LID & Detention Pond
Sizing Tool to Address Hydromodification
and Water Quality in Clackamas County

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Agenda

» WES History/Stormwater Standards
» Hydromodification
» Sizing Tool
  – Low Impact Development (LID) Facilities
  – Detention Pond
» Sizing Comparison
» Communication & Outreach
» Questions
WES Design Standards History

» 2009 Watershed Action Plans
  – Impacts of Hydromodification In District Watersheds
  – Early Action Item to Update Design Standards

» 2010 Revised Stormwater Design Standards
  – Promote the use of Low Impact Development Techniques
  – Address Hydromodification via Continuous Flow Standard

» 2011 Developed LID/Detention Pond Sizing Tool

» 2014 Communications/Outreach

» 2015 Encourage Use of Tools (Not Mandatory)
Hydromodification – What is it?

» Changes in watershed runoff characteristics due to changes in land use conditions (i.e. urbanization)

» Higher/Rapid peak discharge

» More Runoff Volume

Figure 4-2. Changes in stream hydrology as a result of urbanization (Schueler, 1992).
Hydromodification – Impacts

Action Plans Found Impacts in District Watersheds:
- Increased erosion of stream banks
- Channel instability
- Water quality degradation
- Areas of Degraded Riparian Habitat
Hydromodification & Stormwater Management

» Current standards control peak flows for large storms
  – Facilities sized to hold the high peak flows;
  – *Releasing lower flows that are geomorphically significant*

» Updated Standards/Tools have 2 Goals:
  – Promote LID Techniques/On-site Infiltration
  – Address Duration of Elevated Peak Flows

» LID practices reduce runoff volumes and peak flows but may not be sufficient to address the *duration of elevated peak flows* that contribute to hydromodification impacts
Purpose of Sizing Tool

» Develop a simplified tool to easily size both LID and Detention Ponds

» Facilities are sized between a range of **geomorphically significant flows** to minimize the impacts of hydromodification

» Will meet new MS4 Hydromodification permit requirements
Geomorphically Significant Flows

» Geomorphically significant flows range between:
  • Lower Threshold – bed material is mobilized
  • Upper Threshold – channel bank over-topping event

» Use ODOT Thresholds
  – Lower Flow Threshold: $0.42Q_2$ (ODOT)
  – Upper Flow Threshold: $Q_{10}$ (ODOT)

» Other Metrics Available
  – ODOT thresholds provided a good “starting point”
  – Can adjust in the future as new information is available
LID Sizing Strategy – Flow Duration

![Graph showing peak discharge vs. percent time exceeded with labels for upper and lower thresholds.]

Upper Threshold Q(10)
Lower Threshold (0.42Q2)
Sizing Tool Based on HSPF Modeling

» Initial Model Completed by Pacific Water Resources in 2005
  – Calibration for drainage areas within the WES service area
  – Lack of sufficient, high-quality records within the study area, therefore calibration used observed streamflow data for gauge sites in the Tualatin Basin.

» Re-calibrated the HSPF model in 2008
  – Used observed streamflow data from long-term gauges located in the Johnson Creek Basin.
  – Calibrations at three gauges deemed to have hydrologically similar physical characteristics as basins covered by the WES study area
HSPF Modeling for LID Sizing

- Ran *many* pre/post landscape conditions
- Sizing Factors determined for each LID facility type and scenario
LID Sizing Tool – Basic Steps

» Enter pre-developed site conditions
» Enter post-developed site conditions
» Select LID treatment option of choice
» Tool provides required facility size to meet requirements
Sizing Tool

1) General Project Information
Identify Discharge Management Areas
Sizing Tool
2) Input DMA Information

- Drainage Management Area Info:
  - Area of DMA (ft²)
  - Drainage area hydrologic soil group – B, C, D
  - Pre-developed Surface (Grass, Forest or Impervious)
  - Post-Developed Surface
    - Grass, Forested, Roofs, Concrete, Pavers etc.,
Select LID Facilities

LID Facility Types (7 options)
– Planter (Infil & Fil)
– Rain Garden (Infil & Fil)
– Vegetated Swale (Infil & Fil)
– Infiltrator
Sizing Tool
3) Input Information & Link to DMA

- Developer Enters:
- DMA Draining to LID/BMP
- Treatment Type
  - Treatment and Flow Control
  - Treatment Only
- Site Specific Infiltration
- Can drain an LID facility to detention pond
Detention Pond Sizing Approach

» The detention pond sizing tool performs the following functions
  – Configure pond geometry
  – Design outlet structure
  – Route post-project runoff
  – Compare pre-project and mitigated flow duration
  – Size the facility automatically

» Flow duration modeling completed within the tool/not based on sizing factors
Detention Pond

User inputs initial pond configuration including surface area, depth and side slopes or stage-storage-discharge curve. Tool will pass or fail the pond.
Detention Pond Interface

Alternatively, the tool can calculate pond depth or surface area.
Flow duration comparison is performed for pre- and mitigated time series hydrograph.

