



**LAND & WATER
RESOURCES
DEPARTMENT**

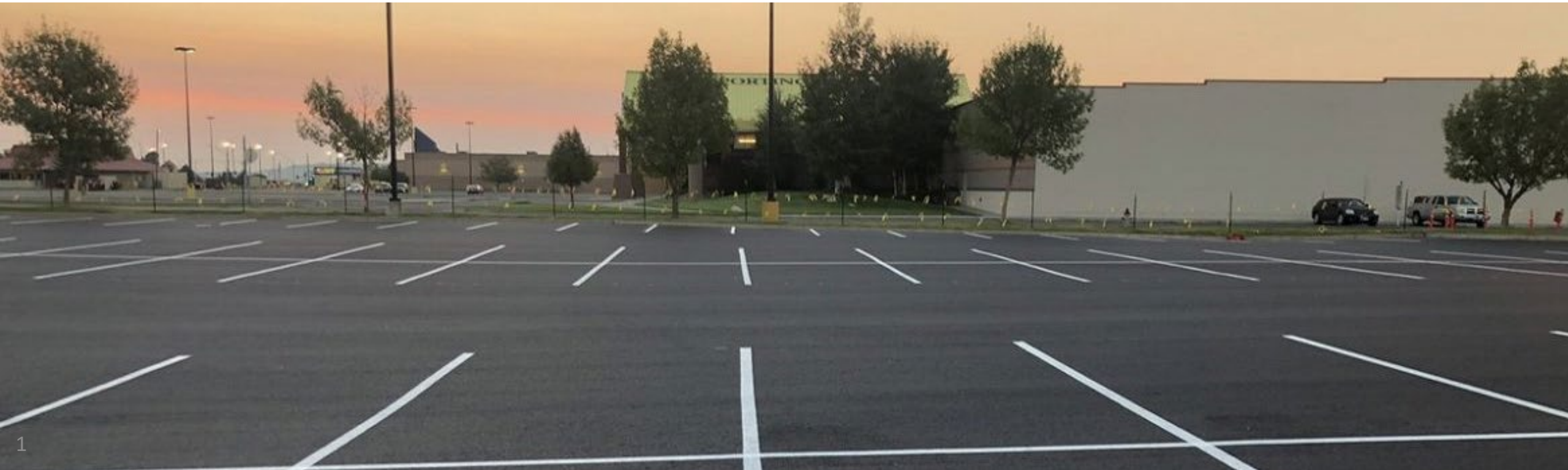
It's All Impervious to Me!

Redevelopment and Green Infrastructure Modeling Guidance

Dane County Land & Water Resources Department

Water Resource Engineering Division

September 15, 2022



Presenters



Theresa Nelson, PE
Stormwater Engineer



Elliott Mergen, PE
Conservation Engineer

AND

Jeremy Balousek, PE
WRE Division Manager

Webinar Information



**All
Participants
Muted**



**Use
Q&A
for Questions**



**PDH
Certificates
Emailed**

Presentation Outline



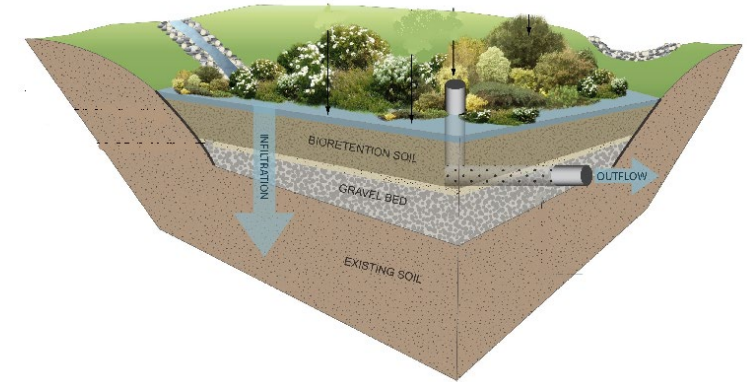
Redevelopment

- Definition
- Scenarios



Green Infrastructure

- New Standard
- Benefits
- Practices



Modeling

- Half-inch Requirement
- Peak Rate

Poll #1



An architectural rendering of a modern, multi-story mixed-use building. The ground floor features a large glass-fronted grocery store with the word "GROCERY" visible above the entrance. The upper floors consist of residential units with balconies and large windows. The building is situated on a street corner, with a sidewalk and a few cars visible. The sky is blue with light clouds.

Redevelopment

What is Redevelopment?



Replaces existing impervious surfaces



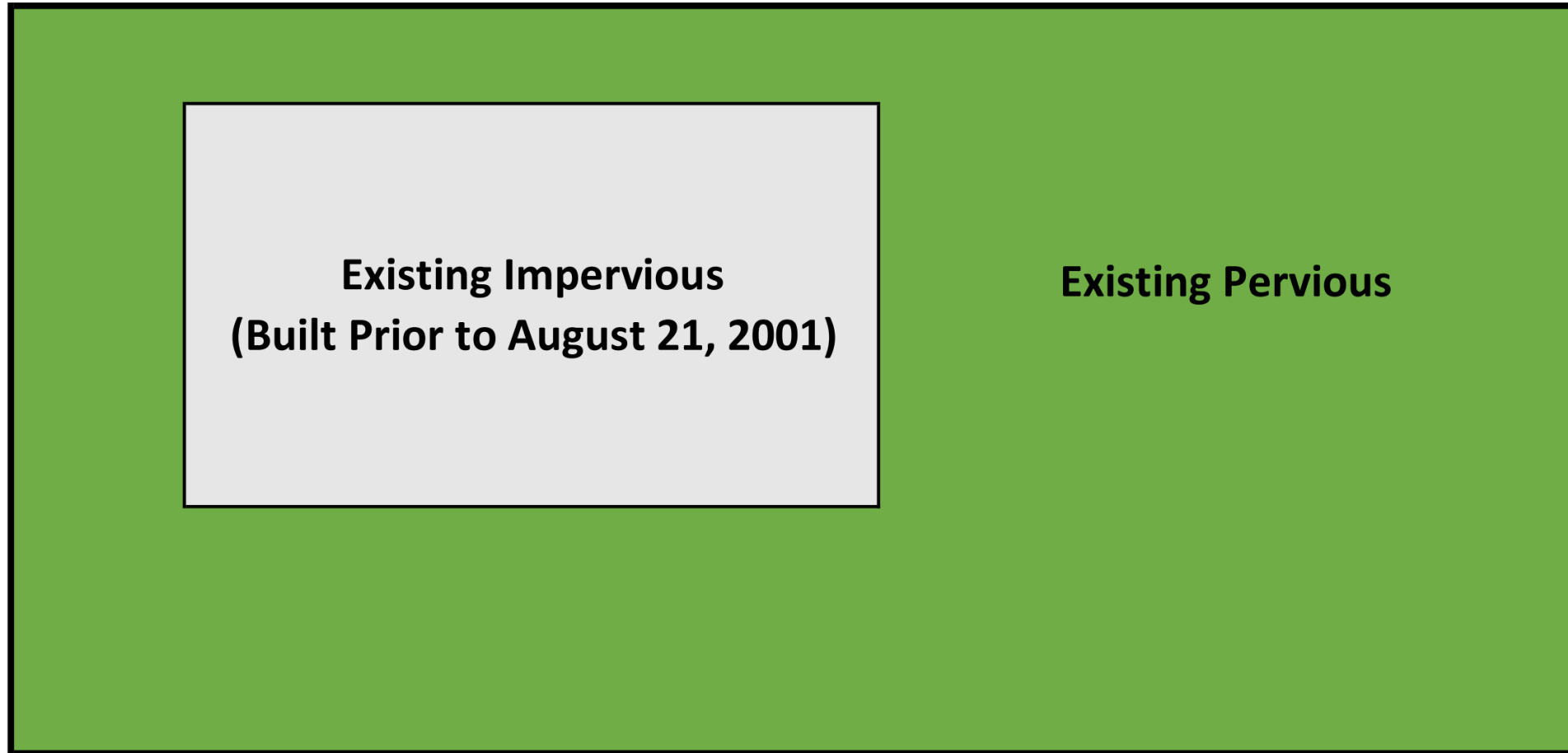
Results in the cumulative increase of less than 20,000 square feet of impervious surface to a site since August 21, 2001 on sites predominately developed as commercial, industrial, institutional or multifamily.

