Sediment Basins and Skimmers

Jay Dorsey/John Mathews
Ohio Dept. of Natural Resources, Division of Soil and Water Resources
Dewatering Risers in Basins:

- Single orifice
- Perforated and wrapped riser
- And now skimmers
Ohio EPA Construction General Permit Requires Use of Skimmers

- Part II. G. d.ii “…sediment settling ponds shall be dewatered at the pond surface using a skimmer or equivalent device.”

- Why? Because it is one of the easiest ways to improve the effectiveness of sediment basins.
What is a Skimmer?

- A dewatering device that draws water from the water surface. This removes the least turbid water from the sediment basin.
National Trends

• Doubling of pond capacity
  – From 67 to 134 yd³/ac (wtrshd)

• Sometimes without detention time specified
  (Both Ohio EPA and the Rainwater and Land Development manual require 48 hours.)
Variety of Skimmers

- 2 commercially-available (constant head) skimmers:
  - JW Faircloth and
  - Innovation Applied Systems
- Delaware DOT skimmer (variable head)
- Something else you might design and build?
JW Faircloth Skimmer

- Developed by Warren Faircloth who was a former county Erosion Control Supervisor in NC.

(See www.fairclothskimmer.com)
IAS Water Quality Skimmer

• Also developed in North Carolina.
IAS Water Quality Skimmer

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IAS is Innovative Applied Solutions, LLC. See www.iasllcusa.com
Delaware DOT Skimmer

Skimmers Are Reuseable If Site Conditions Are Right

• Each type of skimmer has a set orifice (and/or pipe size) appropriate for a certain range of particular watershed conditions
  – Faircloth has a removable cap that can be drilled to provide a smaller orifice size
Need to Acknowledge that Ohio Has a Poor Record with Basins
(& Skimmers won’t undo poor basin design)

This outlet was sized (perforations and spacing) for 100s of acres versus the actual 10s of acres going to it. It provided only a few hours of detention instead of the required 48 hours.
Ohio’s Sediment Basin Requirements

1. Basin capacity
   - Dewatering volume, 67 yd$^3$/ac of drainage area
   - Sediment storage volume, 37 yd$^3$/ac of disturbed area

(often planned wet, but may be dewatered as well)
Ohio’s Sediment Basin Requirements

1. Basin capacity
   - Dewatering volume, 67 yd$^3$/ac of drainage area
   - Sediment storage volume, 37 yd$^3$/ac of disturbed area

2. Drain time: min. 48 hours for the dewatering volume.
   - Recommend that the drain time be extended up to 72 hours if the sediment storage volume is also dewatered.

Drain time is a function of the orifice size or the pipe size of the skimmer.
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3. Area and shape of the basin
   - L:W = 4:1 or plan baffles to increase flow length or slow flow
   - Basin depth and surface area
Effective Pool Shape

- Utilize entire shape of pond
- Optimum depth is ~ 3 feet
- Length to width especially for non-dewatering (optimum 4:1 or greater)
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6. Other requirements: embankment height, width and side slopes; anti-seep collars, outlet and inlet protection, non-floating riser...
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Size the skimmer to draw down over 48 hours

• The skimmer must be selected and the skimmer’s control orifice properly sized so that it dewater the sediment control design capacity over a minimum 48 hour period.

• The principal spillway and emergency spillway must be stable and able to be used as overflow if subsequent storms cause the detention storage volume to remain full.
Sizing Your Skimmer

• Determine volume to be dewatered
• Determine the dewatering time desired (2-3 days)
• Use the manufacturer’s materials to select the size of the outlet (pipe size)

\[
\frac{\text{Dewatering zone volume}}{\text{Dewatering time}} = \text{Required flow rate of skimmer}
\]

• Or use the orifice equation to determine the orifice needed
Faircloth Skimmer Sizing

• Use their spreadsheet calculator or instructions to first determine size and any orifice adjustments

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**Calculate Skimmer Size**

<table>
<thead>
<tr>
<th>Basin Volume in Cubic Feet</th>
<th>Skimmer Size</th>
<th>0.0 Inch</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 Cu.Ft</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Days to Drain*</td>
<td>Orifice Radius</td>
<td>Inch[es]</td>
</tr>
<tr>
<td>0 Days</td>
<td>Orifice Diameter</td>
<td>Inch[es]</td>
</tr>
</tbody>
</table>

*In NC assume 3 days to drain

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**Estimate Volume of Basin**

<table>
<thead>
<tr>
<th>Top of water surface in feet</th>
<th>Length</th>
<th>Width</th>
<th>Feet</th>
<th>VOLUME</th>
<th>0 Cu. Ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottom dimensions in feet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depth in feet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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www.FairclothSkimmer.com
Faircloth Guidance

- Guidance provides the approximate maximum drainage given the orifice position below the water (head).

<table>
<thead>
<tr>
<th>Skimmer Size</th>
<th>24 hours</th>
<th>48 hours</th>
<th>72 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>4” skimmer:</td>
<td>20,109</td>
<td>80,436</td>
<td></td>
</tr>
<tr>
<td>with a 4” head</td>
<td>40,218</td>
<td>140,763</td>
<td></td>
</tr>
<tr>
<td>Revised 11-6-07</td>
<td>60,327</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Skimmer Size</th>
<th>24 hours</th>
<th>48 hours</th>
<th>72 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>5” skimmer:</td>
<td>32,832</td>
<td>131,328</td>
<td></td>
</tr>
<tr>
<td>with a 4” head</td>
<td>65,664</td>
<td>229,824</td>
<td></td>
</tr>
<tr>
<td>98,496 cubic feet in 3 days</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Faircloth provides a method for reducing the orifice size with a removable orifice cap cut to a specific orifice size.
Faircloth Skimmer
Adjusting Drain Time

• A removable cap is provided that can be cut and fit inside the trash screen. This allows a particular (smaller) orifice to be fitted to the skimmer.

