: We can consider the different pathways that might result from those choices.
Principle 3: We can anticipate the consequences of those pathways.
Yahara River Watershed
Long-term changes and challenges affecting water

- Intensification of dairy agriculture
- Increasing demand for biofuels
- Urban development
- Changes in climate
  - Increase in annual precipitation
  - More frequent heavy rainfall events
Real-life watershed approach: Yahara WINS
Watershed approach to reducing P

- Regulatory driver
- Point sources and municipalities carry burden
- Allowed to work with largest source of P
  - Agricultural runoff
Collective Goal:
Reduce phosphorus levels in Yahara streams and lakes
First step: Engagement

• Engaging with unfamiliar groups of people
• Developing mutual respect for broad goals
  – Beyond water quality (food production, etc.)
• Honest discussion of potentially conflicting goals and biophysical limitations of the watershed*
Second step: Implementation

- Conservation practices
  - cover cropping, grassed waterways
- Nutrient management
  - manure management

Yahara Pride Farms

Yahara WINS
What about future changes in other drivers?

- Current implementation and evaluation strategies do not explicitly account for...
  - Land-use/land-cover change
  - Climate change
- The next step – long-term thinking and shifting baselines
How can we build water sustainability and climate resilience now for future generations?
The universe is made of stories, not of atoms.

- Muriel Rukeyser (1913 - 1980), "The Speed of Darkness"
We sampled perspectives from the Yahara Watershed through interviews and workshops, clustered them into themes, and condensed them into a few stories.
The stories

<table>
<thead>
<tr>
<th>Name:</th>
<th>Nested Watersheds</th>
<th>Abandonment &amp; Renewal</th>
<th>Accelerated Innovation</th>
<th>Connected Communities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamics:</td>
<td>Adaptation</td>
<td>Transformation</td>
<td>Adaptation</td>
<td>Transformation</td>
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<tr>
<td>Key Factor in Change:</td>
<td>Government</td>
<td>Inaction</td>
<td>Technology</td>
<td>Values</td>
</tr>
<tr>
<td>Nutshell:</td>
<td>Government</td>
<td>Disaster decreases population, leads to reorganization</td>
<td>Massive growth in technology businesses, including green tech</td>
<td>Global shift in values toward sustainability</td>
</tr>
</tbody>
</table>

Each based on a different set of human choices and biophysical events
The “Atoms” = Climate Changes
The “Atoms” = Landscape Changes

Nested Watersheds

2010

2070

Total Urban Land Area

% of Watershed Area

Year

- Land Area Percentage in 2010
- Abandonment & Renewal
- Accelerated Innovation
- Connected Communities
- Nested Watersheds

Total Agricultural Land Area

% of Watershed Area

Year

- Land Area Percentage in 2010
- Abandonment & Renewal
- Accelerated Innovation
- Connected Communities
- Nested Watersheds

Kilometers
The “Atoms” = Nutrient Management Changes

- Diet drives animal numbers (impacts manure inputs)
- Policies/values drive fertilizer rates
Model Outputs

- Food production
- Biofuel production
- Climate regulation
- Freshwater supply
- Flood regulation
- Groundwater quality
- Surface water quality
Implications for future of water and people

Accelerated Innovation

Nested Watersheds

Connected Communities

Abandonment & Renewal
Scenario Applications

• A tool to identify and prepare for vulnerabilities and ways to build resilience
• A framework for weighing tradeoffs and making choices
• A backdrop for priorities and the potential changes that could affect them
• An opportunity to engage people in transformative discussions about the future
Vulnerability and Resilience: Prepare for surprises

Invasive species could be game changers
Tradeoffs and Choices: What do we need/want?

What do we want—or need—the watershed to provide?

What is biophysically possible and socially acceptable?

What choices will allow us to handle shocks and build resilience?
Backdrop for Priorities: What do we value?

People value clean water, and voluntary actions without government intervention are least favored.

- Utility credit (lawn): 6% Strongly oppose, 11% Somewhat oppose, 20% Neither, 14% Somewhat support, 12% Strongly support, 83% Strongly support.
- Certification program (farm): 7% Strongly oppose, 20% Somewhat oppose, 14% Neither, 12% Somewhat support, 12% Strongly support, 73% Strongly support.
- Tax credit (farm): 15% Strongly oppose, 14% Somewhat oppose, 12% Neither, 12% Somewhat support, 14% Strongly support, 71% Strongly support.
- Tax penalty (farm): 18% Strongly oppose, 12% Somewhat oppose, 12% Neither, 12% Somewhat support, 12% Strongly support, 71% Strongly support.
- Regulation (farm): 18% Strongly oppose, 12% Somewhat oppose, 12% Neither, 12% Somewhat support, 12% Strongly support, 69% Strongly support.
- Regulation (lawn): 22% Strongly oppose, 14% Somewhat oppose, 12% Neither, 12% Somewhat support, 14% Strongly support, 63% Strongly support.
- Technological solution (farm): 25% Strongly oppose, 26% Somewhat oppose, 12% Neither, 12% Somewhat support, 26% Strongly support, 49% Strongly support.
- No government (lawns): 38% Strongly oppose, 25% Somewhat oppose, 22% Neither, 22% Somewhat support, 26% Strongly support, 37% Strongly support.
- No government (farms): 52% Strongly oppose, 22% Somewhat oppose, 22% Neither, 22% Somewhat support, 22% Strongly support, 26% Strongly support.
What are the worst threats, and how can we avoid them?

What are the best ideas or results, and how can we achieve them?

What is a desirable future, and how do we get there?
“If you want to build a ship, don’t start with collecting wood, cutting the plank and assigning work, but awake in people the longing for the wide and open sea.”

– Antoine de Saint-Exupery (Citadelle)
“Conversation is at the heart of what we know and how we know it. It is central to both constructing the future and learning how to act on it.”

- Andrew Curry, The Futures Company
“We are called to be architects of the future, not its victims.” – Buckminster Fuller

Explore:
Yahara2070.org
wsc.limnology.wisc.edu