Sites may be required to meet a

combination

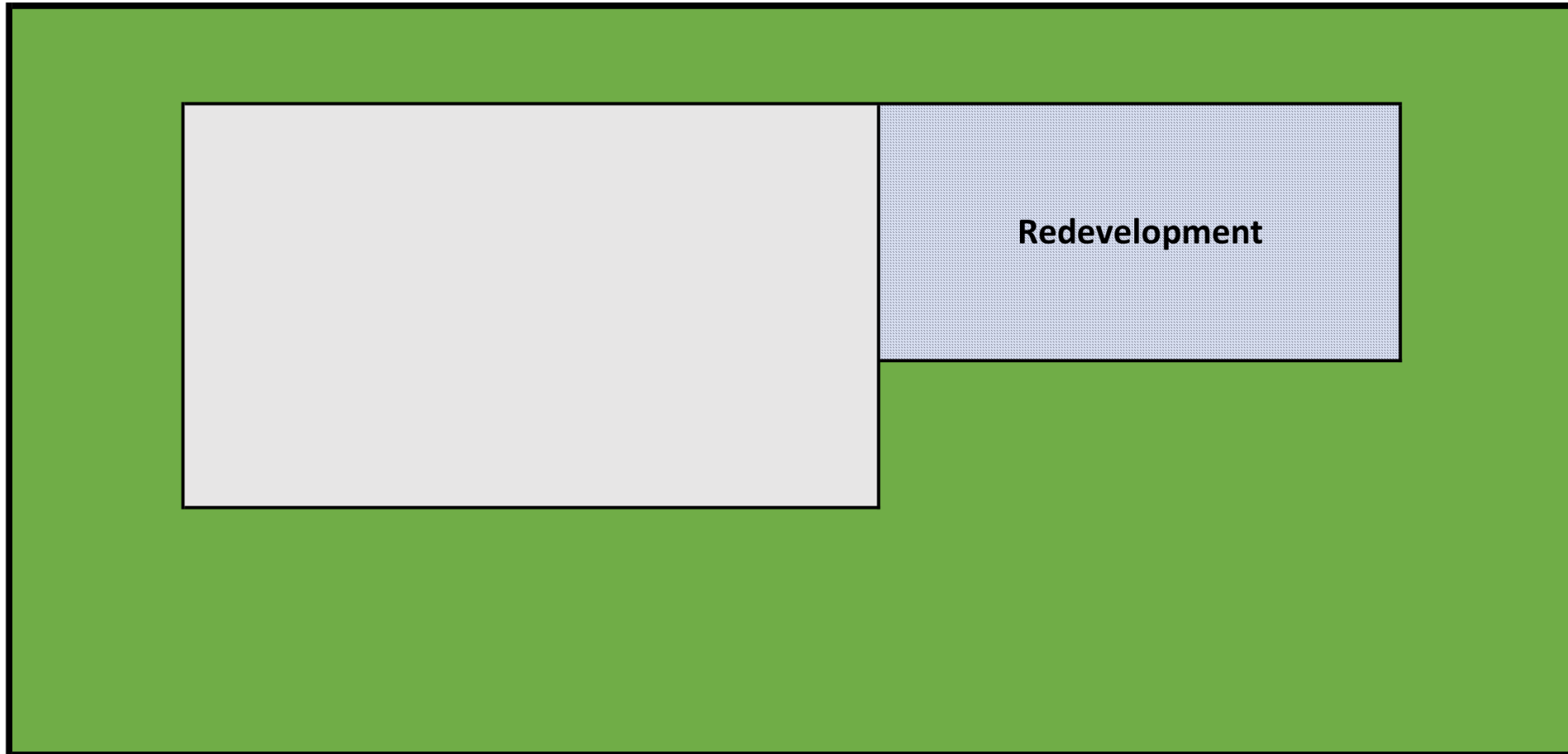
of new development and redevelopment standards

Existing Conditions



Scenario 1

New impervious is less than 20,000 ft².