- Complete time series is analyzed.
- Range of interest is between lower and upper threshold flows.
Resizing the Pond

» If flow duration criteria is not met then the pond is resized iteratively

» The user can use the option to resize by either adjusting the area or depth

» Pond sizing is completed when hydro-modification performance requirements are met
## Sizing Tool Output

### WES BMP Sizing Report

#### Project Information

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Verne Duncan Elementary School</th>
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<tbody>
<tr>
<td>Project Type</td>
<td>Addition</td>
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<tr>
<td>Location</td>
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<tr>
<td>Stormwater Management Area</td>
<td>668346 6125</td>
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<td>Project Applicant</td>
<td>Water Environment Services</td>
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<td>Jurisdiction</td>
<td>Happy Valley CCS D1</td>
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#### Drainage Management Area

<table>
<thead>
<tr>
<th>Name</th>
<th>Area (sq ft)</th>
<th>Pre-Project Cover</th>
<th>Post-Project Cover</th>
<th>DMA Soil Type</th>
<th>BMP</th>
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<tbody>
<tr>
<td>Basin 1</td>
<td>32670</td>
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<td>Basin 5</td>
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<td>Basin 6</td>
<td>62725.4</td>
<td>Grass</td>
<td>Roofs</td>
<td>C</td>
<td>Bioswale #6 and #8</td>
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<td>Basin 7</td>
<td>15681.5</td>
<td>Grass</td>
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<td>Basin 8</td>
<td>17424</td>
<td>Grass</td>
<td>Roofs</td>
<td>C</td>
<td>Bioswale #6 and #8</td>
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<td>Basin 10</td>
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#### LID Facility Sizing Details

<table>
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<tr>
<th>LID ID</th>
<th>Design Criteria</th>
<th>BMP Type</th>
<th>Facility Soil Type</th>
<th>Minimum Area (sq ft)</th>
<th>Planned Area (sq ft)</th>
<th>Orifice Diameter (in)</th>
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<td>Bioswale #4</td>
<td>WaterQuality</td>
<td>Stormwater Planter - Infiltration</td>
<td>B3</td>
<td>653.4</td>
<td>300</td>
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Happy Valley Town Center (HVTC)
- 15.6 Acre Commercial Development
- Traditional Design within last 10-years

Findings
- LID design does not reduce the retail area, or parking
- LID Design $40k more over Actual Cost
- $535k less than Detention Pipe Alternative/New Standards
Cost Comparison – Greenbrier Subdivision

» Greenbrier Subdivision
  – 12.45 acre site residential
  – 59 single-family lots averaging 7,100 sq-ft (2004)

» Findings
  – Existing Design ($17,291/lot, 59 lots)
  – Treatment and Flow Control Pond ($25,357, 53 lots)
  – Green St. Swale & Pond ($17,771/lot, 61 lots)
Sizing Tool Stakeholder Outreach

Barney & Worth Conducted Outreach Nov/Dec 2014

» Developers
  – Icon Construction
  – Renaissance Homes
  – D.R. Horton

» Engineers
  – Bruce Goldson, P.E.
  – OTAK
  – Mackenzie
  – VLMK Engineers,
  – Cardno
Outreach Activities – Preliminary Feedback

– Use of LID is minimal
– Need to know more details about LID before concerned with Tools
– General perception that engineers/developers/County staff/homebuyers do not want it and not comfortable
– The tools are not currently being used on a regular basis, and not likely to unless it is a requirement
– Above all, participants want **simplicity, flexibility, transparency, and cost efficiency**
Next Steps

» Internal Interviews (WES and Other County Agencies)
» ID Sizing Tool Modifications
» Possible Regional Coordination
  – Oregon City & Wilsonville Using Sizing Tool
  – Identify Other Agencies Interested
» Continue Outreach
» Modify Tool
Questions?

» Water Environment Services Sizing Tool
   – www.riverhealth.org/stormwater-management-design-tools

» Contra Costa County IMP Sizing Tool
   – www.cccleanwater.org/stormwater-c-3-guidebook/

» Contact Info:
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   – Libby Barg Libbybarg@barneyandworth.com