Modeling the Potential Reduction of Stormwater Runoff Using BMPs

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Managing Stormwater in Our Communities
College Misericordia
Dallas, Pennsylvania
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Stormwater Management Study for Wilkes University Utilizing Best Management Practices

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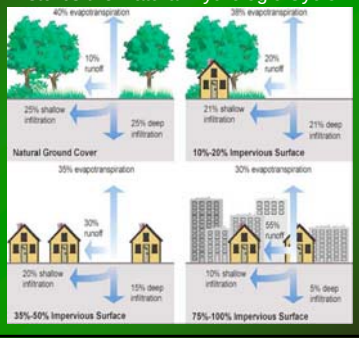
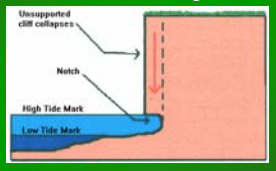
Stormwater Problems Associated with Developed Environments

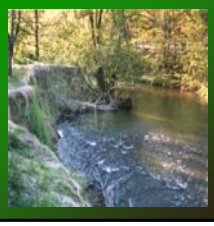
Disturbs the Natural Hydrologic Cycle



Stormwater Problems Associated with Developed Environments

- Frequency of flooding increases
  - Stream Bank Erosion
  - Undercutting
  - Channel Widening





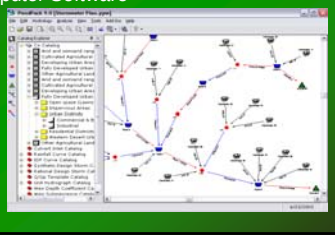
Project Objectives

- Create a Stormwater Management Plan for the main block of Wilkes University Campus using Best Management Practices (BMPs)
  - Eliminate stormwater runoff for small, frequently occurring rain events by using available space
  - Reduce peak flow of larger storm events
- Develop a Stormwater Model for the Study Area
  - Compare design alternatives to current runoff conditions

Study Area

Modeling Software

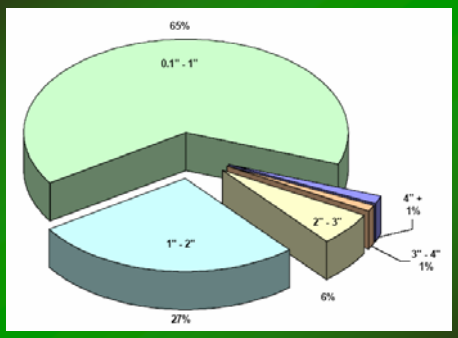
- Create model of study area using PondPack
  - Bentley Systems, Inc.
  - Detention Pond Design and Urban Modeling Computer Software



General Model Inputs

- Soil Conservation Service (SCS) Curve Number (CN) Method (TR-55)
  - CN
    - Land use
    - Hydrologic Soil Group (HSG)
  - Area
  - Time of Concentration – TR-55 Sheet Flow
    - Hydraulic length
    - Mannings number for surface flow
    - Unitless Slope
    - Depth of precipitation for 2-yr, 24-hour storm event

Distribution of Total Rainfall per Year by Rain Event



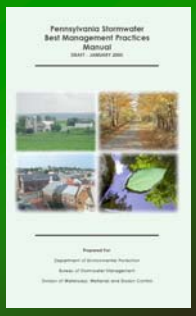
PA State Climatological Office (1926-2003)

Rainfall Criteria for Model

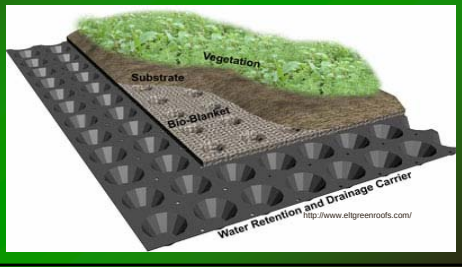
- Develop a Stormwater Management Plan to Minimize the Runoff from a 3-inch Rain Event (24 hours)
- Accounts for 98% of the storm events that occur during the year

BMP Design

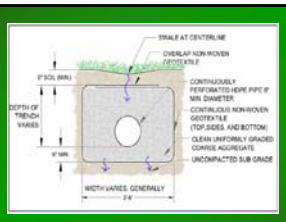
- Estimate runoff volumes and peak rates from the Current Conditions Model
- Place BMP based on the available area for campus
- Design according to PA Stormwater Best Management Practices Manual (Jan 2005)

