Water Centric Design: Restoring Nature’s Balance

James Patchett, FASLA, LEED AP
Conservation Design Forum, Inc.
Re-circulation through evapo-transpiration

Shallow ground water flow

Aquifer recharge
The Botanical Law

“Plants Grow in Habitats to Which They are Adapted”

Bluff Springs Fen
Elgin, Illinois
Bluff Springs Fen
Elgin, Illinois
Bluff Springs Fen
*Elgin, Illinois*
Bluff Springs Fen
*Elgin, Illinois*
Bluff Springs Fen
*Elgin, Illinois*
Floodwater from Poplar Creek
Hoffman Estates, Illinois
Loss of system stability and biodiversity in flood prone habitats
Historical Patterns of Hydrology

Recharge Zone: Uplands
Discharge Zones: Lowlands – rivers, streams, ponds, wetlands

Ground Water Flow Paths Figure
[Wetlands & Groundwater in the United States, Stone & Stone]

Constant, clean discharge flows, year round to sustain stable surface water hydrology with constant water temperature and chemistry
Water in Contemporary Urban, Suburban & Rural Environments

Traditional Stormwater Management Approach: Collect and convey water away from the site just as quickly and efficiently as the law will allow through enclosed storm sewer systems designed with concentrated points of discharge that generate a velocity and volume of flow that is nearly impossible to mitigate.
According to USEPA, 40-60% of nitrogen applied to lawns ends up in surface and groundwater systems.
Reversed hydrological pattern results in runoff containing sediments, oils, greases, salts, fertilizers, pesticides, and higher water temperatures that inundate historical systems adapted to completely different hydrological and water quality conditions.
The Physics of Design

“For every design ‘action’ there are environmental, social, and psychological ‘reactions’ to be observed.”
[Newton’s third law of physics applied to design]
We blame it on too much rain...
Severe erosion of stream and river systems caused by excessive runoff
Collapse of Infrastructure
The hydrology of boom... and bust
Loss of system stability and biodiversity
Confluence of Missouri, Illinois + Mississippi Rivers

August 1991

August 1993

[NASA/Goddard Space Flight Center Scientific Visualization Studio]
Iowa floods of 2008

[Photos taken or compiled by Dr. Tom Weingeist]
CDF Philosophy and First Principles

The Foundation for Sustainable Design

BEGINS WITH WATER
First Principles of Sustainable Design

_Doctrine_
All water is a valuable resource; it should never be squandered or treated as a waste product in any of its forms or contexts.

_Approach_
Replicate, to the degree possible, the historical natural and cultural processes to which local ecosystems are adapted.
Integrated Green Strategies

Distributed Rainwater Management Strategies for all land use cover surfaces with applications appropriate for scale and context;

Replicate natural hydrology and provide multiple benefits on all land use surfaces:

1. Green roof systems
2. Porous pavement systems
3. Bio-retention systems
4. Rainwater harvesting and re-use
5. Wastewater recycling and re-use
6. Native landscape systems
Green Strategies

Green Roof Systems

Chicago City Hall Green Roof
Chicago, Illinois

ASLA Green Roof
Washington DC
Chicago City Hall Green Roof

Chicago, Illinois
Green Strategies

Porous Pavement Systems
Green Strategies

Bio-retention Systems
Green Strategies

Rainwater Harvesting and Re-use Systems
Green Strategies

Wastewater Harvesting and Re-use Systems
Green Strategies
Native Landscape Systems
Blackberry Creek Watershed Alternative Futures

- Develop potential alternative futures for the watershed
- Evaluate the hydrologic and habitat implication of those futures
- Design and evaluate impact of alternative land use and management choices
- Templates
- Scenarios
- Evaluation of hydrologic, water quality, and habitat impacts of templates and scenarios
Blackberry Creek Watershed Alternative Futures
Design Templates

• Commercial
• Moderate Density Residential
• Rural Residential
• Estate Residential
• Agriculture
• Stream Corridors
• Wetlands
Blackberry Creek Watershed Alternative Futures
Commercial Templates
Blackberry Creek Watershed Alternative Futures
Commercial Conservation Design Template
Blackberry Creek Watershed Alternative Futures

Conventional

Conservation
Blackberry Creek Watershed Alternative Futures
Moderate Density Residential Conservation Design Template
Blackberry Creek Watershed Alternative Futures Evaluation Modeling

- Flood Flows ($Q_{10}$ & $Q_{100}$)
- Channel Forming Flows (1 - 2 year event)
- Low Flows ($Q_{7-10}$)
- TQmean
- Habitat/biology
- Water Quality
- Perform Evaluations on Templates and Scenarios
Blackberry Creek Watershed Alternative Futures
Moderate Density Residential Template

