Ecosystem Value Stacking of Solar
Research at the Institute on the Environment

Measuring Storm-Water Runoff of Solar Farms
Prof. Dave Mulla, and Jake Galzki - UMN Department of Soil, Water, and Climate

Ecosystem Services of Solar Co-located with Pollinator Friendly Habitat
Eric Lonsdorf, and Chris Nootenboom - UMN IonE Natural Capital (NatCap)
Pollinator habitat plantings can reduce runoff at solar collector sites while providing habitat for butterflies and bees
Background

- MPCA considers solar panel collector sites disconnected impervious surfaces.
- MPCA has developed a spreadsheet-based solar collector stormwater calculator to estimate a surface runoff credit.
- Average width under panel (Z) is considered impervious in calculator and must be accommodated as stormwater runoff.
- Total Site Area ~40 acres
- 360 panels
  - 10’ x 150’
  - = ~10 acres impervious
## SOLAR SITE EVALUATION

<table>
<thead>
<tr>
<th>Types of ground cover</th>
<th>South facing stationary mount (Arrays run E-W)</th>
<th>Single axis tracker (Arrays run N-S)</th>
<th>No Panels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bare Soil</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Grass</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Pollinator</td>
<td></td>
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</tbody>
</table>
Visual Observations
Phase 1: Data Collection

- Soil Texture analysis completed on 3 sites
- Soil infiltrability measurements collected with Cornell Sprinkle Infiltrometers
- Soil moisture monitoring complete for 2019 season

Atwater, MN
Hydrologic Group B
Clay Loam

North Branch, MN
Hydrologic Group A
Sandy Clay Loam

Mankato, MN
Hydrologic Group C/D
Clay
Infiltration Data

- Measurements taken at each site with Cornell Sprinkle Infiltrometer

![Bar Chart showing field saturated infiltrability of Chisago (A soils), Atwater (B soils), and Eastwood (C/D soils).]
Soil and Water Potential Benefits

SOLAR SITE MANAGEMENT
for soil, storm water, and pollinator benefits.

Image credit: Rob Davis & Heidi Natura
Phase 2: Hydrologic Modeling

- A one-dimensional flow simulation model such as Hydrus 1-D will be used to estimate soil water infiltration.
- Calibration of the model will utilize site specific experimental data collected in Phase 1.
Draft Manuscript on Solar+Pollinator Ecosystem Services Modeling

<table>
<thead>
<tr>
<th>State</th>
<th>Total Nameplate Capacity (MW)</th>
<th>Total Footprint Size (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illinois</td>
<td>38.5</td>
<td>86.7</td>
</tr>
<tr>
<td>Indiana</td>
<td>214.3</td>
<td>574.2</td>
</tr>
<tr>
<td>Iowa</td>
<td>9.2</td>
<td>15.9</td>
</tr>
<tr>
<td>Michigan</td>
<td>98.3</td>
<td>250.1</td>
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<tr>
<td>Minnesota</td>
<td>741.5</td>
<td>2,252.7</td>
</tr>
<tr>
<td>Missouri</td>
<td>61.1</td>
<td>173.2</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>20.9</td>
<td>63.2</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>1,183.8</strong></td>
<td><strong>3,416.0</strong></td>
</tr>
</tbody>
</table>

*Results pending peer-reviewed publication*
Upcoming Research

- **PV Stormwater Management Research and Testing (PV-SMaRT)**
  - NREL, University of Minnesota, Great Plains Institute, and Fresh Energy
  - 3 years, 5 states, $800,000

1) Establish and engage Water Quality Task Force to provide technical and applied guidance
2) Conduct field research to quantify stormwater runoff and water quality
3) Calibrate and validate a 3-D hydrologic model
4) Develop PV-specific stormwater management best practices
5) Education and outreach to stakeholders