Green Infrastructure: "Coming to a Plan Set Near You"

Clay Emerson PhD PE CFM
Princeton Hydro, LLC

NJSME June Meeting
June 5, 2019

What do we plan on getting out of this presentation?

- How will the new rules change site plans?
- What will need to go into a quality submission?
- What are some common issues with plans (old or new)?
- What topics will become more relevant?

(*insert disclaimer here…seriously, don't forget the disclaimer*)

A New Perspective???

Woodlands New Community, Wallace, McHarg, Roberts and Todd, **1973**

Design with Nature
Ian McHarg, 1969

What is GI?

NJDEP:

A stormwater management measure that either treats stormwater runoff through infiltration into subsoil, treatment by vegetation or soil, or storage for reuse.

What is GI? Living systems.

One growing season.

What is not GI?

What is GI?

GI Influence on LD Applications?

Still somewhat of an unknown but…

- Drainage Area Limit ⇨ Decentralization of BMPs

GI Influence on LD Applications?

Common Mistakes

Curve Numbers: You've got to keep them separated!

- NJAC 7:8-5.6(a)4.

4. In computing stormwater runoff from all design storms, the design engineer shall consider the relative stormwater runoff rates and/or volumes of pervious and impervious surfaces separately to accurately compute the rates and volume of stormwater runoff from the site. To calculate runoff from unconnected impervious cover, urban impervious area modifications as described in the NRCS Technical Release-55, Urban Hydrology for Small Watersheds or other methods may be employed.

- Essentially "dilutes" the impact of impervious coverage and under predicts runoff volume and flow rate.

Common Mistakes

Too many to list…..here's an example:

Site contains: 1 acre Impervious Cover CN=98
1 acre Meadow HSG B CN=58
Average/Composite/Weighted CN=78

2-Year storm (3.3") Runoff Volume = **9,801 CF**

Keep them separated!

Site contains: 1 acre Impervious Cover CN=98 (11,025 CF)
1 acre Meadow HSG B CN=58 (1,329 CF)

2-Year storm (3.3") Runoff Volume = **12,240 CF** ✓

Common Mistakes

Existing Site Topography

- NJAC 7:8-5.6(a)3.

3. In computing pre-construction stormwater runoff, the design engineer shall account for all significant land features and structures, such as ponds, wetlands, depressions, hedgerows, or culverts, that may reduce pre-construction stormwater runoff rates and volumes.

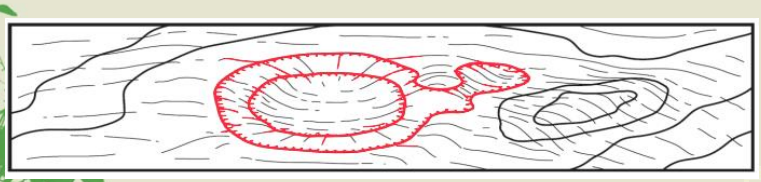
- What is a closed depression???

Common Mistakes

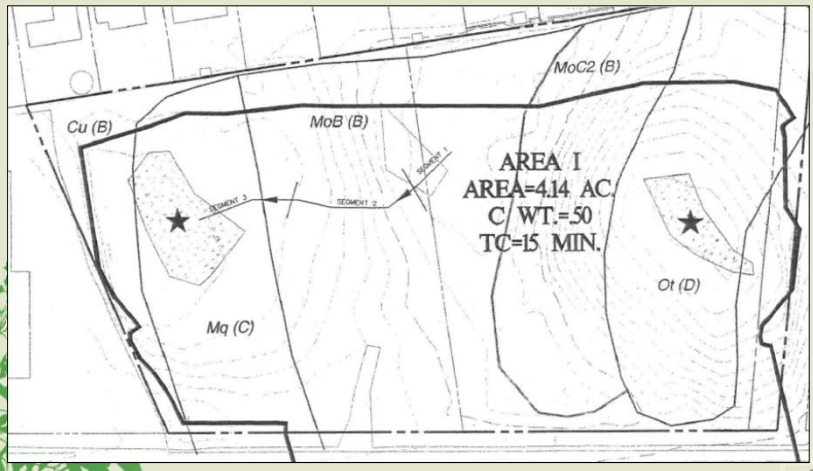
What is a closed depression?

Common Mistakes

- Function as existing detention/infiltration features.
- Often disregarded in the existing condition analysis.
- It takes time to account for them from a calculation standpoint.



Common Mistakes



In this case the existing peak outflow should be 0 cfs.