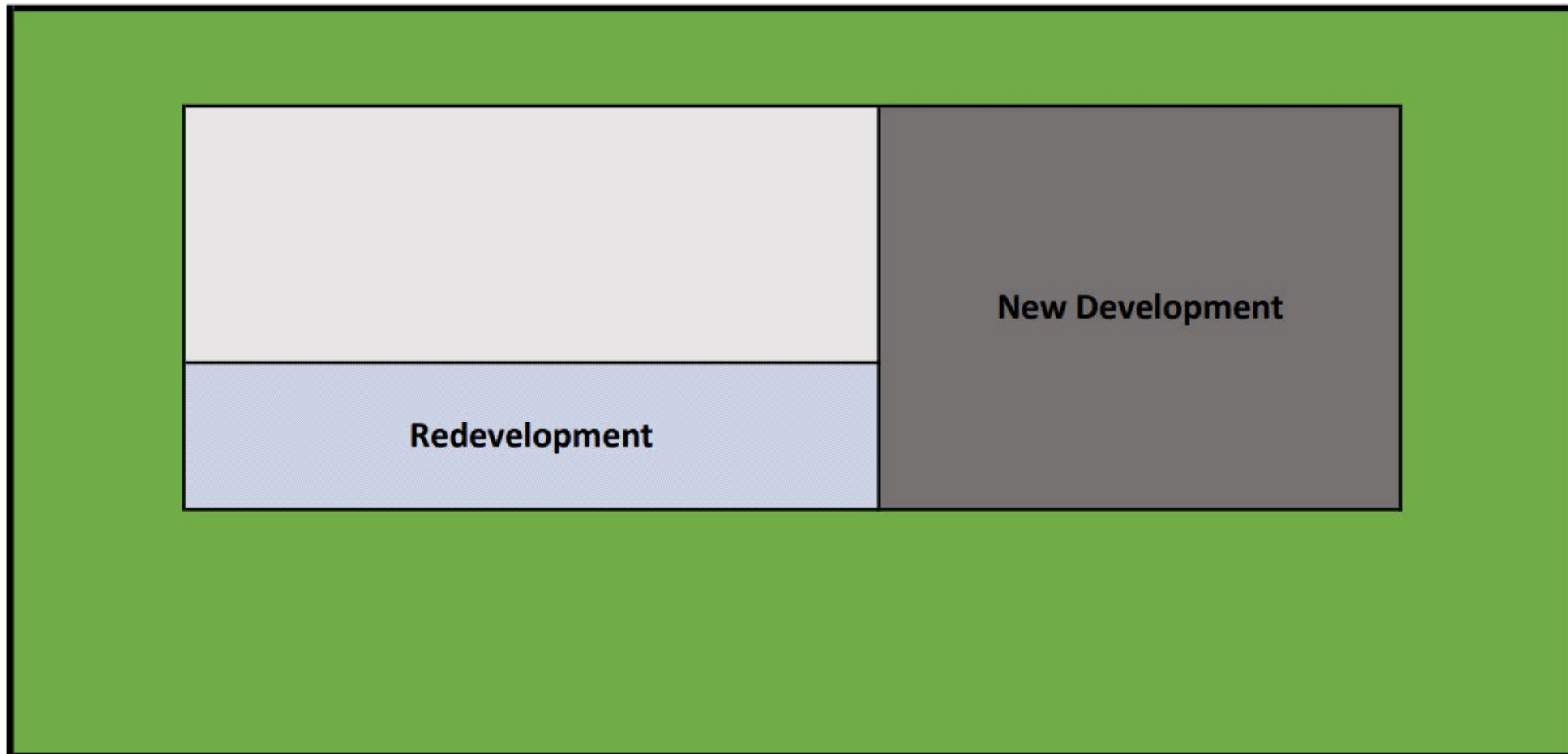
Scenario 2

Proposed impervious area is greater than 20,000 ft².



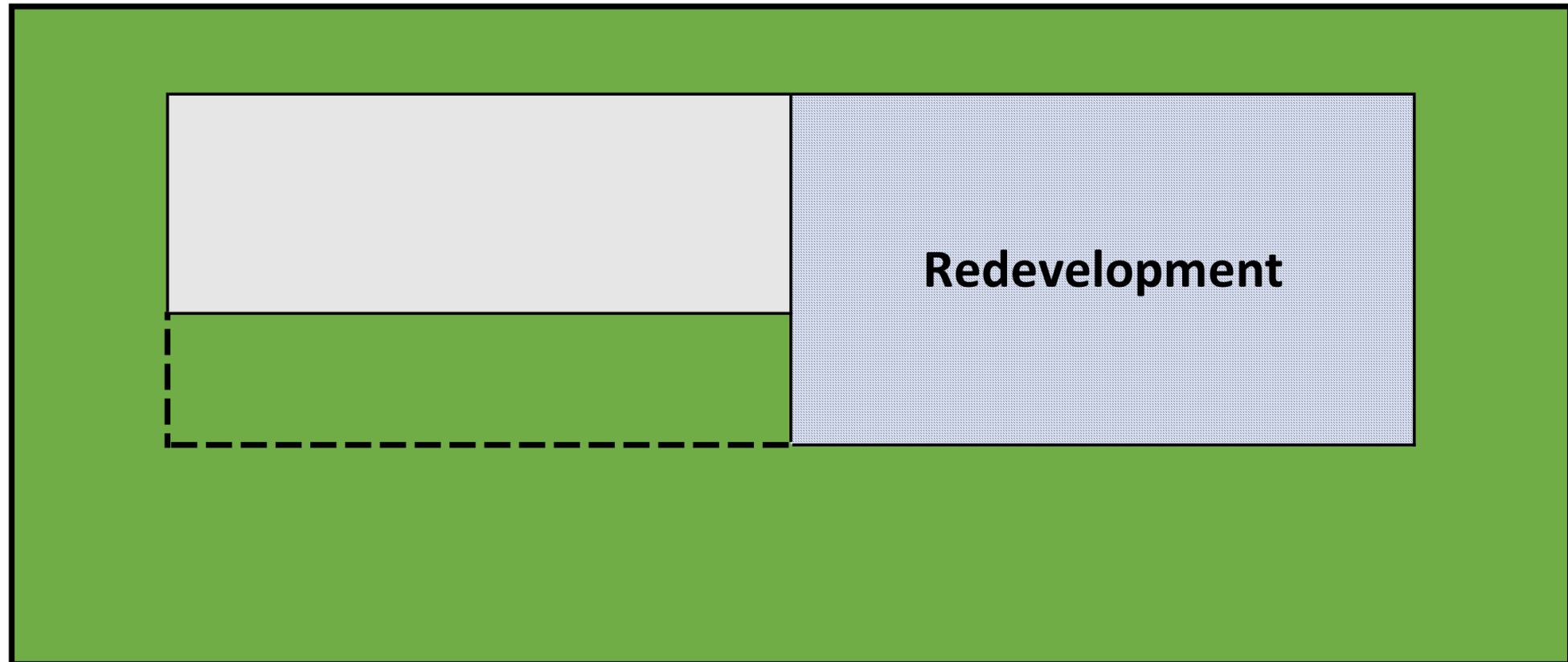
Scenario 3

New impervious is greater than 20,000 ft²,
a portion of existing impervious is replaced.