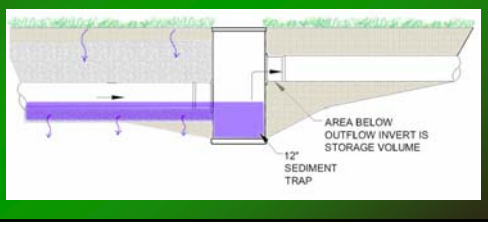


Green Roof Technology

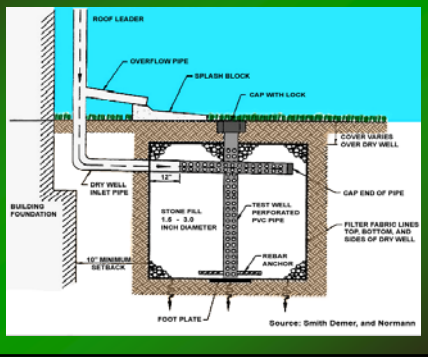


Infiltration Trench/Bed

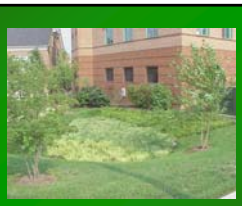


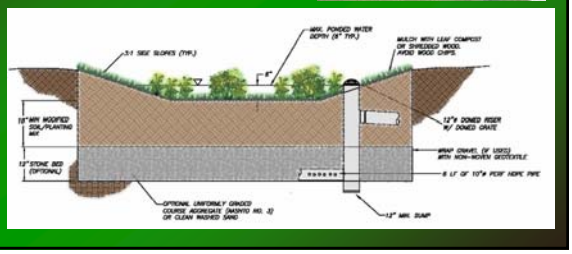


Infiltration Well

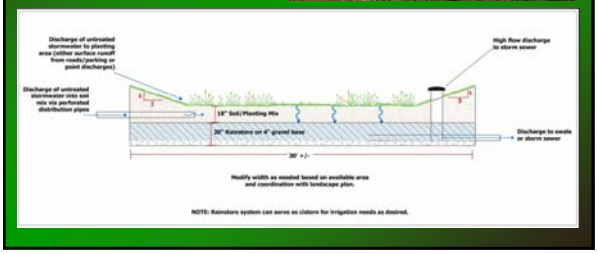


Bio-retention Garden





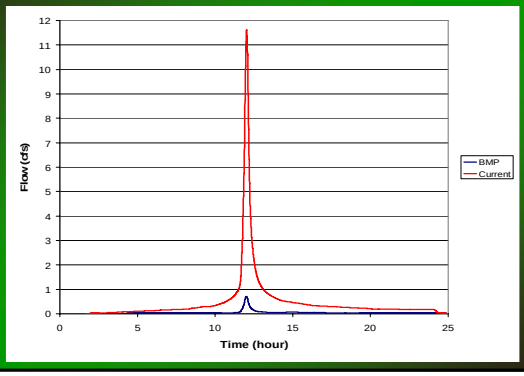
Vegetated Swale



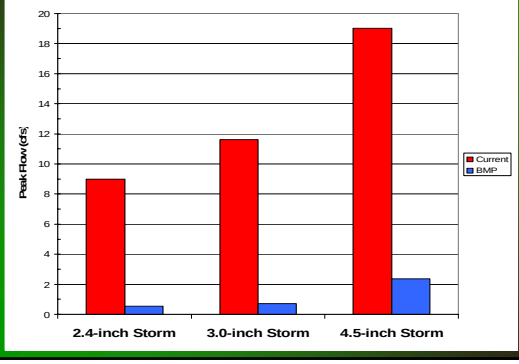
1. Bio-Garden 1
2. Bio-Garden 2
3. Bio-Garden 3
4. Bio-Garden 4
5. Bio-Garden 5
6. Infiltration Bed 1
7. Infiltration Bed 2
8. Infiltration Well
9. Vegetated Swale
10. Infiltration Trench 1
11. Infiltration Trench 2

*not drawn to scale

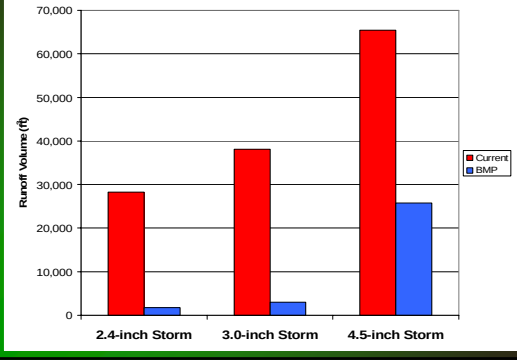
Model Hydrograph: Total Area for a 3-inch Storm Event



