Performance Goal Review
Our GOAL Today

• Identify additional info needed to make a performance goal decision – March 18
  – Provide big picture review of work to date
  – Show some real-world examples
  – Discuss outstanding critical issues
Volume Control Conclusions

• All performance goals come close to matching native runoff *volume* conditions on an *average annual* basis
Comparison of Volume Controls: Stormwater Runoff Volume Leaving 10-Acre Site with B Soils

<table>
<thead>
<tr>
<th>Average Annual Runoff (inches/acre)</th>
<th>Native</th>
<th>95% Impervious</th>
<th>80% Impervious</th>
<th>50% Impervious</th>
<th>20% Impervious</th>
<th>Meadow</th>
<th>Forest</th>
</tr>
</thead>
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</table>

Legend:
- Forest
- Meadow
- 20% Impervious
- 50% Impervious
- 80% Impervious

Note: The graph shows the comparison of average annual runoff volume leaving a 10-acre site with different soil types and percentages of impervious areas.
Rate Control Conclusions

• All performance goals are effective at reducing volume
• Reducing volume reduces rate for small storms (1-yr storm and less)
• Additional rate control is required to get to "natural hydrology"
Water Quality Conclusions

• Not specified in legislation
• Reducing volume improves water quality
• All performance goals are effective and almost equal at improving water quality
• No need to prove that over and over (every project)
Phosphorus Loading Reduction from Volume Control BMPs

Average Annual Total Phosphorus Loading from 10-acre Site (pounds)

- Without BMP
- With Volume Control BMP*

* Based on average loading from the four performance goal scenarios
Performance Goal Comparison

Conclusions

1. All provide similar VOLUME reduction
2. All reduce RATE for small storms
3. All improve water quality – results are practically the same
Performance Goal Volume - Not all the same but close (Metro Area values)

1. RUNOFF of 1.0 inch – no abstractions
   = 1.0 inch

2. RAINFALL of 1.4 inches less abstractions for impervious and pervious
   = about 1.2 inches

3. RAINFALL of 2.4 inches less native runoff & less abstractions for imperv. & pervious, including infiltration during 24hr storm = about 1.2 inches
Performance Goal Volume - All can be adjusted to “mimic” (Metro Area values)

1. Change # to 1.2 inch from 1.0 inch

2. Change rainfall to 1.3 inches from 1.4 inches (94% storm)

3. Change rainfall to 2.6 inches from 2.4 inches (1.5 year 24 hr storm)

All volumes become essentially equal
All Approaches Can Mimic Natural Hydrology
Preliminary Modeling Results from Walker, MN

<table>
<thead>
<tr>
<th>Method</th>
<th>Value Range Needed to Match Forest and Meadow Annual Average Runoff Volume</th>
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<tbody>
<tr>
<td></td>
<td>0.8 inches – 1.0 inches</td>
</tr>
<tr>
<td></td>
<td>87.5% - 95% (0.9 inches – 1.2 inches)</td>
</tr>
<tr>
<td></td>
<td>Not determined – Maybe 0.8-year to 3-year 24-hour event</td>
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</table>

Range is based on Impervious % and soils
# Performance Goal Comparison

<table>
<thead>
<tr>
<th>Issue</th>
<th>Approach 1: X Inches off Impervious Surface</th>
<th>Approach 2: Retain Y% Storm</th>
<th>Approach 3: Match Z-Year 24-Hour Volume</th>
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<tbody>
<tr>
<td>Treatment volume calculation</td>
<td>Very Simple</td>
<td>Simple</td>
<td>Moderately Simple</td>
</tr>
<tr>
<td>Incentive to reduce impervious surfaces?</td>
<td>Yes</td>
<td>Yes, less for sites with non-porous soils</td>
<td>Yes, less for sites with non-porous soils</td>
</tr>
<tr>
<td>Incentive to preserve natural areas with high infiltration rates</td>
<td>No (compensate with credits)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Applicable state wide?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Mimics native hydrology?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Provides consistent treatment among various impervious surfaces percentages?</td>
<td>Appears to be the most consistent</td>
<td>Appears to be very similar to Approach 3</td>
<td>Appears to be very similar to Approach 2</td>
</tr>
</tbody>
</table>
Example of Method – Rushmore RWGs, Burnsville

- 17 Rainwater Gardens
- Sized to capture 1.0 inch from tributary impervious
- Actual volume was 0.9 inches due to ROW limitations
- Monitoring completed before and after construction
Example of Method – Rushmore RWGs, Burnsville
Total Area = 16,000 sf

Imperv Area = 4,000 sf

Storage Volume = 4,000 sf $\times$ 0.9 inch/12 = 300 cubic feet
Monitoring Results

Control Volume (14371.5 cf)  Study Volume (1164.3 cf)  Rainfall (1.44 in)

- 0.9 cfs
- 0.1 cfs
- 14,400 cf
- 1,200 cf

Tue Jun 2004
6/8/2004 4:00:00 PM - 6/9/2004 12:00:00 PM
Results - Burnsville

• Storage volume = 0.9 inches from tributary impervious (30%)
• Annual measured volume reduction about 90% compared to developed w/no BMPs
• Measured Runoff = 0.4 inches during non-frozen period
• Native RO, modeled, A soils = 0.2 inches
Example of Method – Lockheed Martin, Eagan

- 1.2 acre site
- sized for 1.0”
- Parking lot, 70% impervious
- Infiltration basin and porous bituminous
Infiltration Basin
145 Car Parking Lot
Lockheed Martin 2010 Flow Data - Monitor 9
April 13-15, 2010

Max Flow Rate Monitored: 0.03 cfs

Modeled Pre-Phase A Flow

Monitored Flow

Total Rainfall
1.78 inches

Total Observed Volume
91 cubic feet

Modeled Volume
1.21 Acres, 71% Impervious
5,067 cubic feet

Reduction:
4,976 cubic feet
98.2%

Flow Rate (cfs)

Hourly Rainfall (in)
Results – Lockheed Martin

- Measured Runoff = 2.2 inches during non-frozen period
- Native RO, modeled, B soils = 0.9 inch
- Very wet period – rain gage = 30.2 inches
- 3 large storms (1.8”, 2.7”, 3.6”) accounted for 1.5 inches of the 2.2 inches
Frozen Ground Runoff

• Outstanding issue
  – How much of the 4 inches of winter precipitation runs off? 100%?, 50%?
    • Native conditions
    • Developed conditions
      – Do Infiltration BMPs work during the frozen ground period
Frozen Ground Runoff

- Working with MPCA to address issues and gain consensus on assumptions
- Results could affect the Performance Goal Volume.
Any Performance Goal can mimic natural hydrology!

- Goal today: Identify additional info needed to make a performance goal decision – March 18