## Statewide LID Training Program

1

## Statewide LID Training Program

### INSTRUCTORS

**REBECCA DUGOPOLSKI, PE**

Senior Engineer

Key project experience: Stormwater monitoring, design, hydrologic modeling and NPDES Permit compliance

HERRERA

**KRISTEN MATSUMURA**

Staff Engineer

Key project experience: Stormwater monitoring, design, and hydrologic modeling

HERRERA

2

## Statewide LID Training Program

### PROGRAM OVERVIEW

- 2012: Public and private partners engage state legislature to fund program
- June 2012: LID Training Steering Committee convened
- 2012-2013: Washington State LID Training Plan developed: www.wastormwatercenter.org/statewide-lid-training-program-plan
- 2014: Training program built from state LID Training Plan

3

## Statewide LID Training Program

### PROGRAM OVERVIEW

- Implement second phase of trainings (September 2014 through May 2015)
- 49 trainings offered in western and eastern WA first year
- 45 trainings scheduled for western and eastern WA in current phase (through June 2016)
- Three levels: Introductory, Intermediate, and Advanced
- Statewide LID Certificate now available

4

## Statewide LID Training Program

### OVERVIEW OF PROGRAM

**PROJECT LEAD**

HERRERA

**CORE TEAM**

CASCADIA

**ADDITIONAL TRAINING SUPPORT**

CH2MHILL, SvR Design Company, Kindred Hydro, MITHUN, Leaping Frog Films, Mutual Materials