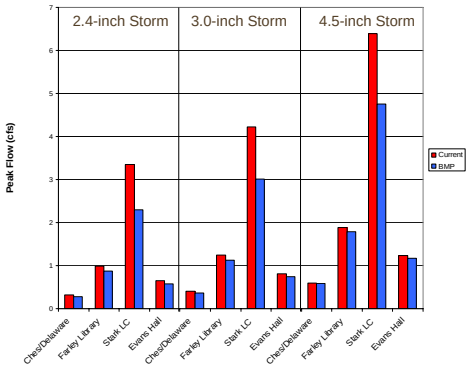
Total Area Peak Flow with and without BMPs



Total Area Runoff Volume with and without BMPs



Peak Flow from Buildings with a Green Roof



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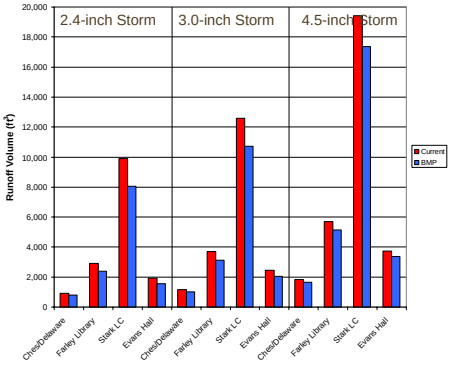
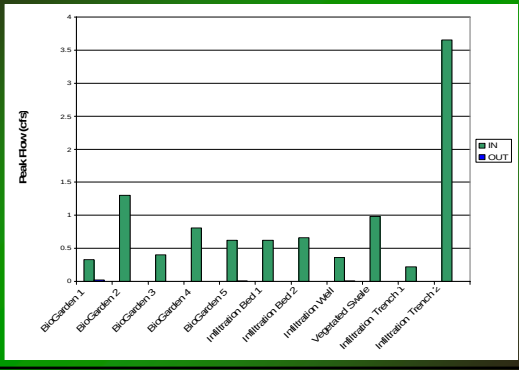
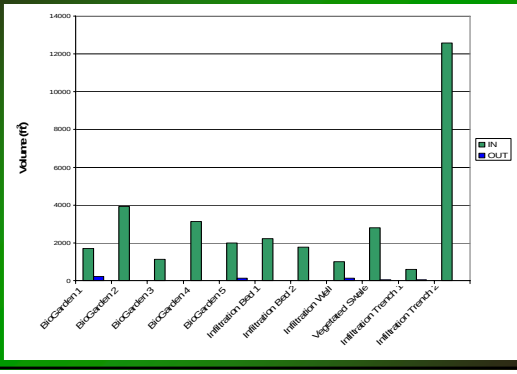


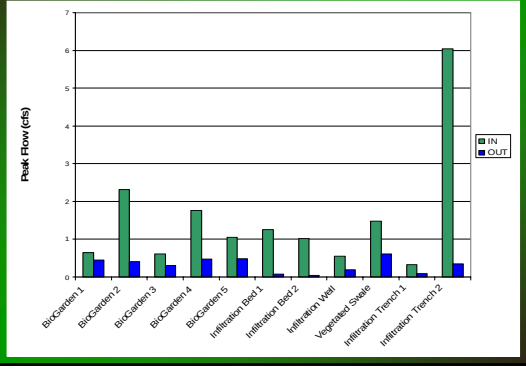
Peak Flow for a 3.0-inch Storm Event



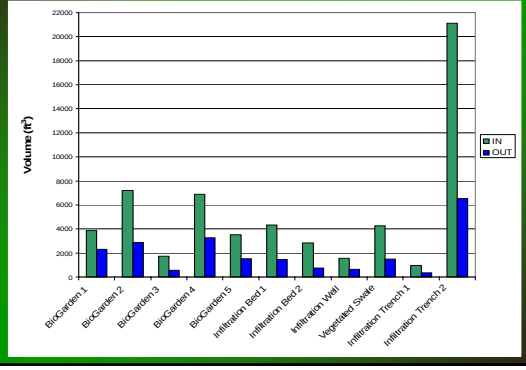
Runoff Volume for a 3.0-inch Storm Event



Peak Flow for a 4.5-inch Storm Event



Runoff Volume for a 4.5-inch Storm Event



Project Conclusions and Final Thoughts

- BMPs can be implemented on the Wilkes University Campus with minimal loss of open space
- The 3.0-inch storm event (24 hour) was completely infiltrated in areas where in-ground BMPs could be placed
- The peak flow and runoff volume for a larger storm event can be reduced

- Model needs to be calibrated and verified
- BMPs could be effective if systematically and strategically placed