Conventional $3,350,000 ($37,600/lot) / Conservation $2,880,000 ($32,400/lot)
Etowah River Alternative Futures

Canton, GA
Water Management, Energy Savings, Food Production

IEPA/CDF Green Roof Monitoring Station
Elmhurst, IL

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Control Roof</td>
<td>This roof consists of waterproofing and a protective layer such as a ballast or liners. This system contains no green roof materials.</td>
</tr>
<tr>
<td>2 4&quot; Optima Green Roof System</td>
<td>4&quot; of growing medium, and a layer of lightweight gravel.</td>
</tr>
<tr>
<td>3 4&quot; Hydrotech Green Roof System</td>
<td>4&quot; of growing medium, and a drainage retention board.</td>
</tr>
<tr>
<td>4 4&quot; Garland Green Roof System 5</td>
<td>4&quot; of growing medium, a drainage board and two tiers of vegetation.</td>
</tr>
<tr>
<td>5 Green Grid Roof System</td>
<td>4&quot; of growing medium, and a drainage board.</td>
</tr>
<tr>
<td>6 Test Bed</td>
<td></td>
</tr>
<tr>
<td>7 Organic Agriculture Roof Terrace</td>
<td>6&quot;-12&quot; of growing medium over a 4&quot; layer of lightweight gravel (drainage media).</td>
</tr>
<tr>
<td>8 2 1/2&quot; Garland Green Roof System</td>
<td>2&quot; of growing medium, and a drainage management fabric.</td>
</tr>
<tr>
<td>9 2 1/2&quot; Garland/Hydrotech Green Roof System</td>
<td>2&quot; of growing medium, and a drainage retention board.</td>
</tr>
<tr>
<td>10 2&quot; Xero Flor Green Roof System</td>
<td>2&quot; of growing medium, and a drainage board.</td>
</tr>
<tr>
<td>11 Test Bed</td>
<td></td>
</tr>
<tr>
<td>12 Test Bed</td>
<td></td>
</tr>
</tbody>
</table>
Hydrological Response Research

IEPA/CDF Green Roof Monitoring Station
*Elmhurst, IL*
September 22, 2006 rain event totaling 0.75 inches

IEPA/CDF Green Roof Monitoring Station
Elmhurst, IL
On average, CDF has saved **$1,384.99 per year on cooling costs** since installing the green roofs due to a reduction in the number of Kwh used per degree day.

**IEPA/CDF Green Roof Monitoring Station**
*Elmhurst, IL*
Rooftop urban agriculture

Rooftop Urban Agriculture is a success, multiple varieties of fruits and vegetables can be grown.

Deeper media (6-8”) allows for native prairie grasses and perennials to succeed.

IEPA/CDF Green Roof Monitoring Station
Elmhurst, IL
Integrated Site Planning +
Green Infrastructure Solutions
Sustainable solutions for any environment
First Principles

Sustainable results can only be achieved with a:

- Committed sponsor
- Experienced team
- Integrated, collaborative design process
Maximizing Retention Capacities
The Reith Village at Merry Lea Environmental Learning Center
Wolf Lake, IN
The Reith Village at Merry Lea Environmental Learning Center

Wolf Lake, IN
The Reith Village at Merry Lea Environmental Learning Center
Wolf Lake, IN
The Reith Village at Merry Lea Environmental Learning Center

Wolf Lake, IN
Villa Park Police Station
Villa Park, IL
Villa Park Police Station
Villa Park, IL
Villa Park Police Station
Villa Park, IL
Porous pavement + bioswales/rain gardens
Evelyn Pease Tyner Interpretive Center

glenview, illinois

Client: The Glen Development Corporation
Completion: 2007
LEED Platinum, 2007
Team: Wight and Company, Phoenix Architects, Bluestone + Associates
Evelyn Pease Tyner Interpretive Center
Glenview, Illinois
Evelyn Pease Tyner Interpretive Center
Glenview, Illinois
Peggy Notebaert Nature Museum
Chicago, IL
Peggy Notebaert Nature Museum
Chicago, IL
Peggy Notebaert Nature Museum
Chicago, IL
Peggy Notebaert Nature Museum
Chicago, IL
Queens Botanical Garden
flushing, new york

Client: Queens Botanical Garden
Completion: 2002 (master plan), 2009 (administration building and gardens)
Awards: Illinois ASLA Merit Award, 2009 (administration building and gardens)
         New York Green Building Design Award, 2004
         Illinois ASLA Merit Award, 2003 (master plan)
LEED Platinum, 2008
Team: Atelier Dreiseitl, BKSK Architects
Queens Botanical Garden
Flushing, New York