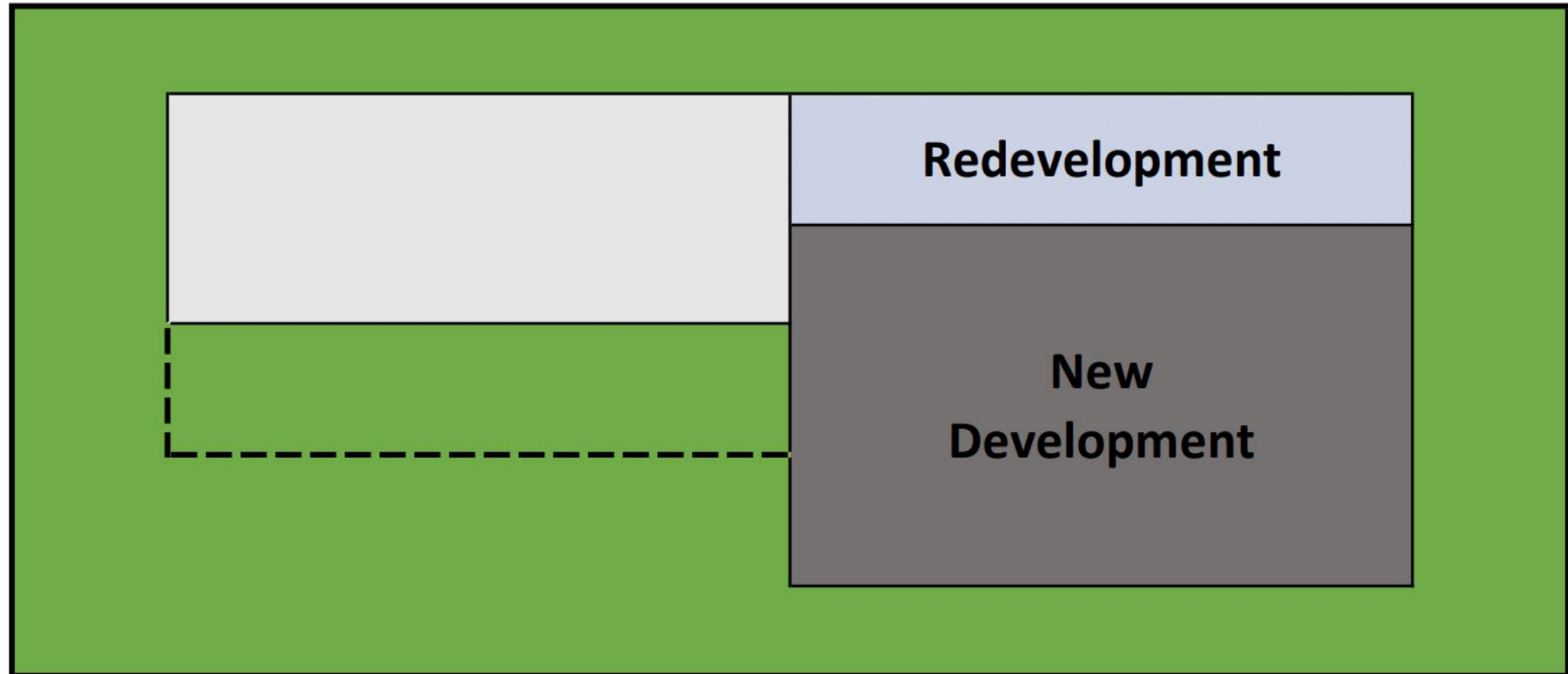
Scenario 4

A portion of existing impervious is converted to pervious.
The cumulative addition of new impervious is less than 20,000 ft².



Scenario 5

A portion of existing impervious is converted to pervious.
The cumulative addition of new impervious is greater than 20,000 ft².



Look Back to 2000!



Looking back to 2000



2014



2020

Cumulative addition of
>40,000 SF impervious
since 2000

Poll #2



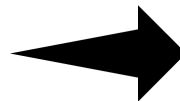


Green Infrastructure

New Regulatory Requirement!

For redevelopment with proposed impervious surface area greater than **80% of existing**, the first 0.5 inches of runoff from redeveloped impervious surfaces must be captured using green infrastructure.

danecountystormwatermanual.com



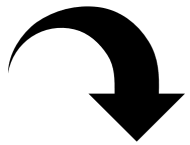
Green Infrastructure



What is Green Infrastructure?



Plant or Soil Systems



Runoff Volume Reduction



Remove Sediment



Types of Green Infrastructure



Rainwater Harvesting



**Infiltration Basin,
Rain Garden,
and Bioretention**



Vegetated Swale



Green Roof



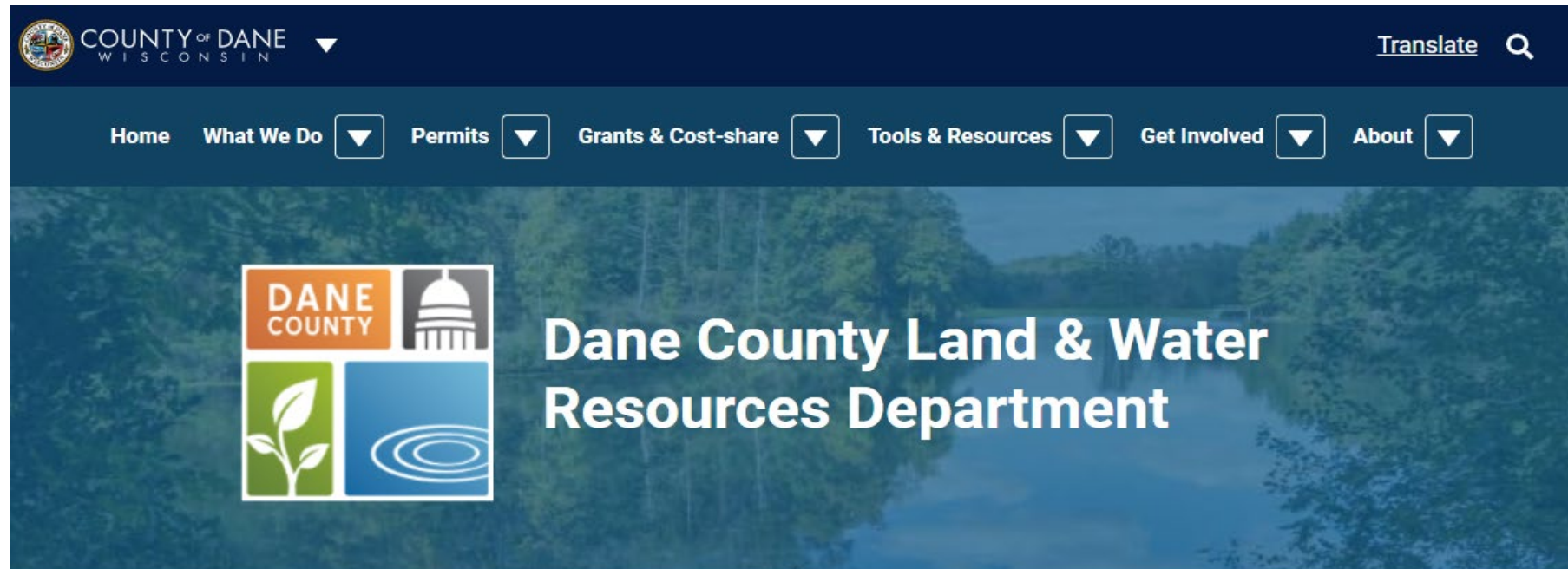
Permeable Pavement

UW Hospital Green Roof



Updated Website

<https://lwrd.countyofdane.com/>



Department Overview

The Land & Water Resources Department strives to protect and enhance the natural, cultural, and historic resources of Dane County; provide the county's residents with a broad array of accessible, high quality resource-based recreational services and facilities;



