Approximation of Discharge Volumes During Precipitation Events for a Portland, Oregon Stormwater System

Class Project Presentation

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PSU Geography 592

March 16, 2009

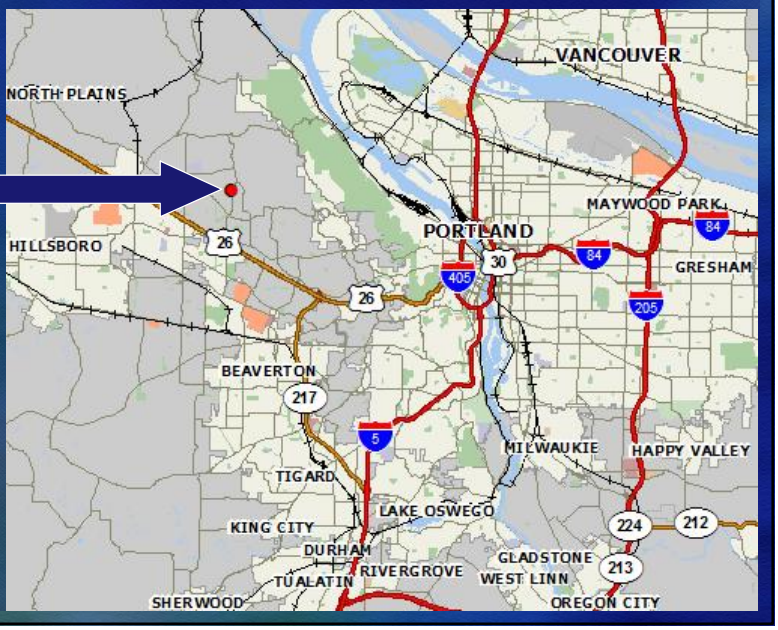
Presentation Outline

- Background
- Methods
- Results
- Conclusions

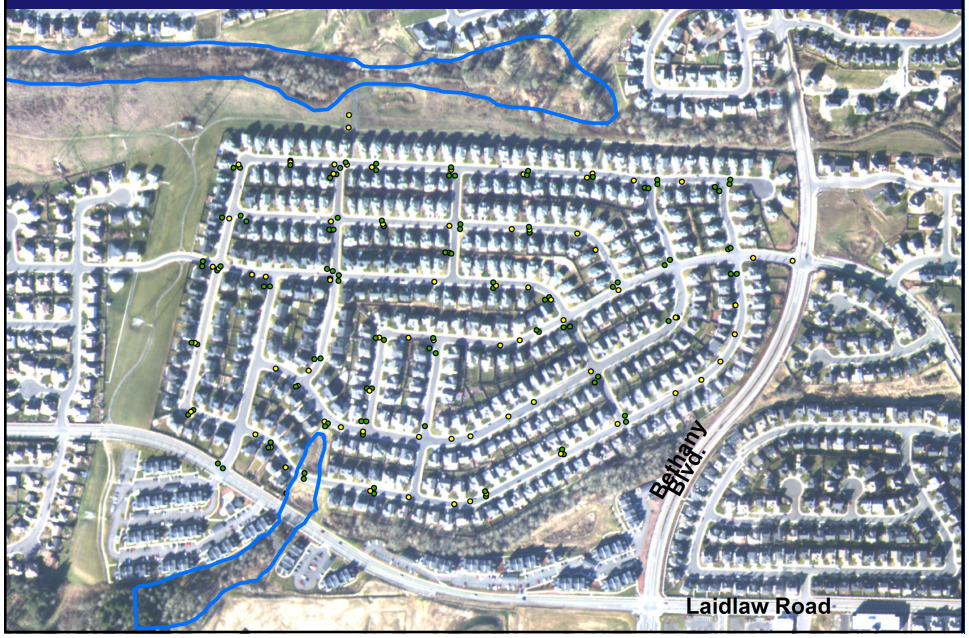
Background

Vicinity Map

Area of Concern



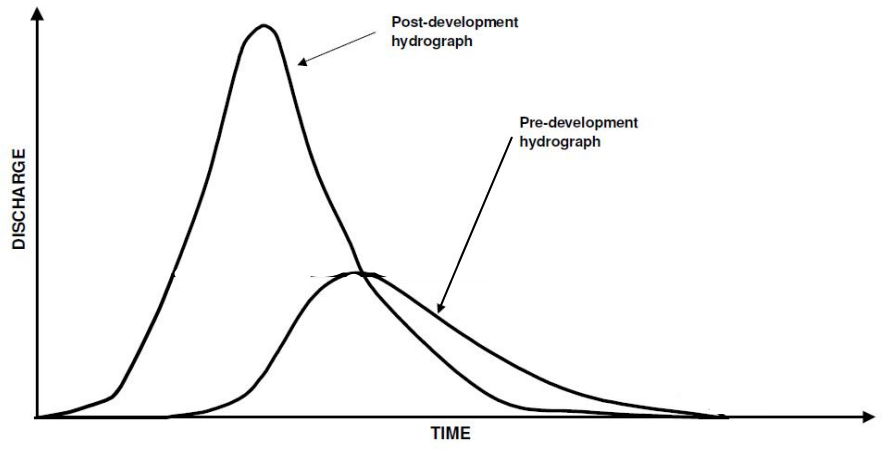
Area of Concern – Bauer Woods Estates



Wetland Health and Urban Stormwater Runoff

- Stormwater runoff and pollutants
- Water quality and water quantity
- Wetlands as filtration system

Idealized Urban Runoff Hydrograph



Research Questions

- What are the Approximate Discharge Volumes of a Community Watershed?
- How does an Artificial Drainage System Affect the Local Watershed?
- At What Precipitation Rate does Flooding Occur?