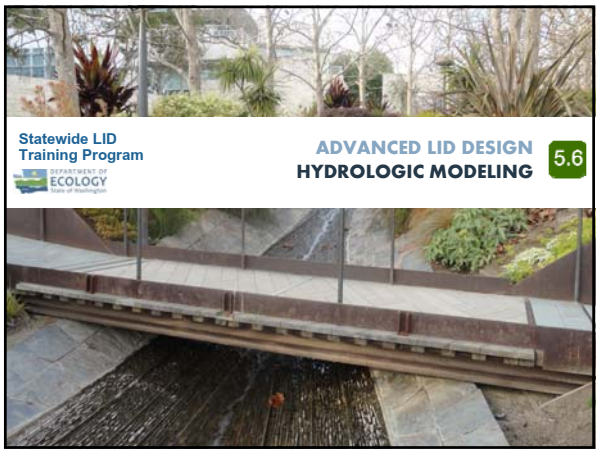
5

## Statewide LID Training Program

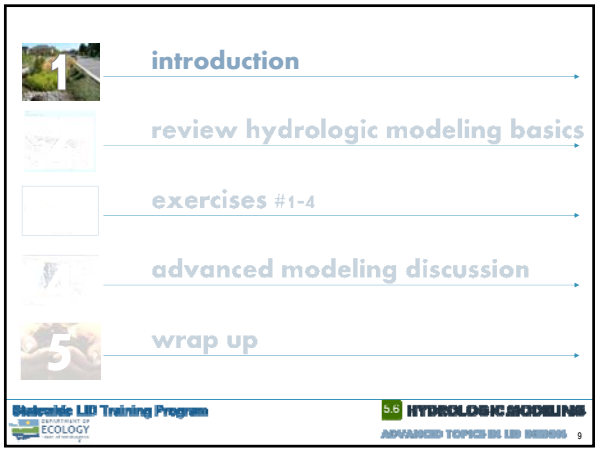
### OVERVIEW OF PROGRAM

| INTRODUCTORY | INTERMEDIATE | ADVANCED | |
|---|---|---|---|
| 2.1 Introduction to LID for Inspection & Maintenance Staff | 3.1 Intermediate LID Topics: NPDES Phase I & II Requirements | 5.0 Advanced Topics for Long-term LID Operations: Bioretention | 5.6 Advanced Topics in LID Design: Hydrologic Modeling |
| 2.1 Introduction to LID for Inspection & Maintenance Staff | 3.2 Intermediate LID Design: Bioretention | 5.1 Advanced Topics for Long-term LID Operations: Permeable Pavement | 6.2 Advanced Topics in LID Design: Bioretention Media and Compost Amended Soils |
| 2.2 Introduction to LID for Developers & Contractors: Make Money be Green | 3.3 Intermediate LID Design: Permeable Pavement | 5.2 Advanced Topics in LID Design: Bioretention | |
| | 3.4 Intermediate LID Design: Site Assessment, Planning & Layout | 5.3 Advanced Topics in LID Design: Permeable Pavement | |
| | 3.5 Intermediate LID Design: Rainwater Collection Systems & Vegetated Roofs | 5.4 Advanced Topics in LID Design: Site Assessment, Planning & Layout | |
| | 3.6 Intermediate LID Design: Hydrologic Modeling | 5.5 Advanced Topics in LID Design: Rainwater Collection Systems & Vegetated Roofs | |

6


Statewide LID
Training Program
ECOLOGY
ADVANCED LID DESIGN
HYDROLOGIC MODELING
5.6


AGENDA
1
introduction
2
review hydrologic modeling basics
3
exercises #1-4
4
advanced modeling discussion
5
wrap up
Statewide LID Training Program
ECOLOGY
5.6 HYDROLOGIC MODELING
ADVANCED TOPICS IN LID DESIGN
8


1
introduction
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Statewide LID Training Program
ECOLOGY
5.6 HYDROLOGIC MODELING
ADVANCED TOPICS IN LID DESIGN
9

## LEARNING OBJECTIVES

1. Gain an intermediate to advanced level of knowledge using WWHM and MGSFlood to predict pre- and post-development flow volumes and durations.
2. Learn intermediate to advanced level skills to size bioretention, permeable pavement, and vegetated roofs in residential and commercial settings using WWHM and MGSFlood.
3. Understand the advantages and limitations of WWHM and MGSFlood and are introduced to additional modeling tools for specific predictions



## LOGISTICS

### SCHEDULE

- 8-hour classroom training with breaks as needed
- Lunch (provided)

### OTHER LOGISTICS

- Restroom location
- Food
- Turn off cell phones
- Sign in and sign out





introduction



review hydrologic modeling basics

exercises #1-4

advanced modeling discussion



wrap up

introduction

review hydrologic modeling basics

exercises #1-4

advanced modeling discussion

wrap up



## Advanced Modeling Topics: Optimizing Detention

**19.3 Guidelines for Adjusting Pond Performance**

General guidance for adjusting the geometry and outlet works of stormwater ponds to meet the duration standard were developed by King County[19], are summarized in Figure 19.6, and described below. Refinements should be made in small increments with one refinement at a time.

1. *Bottom Orifice Size* – Adjust the bottom orifice to control the lowest arc of the postdeveloped flow duration curve. Increase the orifice size to raise the arc, decrease it to lower the arc.
2. *Height of Second Orifice* – The invert elevation of the second orifice affects the point on the flow duration curve where the transition (break in slope) occurs from the curve produced by the low-level orifice. Lower the invert elevation of the second orifice to move the transition point to the right on the lower arc. Raise the height of the second orifice to move the transition point to the left on the lower arc.
3. *Second Orifice Size* – Adjust to control the arc of the curve for postdeveloped conditions. Increase the size to raise the arc, decrease it to lower the arc.
4. *Pond Volume* – Adjust the pond volume to control the upper end of the duration curve. Increase the volume to prevent overflow, decrease the volume if the duration curve is substantially below the overflow level.

MGS Flood User Manual (2009)



## Advanced Modeling Topics: Optimizing Detention

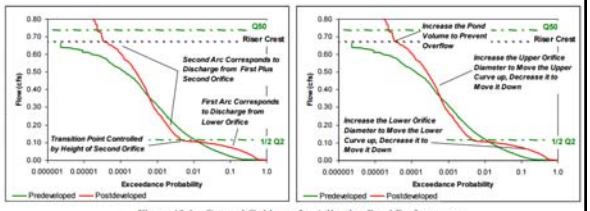



Figure 19.6 – General Guidance for Adjusting Pond Performance

MGS Flood User Manual (2009)