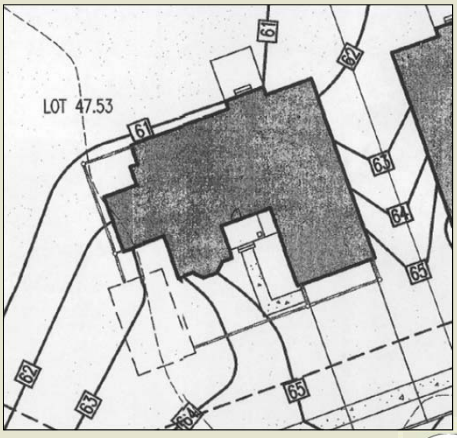
Common Mistakes

Plans are 2D, the real world isn't…

- Things that look great in plan view don't always make sense.
- Water flows down hill, no plan set is going to change that....

Common Mistakes

On lot dry wells:
Good idea, but will they work, and will NJDEP consider it GI?



…you can always pump it?

Groundwater Recharge Req.

Groundwater Recharge (GWR):

- Does not apply to projects within the “urban redevelopment area.”
- "Urban Redevelopment Area" is defined as previously developed portions of the Metropolitan Planning Area (PA1).

Groundwater Recharge Req.

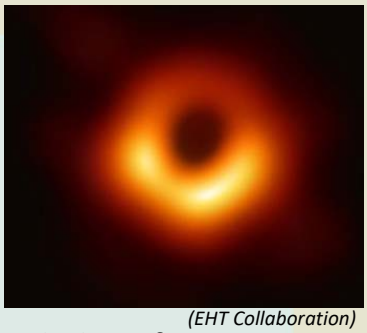
NJDEP

Infiltration Basins

Infiltration Basins:

Functional BMP or

Mysterious Black Hole?



(EHT Collaboration)

- Proper design requires basic knowledge of groundwater hydraulics.
- It is fair to say the designer may not have that basic knowledge.

Infiltration Basins

Infiltration Basins

- **Fiction**

  "All infiltration BMPs clog and eventually fail."

- **Fact**

  "A lot of poorly sited, poorly designed, and poorly maintained infiltration BMPs fail."

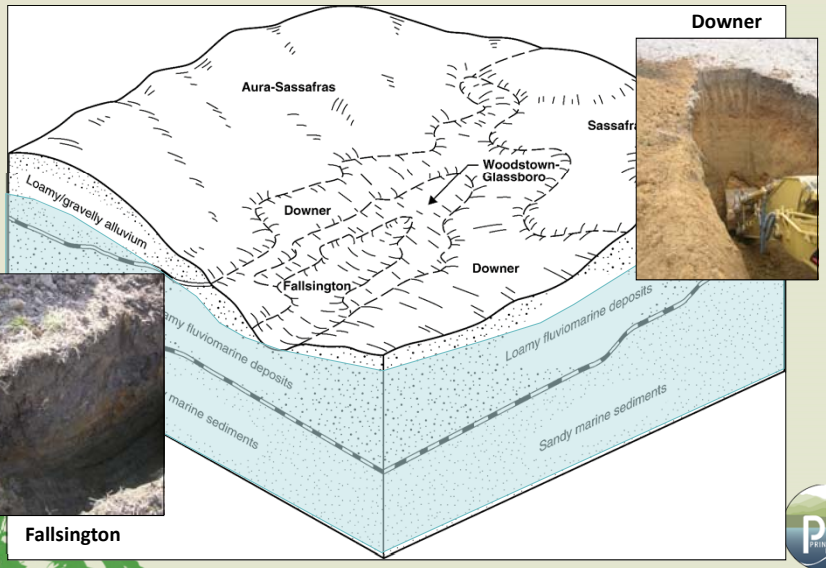
Infiltration Basins

Infiltration Basins: Here are some things to look for.

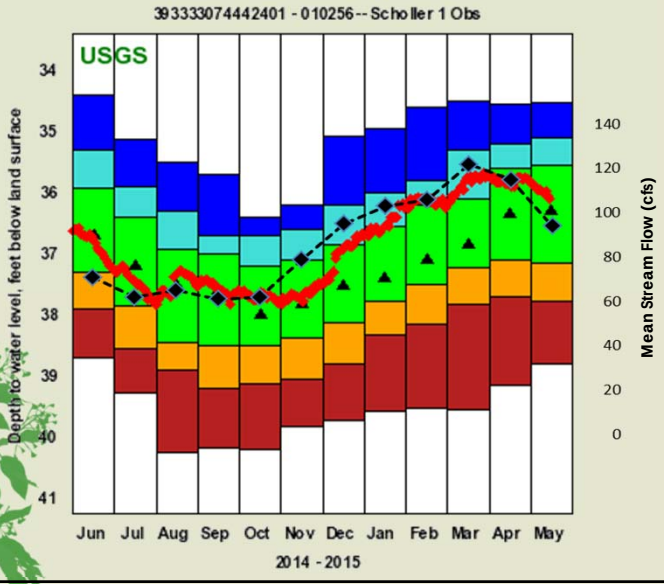
- A two-foot separation from Seasonal High Groundwater (SHWT) is required…

BUT THAT DOES NOT MEAN IT WILL WORK!!!