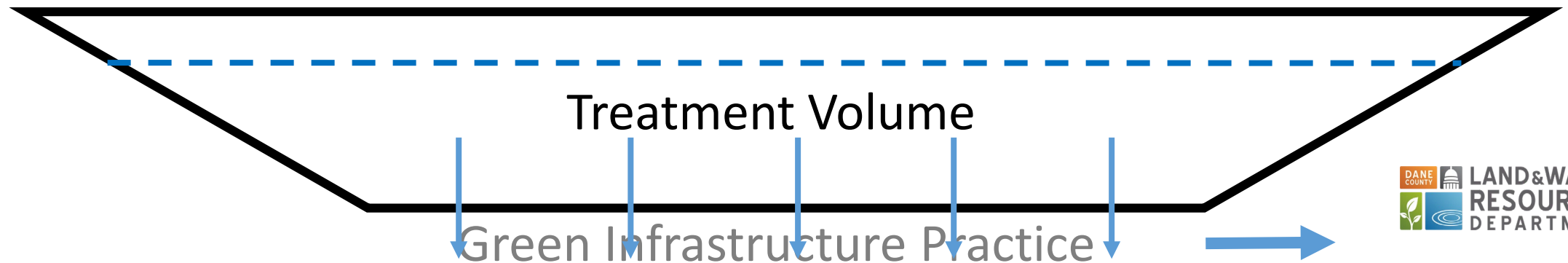
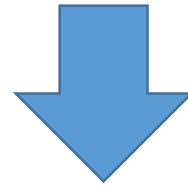
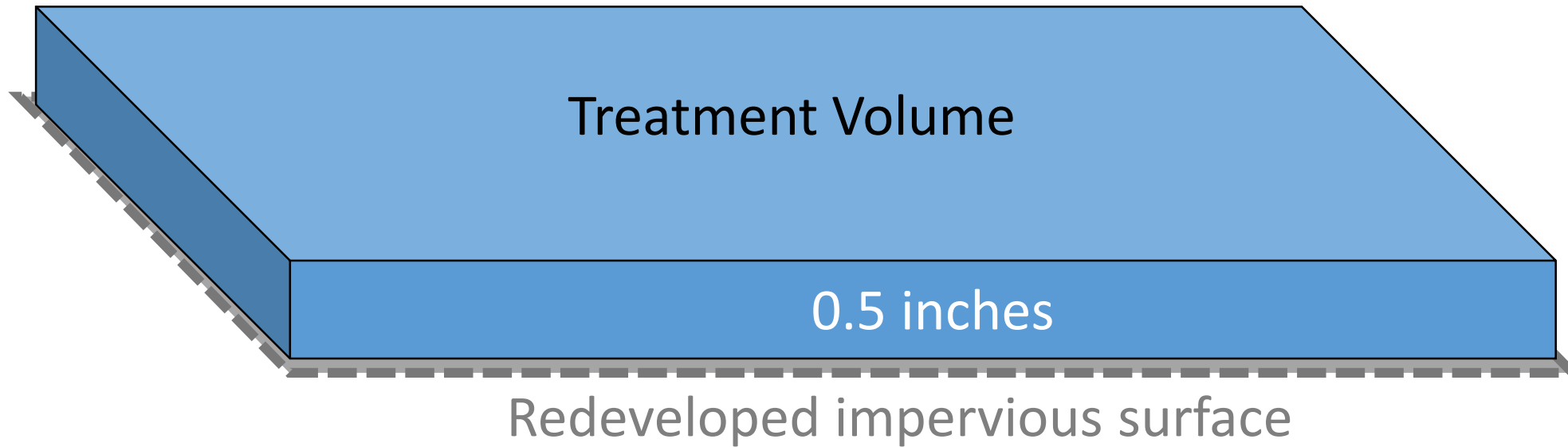
Poll #3



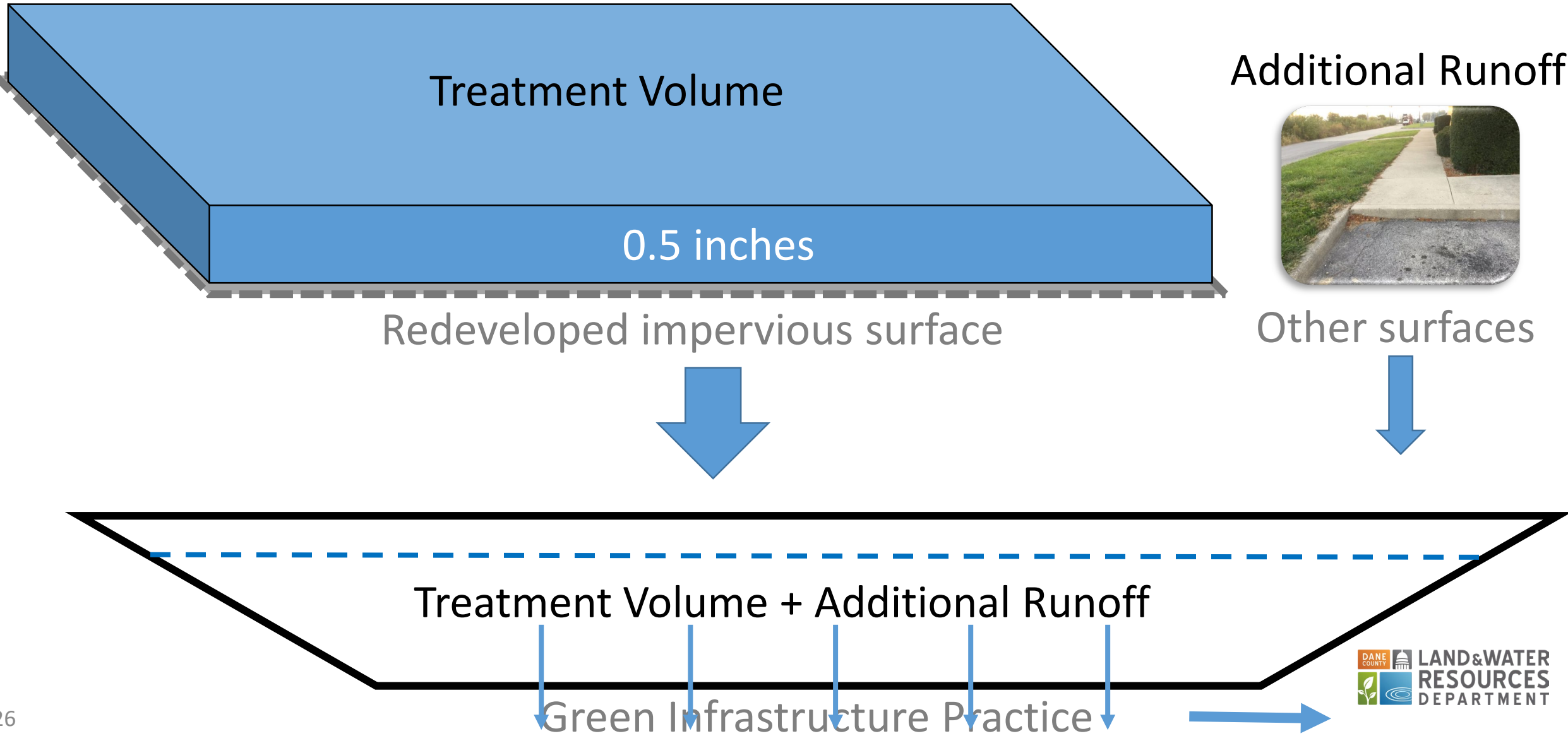
A photograph of a grassy field with a stone-lined drainage ditch in the foreground and a line of trees in the background. The ditch is filled with water and has a stone border. The field is green and appears to be a golf course or a similar recreational area. The trees in the background are dense and green.