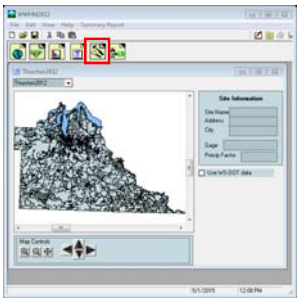
## Advanced Modeling Topics: Optimizing Detention

- Analyze the duration curve from bottom to top, and adjust orifices from bottom to top.
- The bottom arc corresponds with the discharge from the bottom orifice. Reducing the bottom orifice discharge lowers and shortens the bottom arc while increasing the bottom orifice raises and lengthens the bottom arc.
- Inflection points in the outflow duration curve occur when additional structures (orifices, notches, overflows) become active.
- Lowering the upper orifice moves the transition right on the lower arc and raising the upper orifice moves the breakpoint left of the lower arc
- The upper arc represents the combined discharge of both orifices. Adjustments are made to the second orifice as described above for the bottom orifice.
- Increasing the facility volume moves the entire curve down and to the left. This is done to control riser overflow conditions. Decreasing facility volume moves the entire curve up and to the right. This is done to ensure that the outflow duration curve extends up to riser overflow.

MGS Flood User Manual (2009)



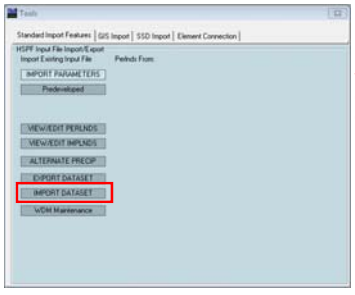
## Advanced Modeling Topics: Importing Precip



Select Tools

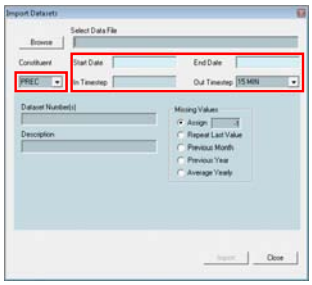


## Advanced Modeling Topics: Importing Precip




Import Dataset – allows users to import any time series data in comma-delimited file or text file.

## Advanced Modeling Topics: Importing Precip

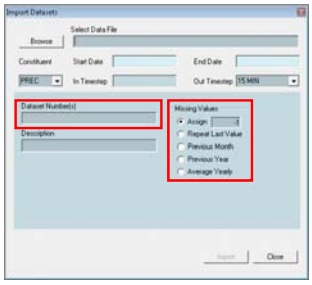



Specify time series type. Can be precipitation, flow, evaporation, or stage data.

Specify start date, end date, timestep, and the timestep to be used in the model.



## Advanced Modeling Topics: Importing Precip




A WDM data set number between 1 and 9999 must be assigned.

Select missing value method.



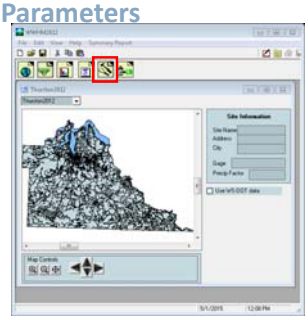
## Advanced Modeling Topics: HSPF Parameters

**PERLNDS** – Pervious Land Segments – model parameters that define interception, infiltration, and movement of moisture through soil.

PERLND parameter definitions:
LZSN =lower zone storage nominal (inches)
INFILT =infiltration capacity (inches/hour)
LSUR =length of surface overland flow plane (feet)
SLSUR =slope of surface overland flow plane (feet/feet)
KVARY =groundwater exponent variable ($inch^{-1}$)
AGWRC =active groundwater recession constant ($day^{-1}$)
INFEXP =infiltration exponent
INFILD =ratio of maximum to mean infiltration
BASETP =base flow evapotranspiration (fraction)
AGWETP =active groundwater evapotranspiration (fraction)
CEPSC =interception storage (inches)
UZSN =upper zone storage nominal (inches)
NSUR =roughness of surface overland flow plane (Manning 's n)
INTFW =interflow index
IRC =interflow recession constant ($day^{-1}$)
LZETP =lower zone evapotranspiration (fraction)

MGS Flood User Manual (2009)