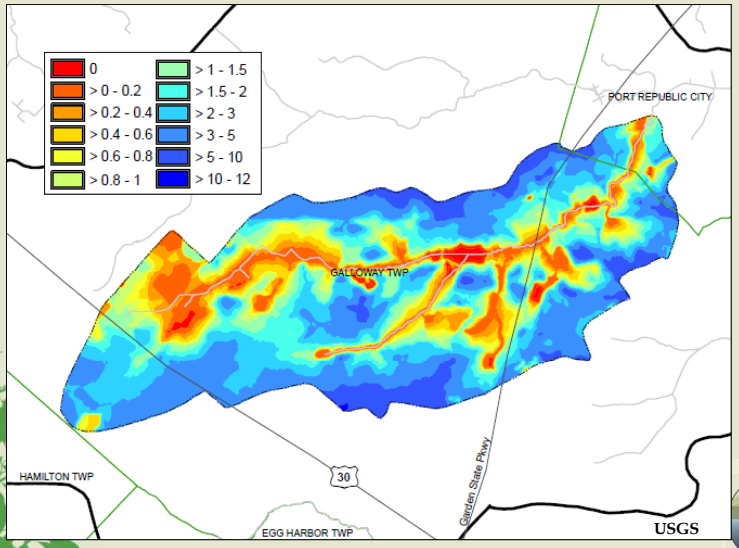
Seasonal High Water Table



Seasonal High Water Table



Seasonal High Water Table



Seasonal High Water Table

- A field determination by someone who has the necessary experience.
- Redoximorphic Features “mottling”
- Wet season monitoring is the most reliable. (Jan-Apr)

Seasonal High Water Table

Here's the thing about the miracle two-foot separation:

- Two feet of unsaturated soil can reliably store about six inches (6") of water.
- Anything beyond that will require some additional justification.

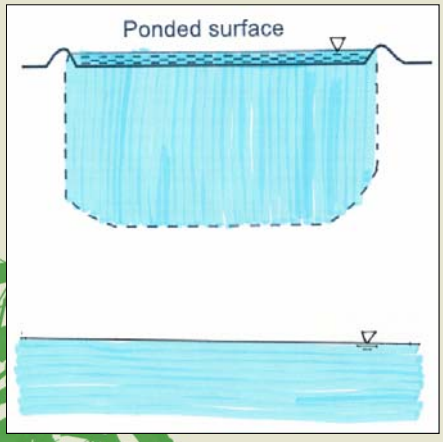
Proper Soil Investigation

Infiltration Basins: Here are some questions to ask.

- Did they complete testing in the location of the proposed basin?
- Did they test at the correct elevations?
- Did they test the most restrictive layer?
- Did they identify SHWT *above* any observed seepage?
- When was the testing completed (January – April)?

Influence of Groundwater

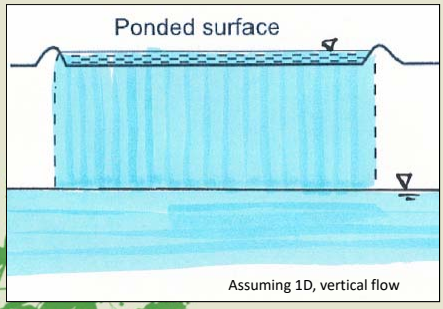
CASE 1: Infiltration BMP is unaware of the groundwater table.



- Infiltration from the BMP flows unimpeded through the unsaturated zone
- Hydraulic gradient is greater than, but approaches one (1)
- K is a good, yet conservative estimate of the recession rate in the BMP

Influence of Groundwater

CASE 2: Infiltration BMP is VERY aware of the groundwater table.



- Saturated groundwater mound intersects basin bottom
- If only vertical (1D) flow is considered, the hydraulic gradient is zero (0), no flow
- K is a gross overestimate of the recession rate in the BMP

Groundwater Mounding

Stakeholder meetings – DRAFT BMP Chapter

–Hantush model

- Specific Yield (drainable porosity):
  - Sy = 0.15 or test to a max of 0.20
- Horizontal Hydraulic Conductivity:
  - 5:1 (coastal plain) or 1:1 (everywhere else) horizontal to vertical conductivity
- Initial Thickness of Saturated Zone:
  - 10 feet assumed, for more need boring with continuous sampling to 75 feet
- Run scenarios w/ FOS (BMP design) and w/out FOS (potential impact to nearby underground structures)

Questions?

Clay Emerson PhD PE CFM
Princeton Hydro
cemerson@princetonhydro.com