Modeling

How to Demonstrate 1/2-inch Requirement



How to Demonstrate 1/2-inch Requirement



How to Demonstrate 1/2-inch Requirement

Practice	Method	Details
Cistern, Rain Barrel	Storage Volume Calculation	<ul style="list-style-type: none">• Volume of container must be equal to or greater than treatment volume required
Bioretention Basin, Infiltration Basin, Rain Garden, Infiltration Trench	Model in WinSLAMM, HydroCAD, or similar	<ul style="list-style-type: none">• WinSLAMM: model 4/7/81 event• HydroCAD: model 0.7 inch MSE₄ storm
Permeable Pavement, Green Roof	Follow technical standards and/or guidance	<ul style="list-style-type: none">• Show void space is equal to or greater than treatment volume

Cisterns & Rain Barrels



Size

Size to temporarily store the treatment volume



Release Rate

Must have plan for release within 72hrs of storm

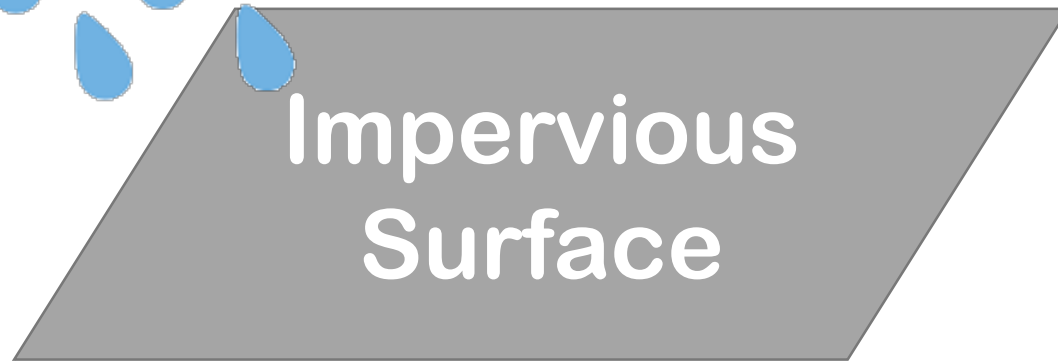


Pervious Surface

Must release to a pervious surface

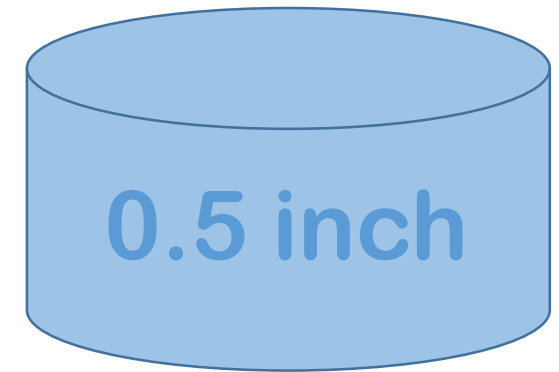


Modeling the 1/2-inch Requirement



What size storm?

Using TR-55, a 0.7-inch rainfall produces 0.5-inch of runoff from an impervious surface (CN=98).



Modeling the 1/2-inch Requirement



WinSLAMM

- Run model with start date 4/6/81 and end date 4/7/81.
- Show no surface outlet discharge

Current File Data

SLAMM Data File Name:
M:\Personal Folders\Modeling\WinSLAMM\halfinch_testing.mdb

Site Descript.:

Edit Seed: -42

Edit Rain File: C:\WinSLAMM Files\Rain Files\WisReg - Madison WI 1981.RAN

Edit Start Date: 04/06/81 Winter Season Range
Edit End Date: 04/07/81 Start of Winter (mm/dd) 12/02 End of Winter (mm/dd) 03/12

Edit Pollutant Probability Distribution File: C:\WinSLAMM Files\WI_GEO03.ppd

Edit Runoff Coefficient File: C:\WinSLAMM Files\WI_SL06 Dec06.rvx

Edit Particulate Solids Concentration File: C:\WinSLAMM Files\v10.1 WI_AVG01.pscx

Edit Street Delivery File (Select LU): C:\WinSLAMM Files\WI_Res

Residential LU Other Urban LU
 Institutional LU Freeways
 Commercial LU
 Industrial LU

Edit Source Area PSD and Peak to Average Flow Ratio File: C:\WinSLAMM Files\NURP.S

Use Cost Estimation Option

Land Uses				Junctions		Control Practices						Outfall		Output Summary							
Runoff Volume				Part. Solids Yield (lbs)		Part. Solids Conc. (mg/L)						Summary Table									
Col. #:	Control Practice No.	Control Practice Type	Flow Weighted Effluent Conc (mg/L)	Percent Conc. Reduction	Influent Median Part. Size (microns)	Effluent Median Part. Size (microns)	Notes	Maximum Stage (ft)	Hydraulic Volume Out (cf)	Maximum Surface Ponding Time (hrs)	Maximum Subsurface Ponding Time (hrs)	Volume Infiltrated (cf)	Underdrain Discharge Vol. (cf)	Evapo-Transpir. Vol. (cf)	Minimum Soil Moist. (frac)	Surface Discharge Bypass Vol. (cf)	Evap. Vol. (cf)	Volume Supplementl. Irrig.(cf)	Surface Ponding Events >72 hrs (Count)	Residence Time in Media (hrs)	Runoff Producing Events/Ttl. Rains
1	1	Biofilter	65.61	0.000	7.80	7.80	No Biofilter Overflows	2.01	454	0.0	3.05	28.23	454			0.00			0	1.35	1/1

Modeling the 1/2-inch Requirement

Calculation Settings

General **Rainfall** Time Span Reports Unit Hydro Advanced

Storm Type: MSE 24-hr Storm Curve: 4 View Storm More Storms

NRCS rainfall distributions from WinTR-55 2015 "Database Update"

Duration Mode: Default Storm Duration: (hours) 24.00 Back-to-Back Storms: 1

Depth: (inches) 0.70

Rainfall Event Name: half_inch Save Delete

Sort by: Manual Name Depth

AMC: 2

Import Events From... Del All View All

OK Cancel Apply Help



HydroCAD

- Run model with 0.7-inch 24-hr MSE₄ storm.
- No weighted curve number
- Show no surface outlet discharge

Calculation Settings

General Rainfall Time Span Reports Unit Hydro **Advanced**

Minimum I_c: (minutes) 6.0 I_a/S Ratio: 0.20 Rainfall Smoothing: Auto

Use composite CN for each subcatchment (Weighted-CN)
 Calculate separate runoff for each CN (Weighted-Q)
 Calculate separate Pervious/Impervious runoff (SBUH weighting)

