SWMM Cascading Runon Flows

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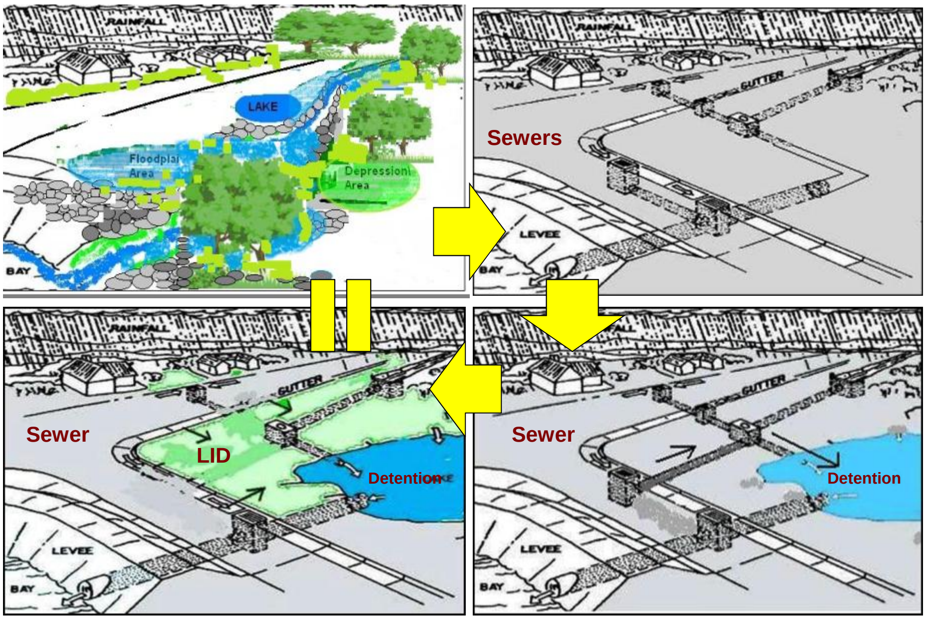
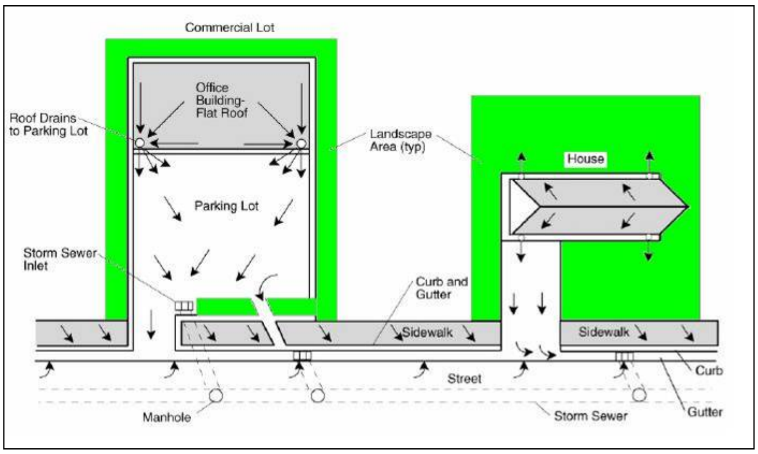
Evolution of Urban Watershed Development and SW Management



Zero-Impact = Preservation of Watershed Pre-development Condition

Conventional Drainage Pattern



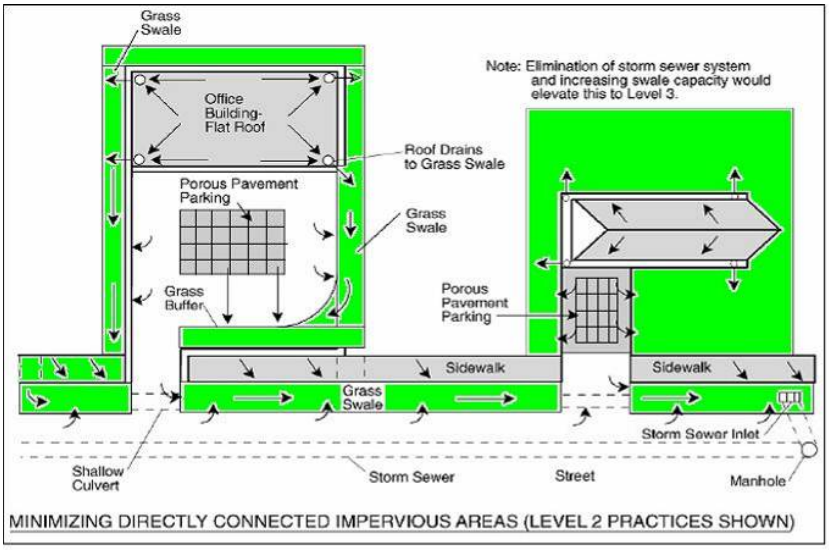
- **Traditional site and street drainage design**
- (Source: UDFCD, Urban Storm Drainage Criteria Manual, 1999)