See http://www.fairclothskimmer.com/gallery-list?id=86
# IAS Skimmer Sizing Chart

**http://www.iasllcusa.com/**

<table>
<thead>
<tr>
<th>SKIMMER SIZE (IN)</th>
<th>COLOR CODE</th>
<th>BARREL SIZE (IN)</th>
<th>DISCHARGE PIPE SIZE (IN)</th>
<th>24 HOUR FLOW (CF)</th>
<th>2 DAY FLOW (CF)</th>
<th>3 DAY FLOW (CF)</th>
<th>4 DAY FLOW (CF)</th>
<th>5 DAY FLOW (CF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5</td>
<td>RED</td>
<td>2</td>
<td>2</td>
<td>1,804</td>
<td>3,608</td>
<td>5,412</td>
<td>7,216</td>
<td>9,020</td>
</tr>
<tr>
<td>1.75</td>
<td>BLACK</td>
<td>2</td>
<td>2</td>
<td>2,405</td>
<td>4,810</td>
<td>7,216</td>
<td>9,621</td>
<td>12,027</td>
</tr>
<tr>
<td>2</td>
<td>YELLOW</td>
<td>3</td>
<td>3</td>
<td>3,928</td>
<td>7,856</td>
<td>11,784</td>
<td>15,712</td>
<td>19,640</td>
</tr>
<tr>
<td>2.5</td>
<td>GREEN</td>
<td>3</td>
<td>3</td>
<td>6,137</td>
<td>12,275</td>
<td>18,412</td>
<td>24,550</td>
<td>30,687</td>
</tr>
<tr>
<td>3</td>
<td>BLUE</td>
<td>4</td>
<td>4</td>
<td>10,205</td>
<td>20,410</td>
<td>30,616</td>
<td>40,812</td>
<td>51,026</td>
</tr>
<tr>
<td>4</td>
<td>ORANGE</td>
<td>4</td>
<td>4</td>
<td>22,220</td>
<td>44,440</td>
<td>66,661</td>
<td>88,881</td>
<td>111,101</td>
</tr>
<tr>
<td>5</td>
<td>SILVER</td>
<td>6</td>
<td>6</td>
<td>34,719</td>
<td>69,438</td>
<td>104,157</td>
<td>138,877</td>
<td>173,596</td>
</tr>
<tr>
<td>6</td>
<td>WHITE</td>
<td>6</td>
<td>6</td>
<td>49,995</td>
<td>99,991</td>
<td>149,987</td>
<td>199,983</td>
<td>249,978</td>
</tr>
<tr>
<td>8</td>
<td>NONE</td>
<td>8</td>
<td>8</td>
<td>102,631</td>
<td>205,262</td>
<td>307,894</td>
<td>410,525</td>
<td>513,156</td>
</tr>
</tbody>
</table>
The Basis For Sizing and Determining Skimmer Discharge

- **Orifice Flow Equation:** \( Q = CA(2gH)^{0.5} \)
  
  Where: 
  - \( Q \) = discharge in cfs
  - \( C \) = orifice coefficient, typically 0.6
  - \( A \) = cross-sectional area of the orifice plate ft\(^2\) square feet
  - \( g \) = acceleration due to gravity, 32.2 ft/sec\(^2\)
  - \( H \) = head (feet), from orifice center to the water surface

- Is head constant or changing?
- What is an appropriate orifice coefficient (manufacturer).
- Make sure that units are consistent.

*Bottom line – Use manufacturers recommendations or Ch. 6 of Rainwater and Land Development for Del DOT type.*
Plan Review and Field Inspectors

- Plans: show specific skimmer to be used including pipe size, connections, and orifice size.
- Use Colors to field check against plans.

Color Codes For Faircloth Skimmers

<table>
<thead>
<tr>
<th>Size</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1/2&quot;</td>
<td>Red</td>
</tr>
<tr>
<td>2&quot;</td>
<td>Yellow</td>
</tr>
<tr>
<td>2 1/2&quot;</td>
<td>Green</td>
</tr>
<tr>
<td>3&quot;</td>
<td>Blue</td>
</tr>
<tr>
<td>4&quot;</td>
<td>Orange</td>
</tr>
<tr>
<td>5&quot;</td>
<td>Silver</td>
</tr>
<tr>
<td>6&quot;</td>
<td>White and unique shape of vent</td>
</tr>
<tr>
<td>8&quot;</td>
<td>None; distinguished by it size</td>
</tr>
</tbody>
</table>

IAS colors generally correspond but add black for 1.75”
(http://www.iasllcusa.com/downloads.html)
Maintenance of Skimmers

- Pull the skimmer to the side and inspect.
- This is primarily cleaning debris from the intake.
- Insure the orifice is fixed as planned (size).
- Insure the flexible pipe is whole without cracks.
Issues and Problems

- Designers must consider how a permanent stormwater outlet will need to be modified to allow the sediment basin to function as planned.
- Do windows need to be blocked to allow sufficient ponding?
- Is a lower opening for the skimmer pipe needed to allow sufficient dewatering?
- The plan should specify how and when the outlet will be modified to function as a water quality basin.