Treat Unconnected Impervious as Pervious

Report Pervious/Impervious areas and CN/C values
 Round internal CN & C values to match displayed values
 Round internal I_c values to match displayed values
 Calculate net flows for reverse outlets
 Anticipate initial tailwater

Set Defaults

OK Cancel Apply Help

Pond 3P: Bioretention

Summary Hydrograph Discharge Storage Events Sizing

Event	Inflow (cfs)	Outflow (cfs)	Primary (cfs)	Secondary (cfs)	Elevation (feet)	Storage (cubic-feet)
half_inch	0.00	0.00	0.00	0.00	860.02	5

Modeling the 1/2-inch Requirement

Trading/Treatment options

Capture runoff from other surfaces in lieu of redeveloped impervious surface or treat to more restrictive standards



Trade “Like” Existing Impervious NOT Being Redeveloped

If site has other existing impervious surfaces (constructed prior to 2001), then an equivalent “like” area can be captured



Treat Redeveloped Impervious to New Development Standards

Assume redeveloped impervious areas are “new development” and model as such to meet new development standards – including infiltration



Other Methods That Meet Intent of the Ordinance

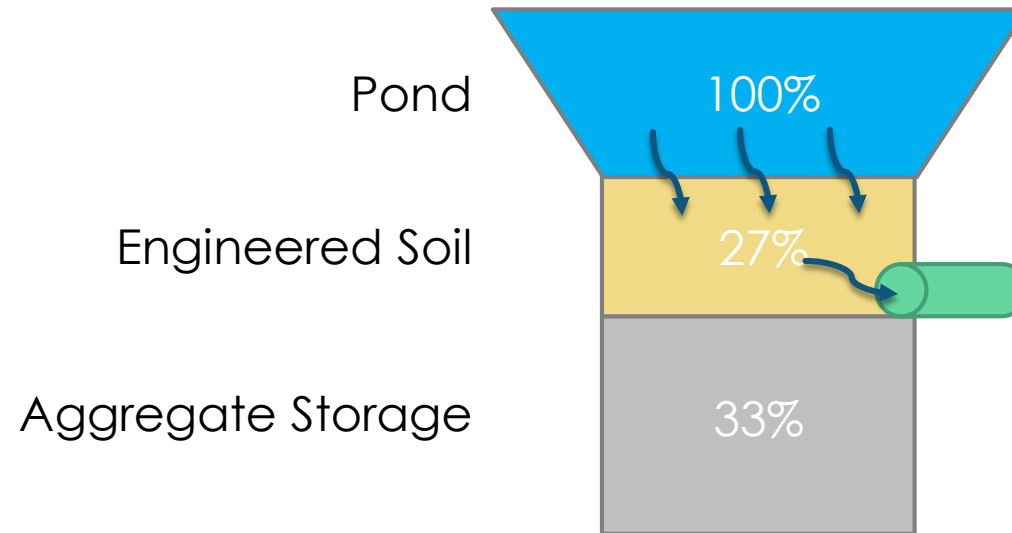
Discuss with WRE staff

Modeling Peak Rate Control in HydroCAD



How to properly model facilities with underground storage zones?

- Following HydroCAD developers guidance:
 - <https://www.hydrocad.net/raingarden.htm>

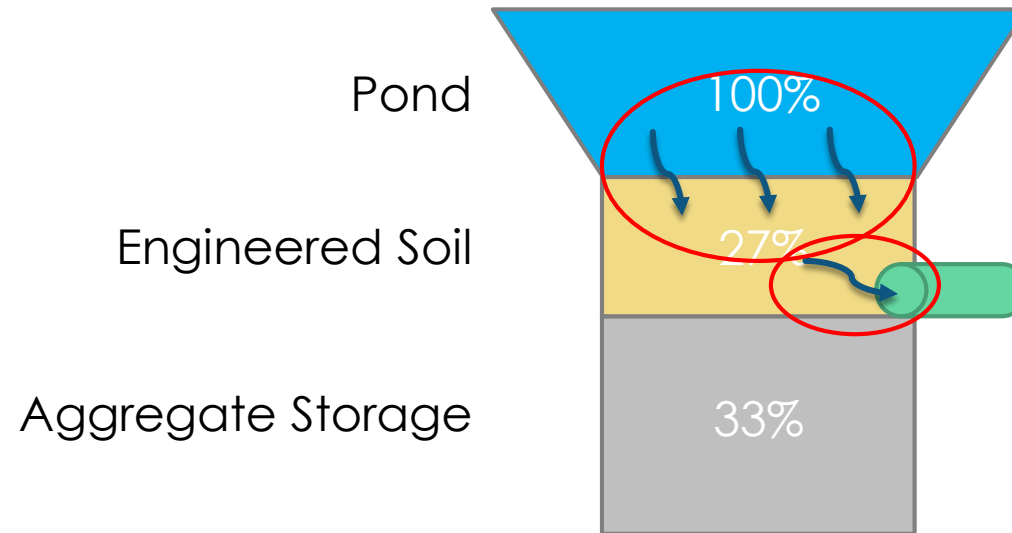


Modeling Peak Rate Control in HydroCAD



Identify most restrictive outflow control

- Compare underdrain outflow to flow through engineered soil

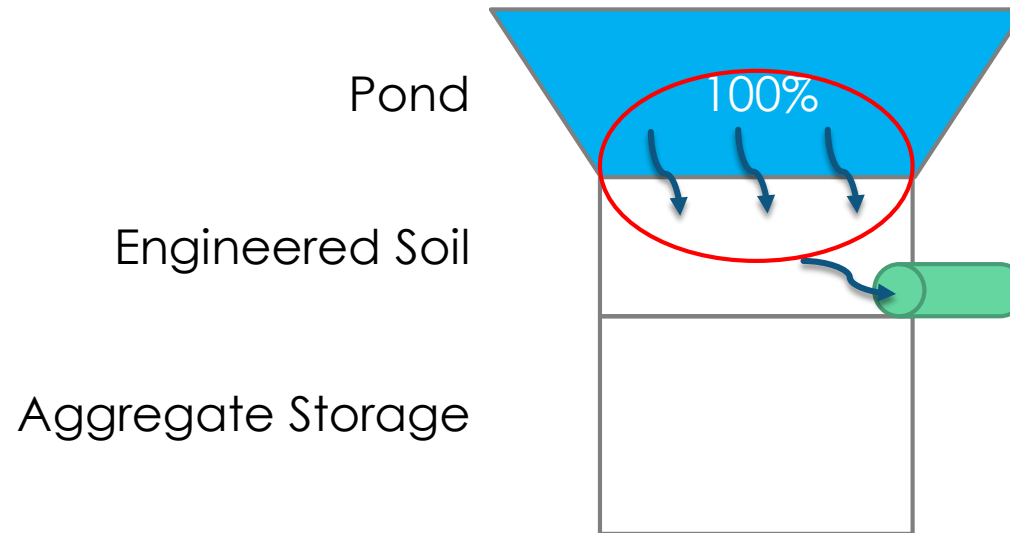


Modeling Peak Rate Control in HydroCAD



Case 1 – Engineered soil is more restrictive

- Most common
- Do not include void space storage
- Model outflow as “exfiltration” (3.6 in/hr for engineered soil) and route to underdrain outlet (optional)