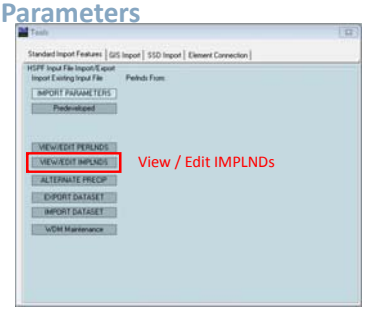
## Advanced Modeling Topics: Editing HSPF Parameters



Select Tools



## Advanced Modeling Topics: Editing HSPF Parameters



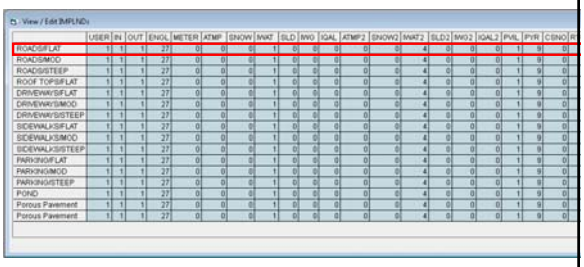

View / Edit IMPLNDs

IMPLND – parameters for simulation of runoff and water quality constituents from impervious land areas.

PRLND – parameters for simulation of runoff and water quality constituents from pervious land areas.

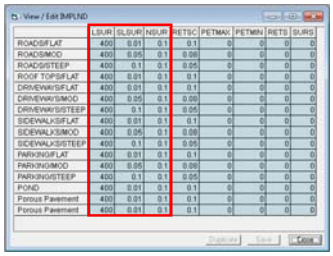


## Advanced Modeling Topics: Editing HSPF Parameters




Change IMPLND by land cover.

## Advanced Modeling Topics: Editing HSPF Parameters in WWHM



LSUR – overland flow length (ft)

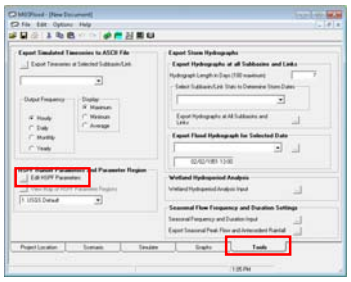
SLSUR – slope of overland flow (ft/ft)

NSUR – Manning's n

*Note that the 2012 SWMMWW (Amended 2014) only allows the user to edit LSUR, SLSUR, and NSUR as these are parameters whose values are observable at an undeveloped site, and whose values can be reasonably estimated for the proposed development site.



## Advanced Modeling Topics: Editing HSPF Parameters in MGS Flood

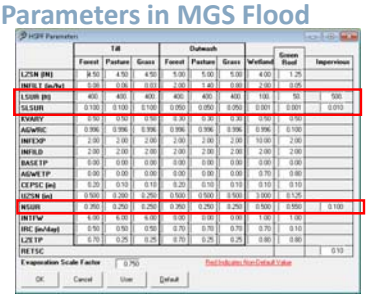


Select Tools Tab

Edit HSPF Parameters



## Advanced Modeling Topics: Editing HSPF Parameters in MGS Flood



LSUR – overland flow length (ft)

SLSUR – slope of overland flow (ft/ft)

NSUR – Manning's n

*Note that the 2012 SWMMWW (Amended 2014) only allows the user to edit LSUR, SLSUR, and NSUR as these are parameters whose values are observable at an undeveloped site, and whose values can be reasonably estimated for the proposed development site.

## Advanced Modeling Topics: HSPF Parameters

**PERLNDS** – Pervious Land Segments – model parameters that define interception, infiltration, and movement of moisture through soil.