Conventional Drainage System:
DIRECTLY Connected Impervious Area (DCIA)

Quick Collection
Concentrated Flows
High Flow Peak
Erodable Flow Velocity
Sediment-laden Flow

LID (Cascading) Drainage Pattern

Minimization of Directly Connected Impervious areas(MDCIA)

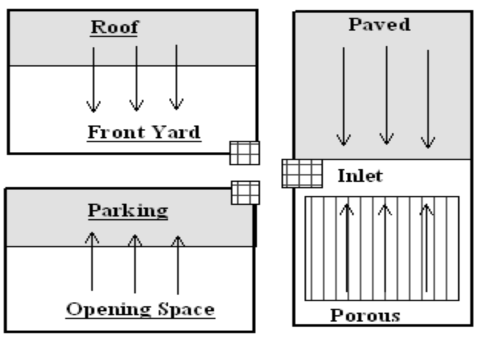


Cascading Flow Systems

Examples of LID Landscape

How to retrofit the flow paths?

SWMM5 --- Types of Outlet and Internal Routing %



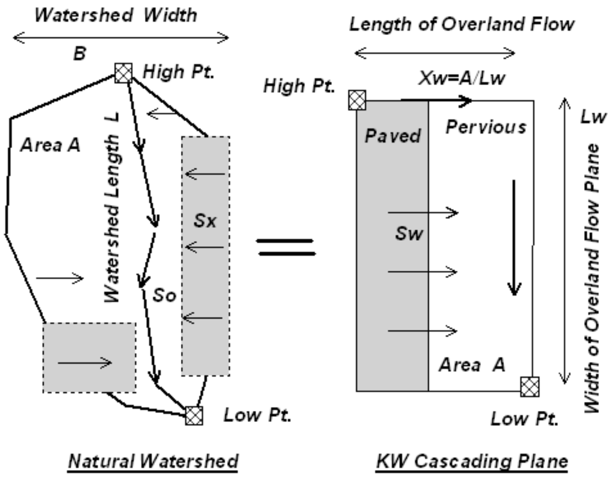
THREE TYPES OF OULET or Sub-area routing

- Impervious Outlet = upper pervious area onto lower impervious area
- Pervious Outlet = upper impervious area onto lower pervious area
- Separate Outlet = two independent flow paths to the outlet

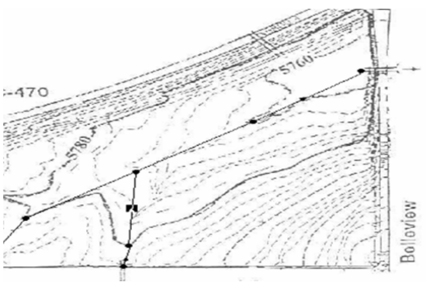
FLOW INTERCEPTION PERCENTAGE or percent routed:

- % of the upper flow runs through the lower plane

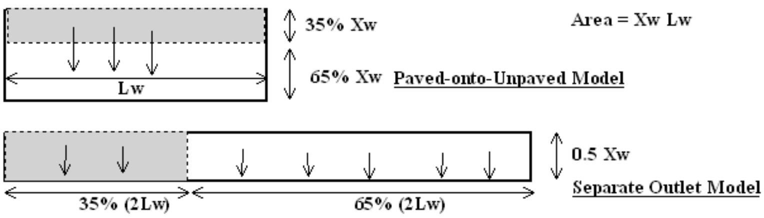
KW CASCADING PLANE – Runon Flow



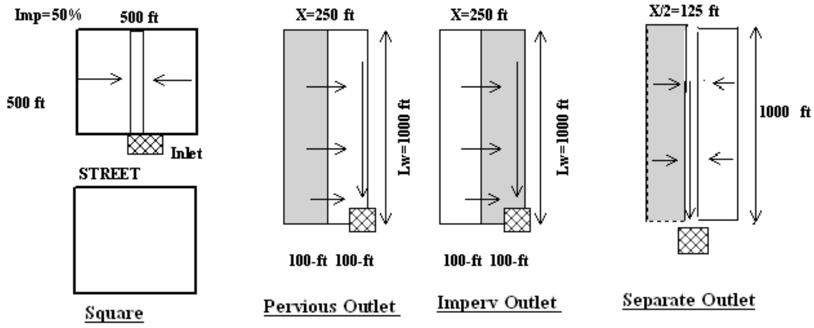
Example of Cascading Flow KW Plane



Area= 67.9 acres
L=2323 ft and Imp% =35
$X=A/L^2$ =0.55
Z=0.5 for center channel
Y=Lw/L = 1.17
Lw = 2709 ft
Xw=1092 ft
So/Sw=X/Y+Y=1.64
Sw=0.02/1.64=1.22%

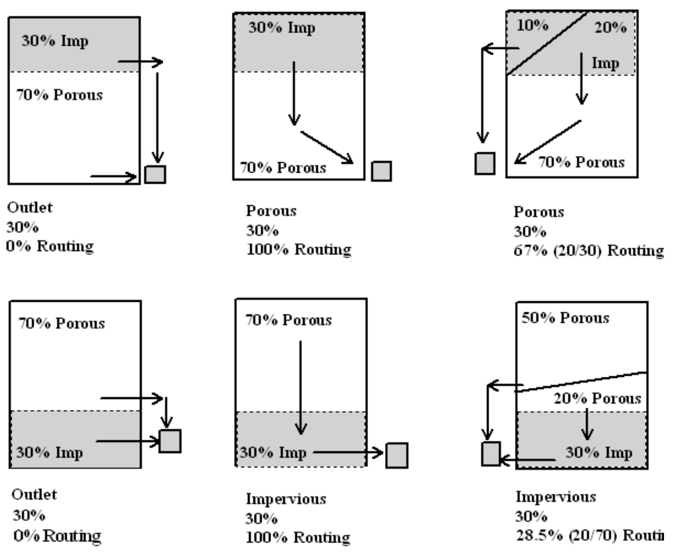


Example for Cascading Planes - LID Settings



(1) How to select the Type of Outlet for a MDCIA layout?
(2) How to determine the percentage of the upper runoff-off flow to be the run-on flow "spreading into" the lower plane?

Flow Routing %= Interception % of flow from Imp Area



How to Model Watershed with LID Outlets -

Question: How to model a catchment that has two separated areas: 30% impervious and 70% pervious.
Answer: (1) Imp%=30, Outlet, and zero% routing

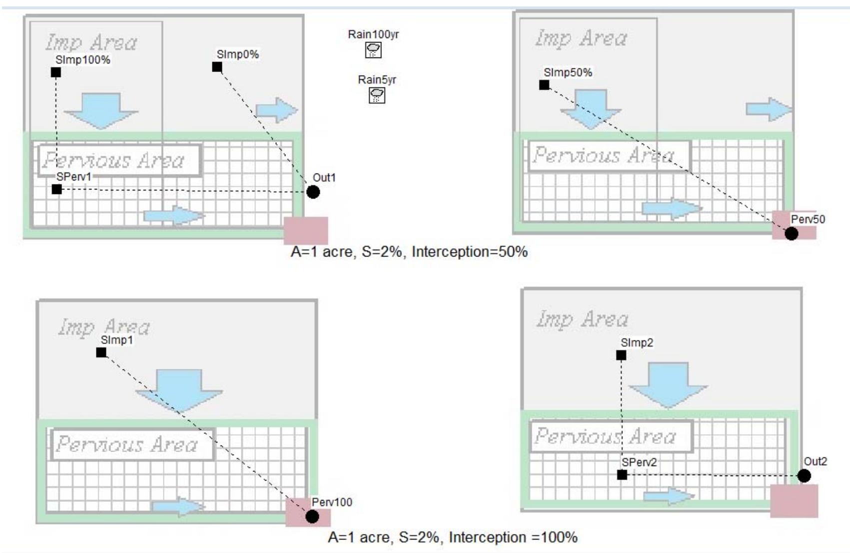
Question: How to model a catchment that has the 30% impervious to run onto the 70% pervious area.
Answer: (1) Imp%=30, Pervious Outlet, and 100% routing

Question: How to model a catchment that has the 70% pervious area to run onto the 30% impervious area.
Answer: (1) Imp%=30, Impervious Outlet, and 100% routing