Modeling Peak Rate Control in HydroCAD

Pond

Pond 3P Custom Stage Data Storage

Description: Custom Stage Data

Allow Exfiltration

Embed Inside: Nothing

Storage Multiplier: 1.00

Voids: 100.0 (%)

Stage Type:
 Surface Area
 Incremental Storage
 Cumulative Storage

Line	Elevation (feet)	Surface-Area (sq-ft)
1	860.00	0
2	860.01	600
3	860.50	850
4		
5		
6		
7		
8		

Shape: Prismatic

Stage Voids Use Large units

Recalculate storage at any elevation

OK Cancel Help

Pond 3P Exfiltration Outlet

Description: Exfiltration

Routing: Secondary

Type:
 Constant Flow Constant Velocity Conductivity

Flow: (cfs)

Discharge Multiplier: 1.00

Velocity: 3.600 (in/hr)

Apply To Available:
 Surface Area
 Horizontal Area
 Wetted Area

Groundwater Elev: (feet) 0.00

Allow Exfiltration:
 At all elevations
 Only above invert
 and below maximum

Invert Elevation: (feet) 859.99

Maximum Elev: (feet) 860.01

Phase-In Depth: (feet)

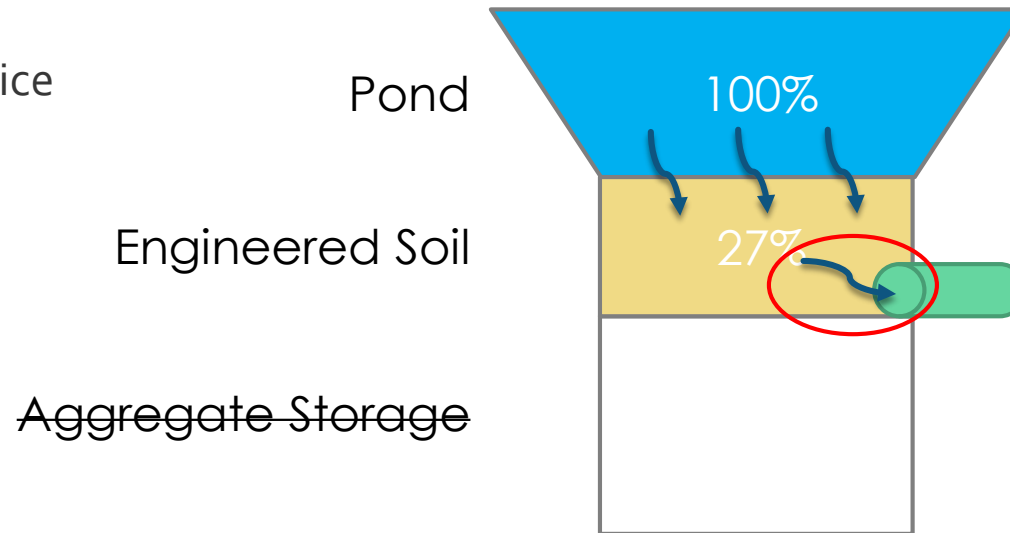
OK Cancel Help

Modeling Peak Rate Control in HydroCAD




Case 2 – Underdrain is more restrictive

- May apply to large bioretention with extensive underdrain systems or those with restricted underdrain
- Model engineered soil void storage as part of pond storage
- Include underdrain outlet as orifice



Modeling Peak Rate Control in HydroCAD

Engineered Soil
Pond

 Pond 3P Custom Stage Data Storage ✕

Description: Custom Stage Data

Stage Type:
 Surface Area
 Incremental Storage
 Cumulative Storage

Allow Exfiltration

Embed Inside: Nothing

Storage Multiplier: 1.00

Voids: (%)

Line	Elevation (feet)	Surface-Area (sq-ft)	Voids (%)
1	858.00	600	27.0
2	859.99	600	27.0
3	860.00	600	100.0
4	860.01	600	100.0
5	860.50	850	100.0
6			
7			
8			

Shape: Prismatic

Stage Voids Use Large units

Recalculate storage at any elevation

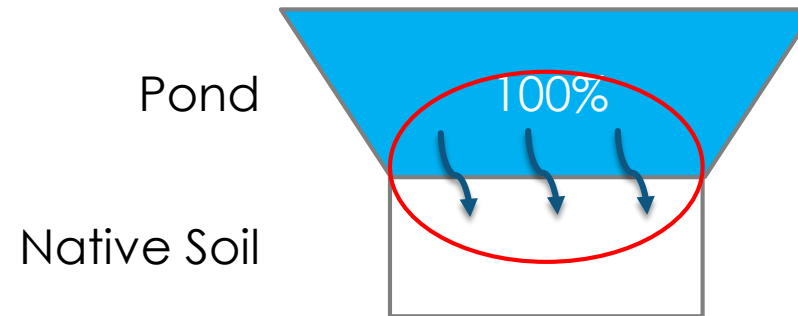
OK Cancel Help

Modeling Peak Rate Control in HydroCAD



Case 3 – No Underdrain

- Infiltration basins
- Do not include void space storage
- Model outflow as “exfiltration” with infiltration rate equal to that of native soil



Modeling Peak Rate Control in HydroCAD

Pond

Pond 3P Custom Stage Data Storage

Description: Custom Stage Data

Allow Exfiltration

Embed Inside: Nothing

Storage Multiplier: 1.00

Voids: 100.0 (%)

Stage Type:

- Surface Area
- Incremental Storage
- Cumulative Storage

Line	Elevation (feet)	Surface-Area (sq-ft)
1	860.00	0
2	860.01	600
3	860.50	850
4		
5		
6		
7		
8		

Shape: Prismatic

Stage Voids Use Large units

Recalculate storage at any elevation

OK Cancel Help

Pond 3P Exfiltration Outlet

Description: Exfiltration

Routing: Device 4

Type:

- Constant Flow
- Constant Velocity
- Conductivity

Flow: (cfs)

Discharge Multiplier: 1.00

Velocity: 0.500 (in/hr)

Apply To Available:

- Surface Area
- Horizontal Area
- Wetted Area

Groundwater Elev: (feet) 0.00

Allow Exfiltration:

- At all elevations
- Only above invert
- and below maximum

Invert Elevation: (feet) 859.99

Maximum Elev: (feet) 860.01

Phase-In Depth: (feet) 0.10

OK Cancel Help



QUESTIONS?



LAND & WATER
RESOURCES
DEPARTMENT

Contact Information

EMAIL:

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WEBSITE:

<https://lwr.dcountyofdane.com/tools/ecsm-manual>

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