| | Pervious Land Segment (PERLND) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Till Soil | | | Outwash Soil | | | Saturated Soil | |
| Parameter | Forest | Pasture | Lawn | Forest | Pasture | Lawn | Forest/Pasture/ or Lawn | Green Roof |
| LZSN | 4.5 | 4.5 | 4.5 | 5.0 | 5.0 | 5.0 | 4.0 | 1.25 |
| INFILT | 0.08 | 0.06 | 0.03 | 2.0 | 1.6 | 0.8 | 2.0 | 0.05 |
| LSUR | 400 | 400 | 400 | 400 | 400 | 400 | 100 | 50 |
| SLSUR | 0.1 | 0.1 | 0.1 | 0.05 | 0.05 | 0.05 | 0.001 | 0.001 |
| KVARY | 0.5 | 0.5 | 0.5 | 0.3 | 0.3 | 0.3 | 0.5 | 0.5 |
| AGWRC | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.996 | 0.10 |
| INFEXP | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 10.0 | 2.0 |
| INFILD | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| BASETP | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| AGWETP | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 | 0.8 |
| CEPSC | 0.2 | 0.15 | 0.1 | 0.2 | 0.15 | 0.1 | 0.1 | 0.1 |
| UZSN | 0.5 | 0.4 | 0.25 | 0.5 | 0.5 | 0.5 | 3.0 | 0.13 |
| NSUR | 0.35 | 0.3 | 0.25 | 0.35 | 0.3 | 0.25 | 0.5 | 0.55 |
| INTFW | 6.0 | 6.0 | 6.0 | 0.0 | 0.0 | 0.0 | 1.0 | 1.0 |
| IRC | 0.5 | 0.5 | 0.5 | 0.7 | 0.7 | 0.7 | 0.7 | 0.1 |
| LZETP | 0.7 | 0.4 | 0.25 | 0.7 | 0.4 | 0.25 | 0.8 | 0.8 |

MGS Flood User Manual (2009)



## Advanced Modeling Topics: HSPF Parameters

**IMPLNDS –** Impervious Land Segments – model runoff parameters for impervious surfaces.

| Parameter | Value |
|---|---|
| LSUR | 500 |
| SLSUR | 0.01 |
| NSUR | 0.1 |
| RETSC | 0.1 |

IMPLND Parameter Definitions:
LSUR = length of surface overland flow plane (feet)
SLSUR = slope of surface overland flow plane (feet/feet)
NSUR = roughness of surface overland flow plane (Manning 's n)
RETSC = retention storage (inches)

MGS Flood User Manual (2009)




introduction


review hydrologic modeling basics

exercises #1-4


advanced modeling discussion

wrap up

## Statewide LID Training Program

### OVERVIEW OF PROGRAM

**INTRODUCTORY**

- 2.1 Introduction to LID for Inspection & Maintenance Staff
- 2.1 Introduction to LID for Inspection & Maintenance Staff
- 2.2 Introduction to LID for Developers & Contractors: Make Money be Green

**INTERMEDIATE**

- 3.1 Intermediate LID Topics: NPDES Phase I & II Requirements
- 3.2 Intermediate LID Design: Bioretention
- 3.3 Intermediate LID Design: Permeable Pavement
- 3.4 Intermediate LID Design: Site Assessment, Planning & Layout
- 3.5 Intermediate LID Design: Rainwater Collection Systems & Vegetated Roofs
- 3.6 Intermediate LID Design: Hydrologic Modeling

**ADVANCED**

- 5.0 Advanced Topics for Long-term LID Operations: Bioretention
- 5.1 Advanced Topics for Long-term LID Operations: Permeable Pavement
- 5.2 Advanced Topics in LID Design: Bioretention
- 5.3 Advanced Topics in LID Design: Permeable Pavement
- 5.4 Advanced Topics in LID Design: Site Assessment, Planning & Layout
- 5.5 Advanced Topics in LID Design: Rainwater Collection Systems & Vegetated Roofs
- 5.6 Advanced Topics in LID Design: Hydrologic Modeling
- 6.2 Advanced Topics in LID Design: Bioretention Media and Compost Amended Soils

31

## Statewide LID Training Program

### CERTIFICATE

Two certificates now available:

- LID Design certificate
- Long-term LID Operations certificate

Sign out!

32

## Statewide LID Training Program

### ONLINE RESOURCES

For information on training and other resources, visit the Washington Stormwater Center website:

http://www.wastormwatercenter.org

Stay connected through Social Media

- Come "Like" our Page
- Sign up to follow and get Tweets

33

## Statewide LID Training Program

### QUESTIONS

**Further questions? Contact:**

training@cascadiaconsulting.com

**(206) 449-1163**

34