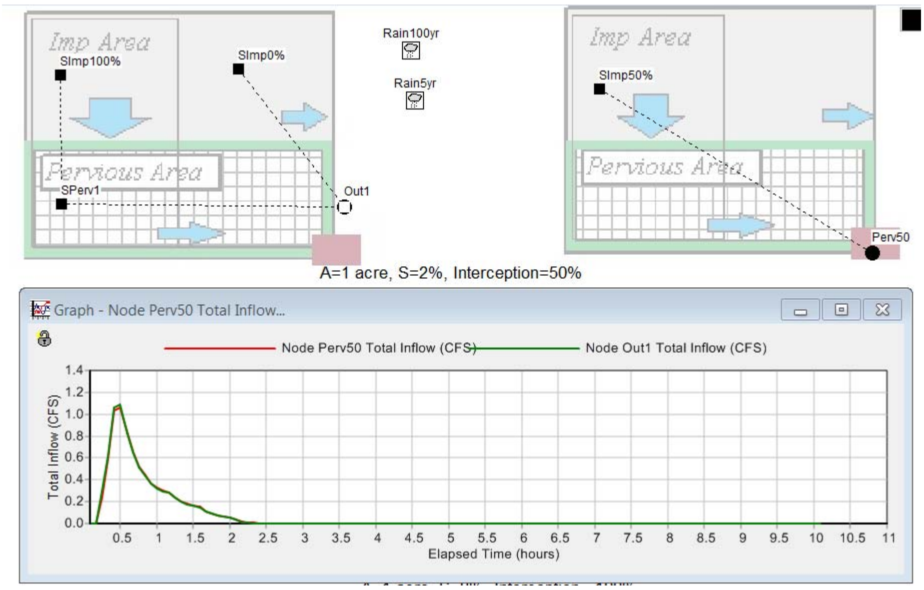
Question: A catchment consists of 10% DCIA, 20% UCIA, and 50% RPA. The runoff from UCIA flows onto the RPA. How to model this case?
Answer: (1) Enter the catchment imperviousness as 30% (10%DCIA+20% UCIA).
(2) Select "Pervious Outlet"
(3) Enter 67% for "Percent Routed" because 20% UCIA out of the total of 30% Impervious area drains onto RPA: 0.2/(0.1+0.2)=67%
(67% of impervious area drains onto pervious area.)

MDCIA Flow Model
Of course, this case can also be modeled by two separate subareas: (1) DCIA (2) UCIA➔RPA
For subarea DCIA : (1) Imp=100% (2) Outlet (3) zero % routing
For subarea UCIA➔RPA (1) Imp=28.5%=20/ (20+50) (2) Pervious Outlet (3) 100% routing
These two flows are drained to the same point to calculate the total outflow.

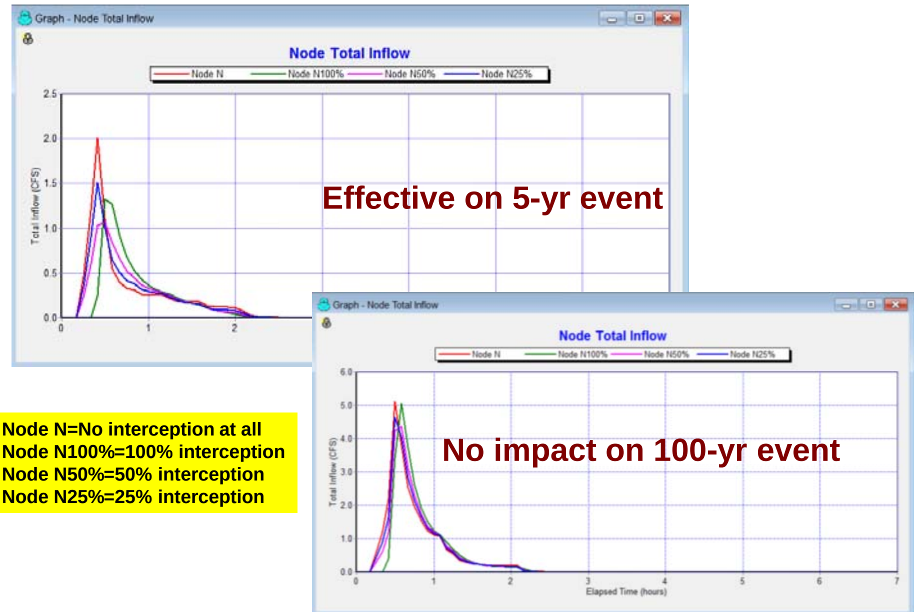
How to model A=1.0 acre, S=2%, *Ia*=50%, runon and runoff



Comparison between Lumped and Discrete Models

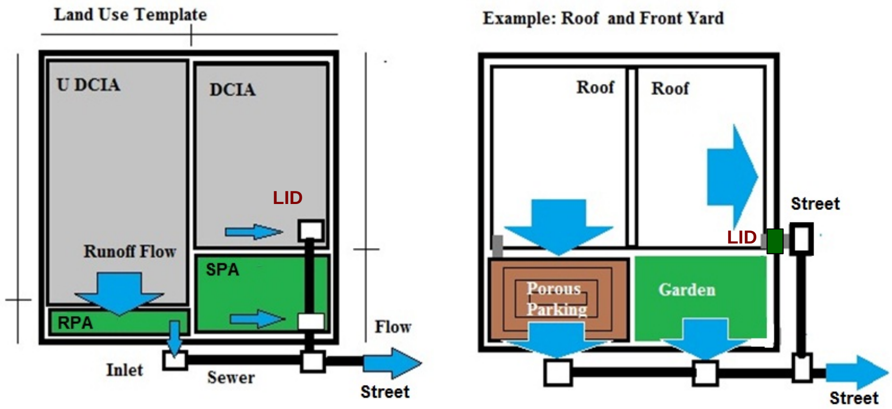


Diminishing Effect of “% Routed”: A=1.0 acre, S=2%, Ia=50%



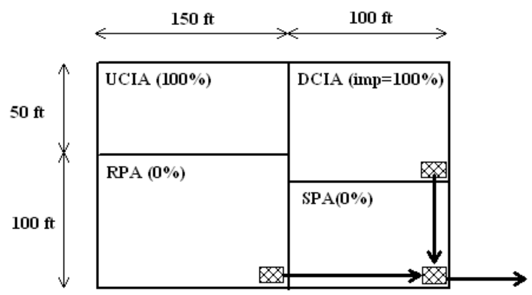
Node N=No interception at all
Node N100%=100% interception
Node N50%=50% interception
Node N25%=25% interception

4-component Lot Layout



DCIA=directly connected impervious area ➔ draining into LIDs or onto street
UDCIA=un-directly connected impervious area ➔ draining onto RPA
RPA= receiving pervious area= self-retaining area= (at least 3-inch storage depth)
SPA= separate pervious area= self-treating area= ➔ (Q2➔zero discharge)

WORKSHOP ON CASCADING LAYOUT



Subarea ID	Area acre	L ft	So %	Z=Am/A	X=A/L^2	Y=Lw/L	So/Sw	Sw %	Lw ft
DCIA	0.11	100.0	2.00	1.00	0.48	0.51	1.45	**1.38**	**51.5**
UIA	0.17	150.0	2.00	1.00	0.33	0.36	1.27	**1.57**	**54.1**
RPA	0.34	150.0	2.00	1.00	0.66	0.69	1.64	**1.22**	**103.5**
SPA	0.23	100.0	2.00	1.00	1.00	1.00	2.00	**1.00**	**100.1**

Q and A

Guo, James C.Y. Guo, Blackler, E G, Earles, A, and MacKenzie, K (2010) "Effective Imperviousness as Incentive Index for *Stormwater LID Designs*" accepted for publication on ASCE J. of Environmental Engineering, Feb, 2010.

Guo, James C.Y. (2008) *Runoff Volume-Based Imperviousness Developed for Storm Water BMP Designs*", ASCE J. of Irrigation and Drainage Engineering, Vol 134, No 2, April.

FOR MORE INFORMATION

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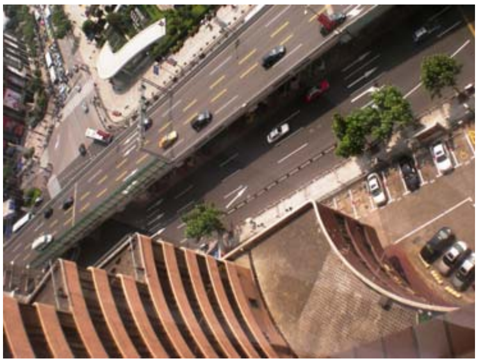
-- Website
-- Free Software
– Training Classes



Porous Floor in the Sky!???