Spatial and Attribute Databases

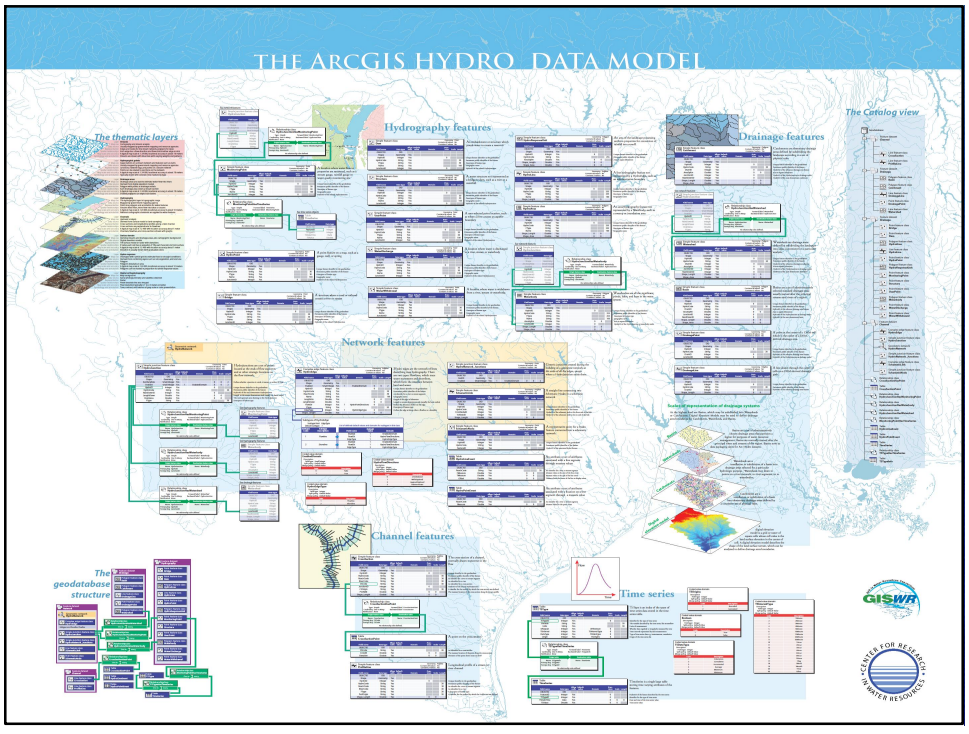
- Digital Elevation Model (DEM)
- Stormwater lines vector layer
- Stormwater catch basins vector layer
- Vector street layer
- Vector parcel layer
- Soils layer
- Precipitation data

Methods

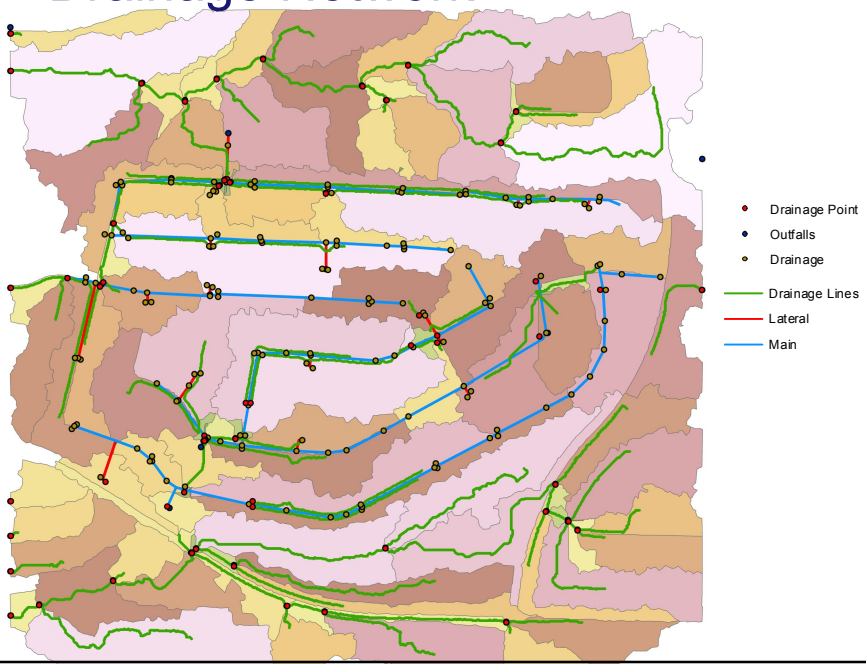
- Terrain Modeling and Stormwater System Networking
- Automating Precipitation Data
- Determining Wetland Water Levels

Methods

- Terrain Modeling and Stormwater System Networking



Drainage Network



Methods

- Defining Watershed Features

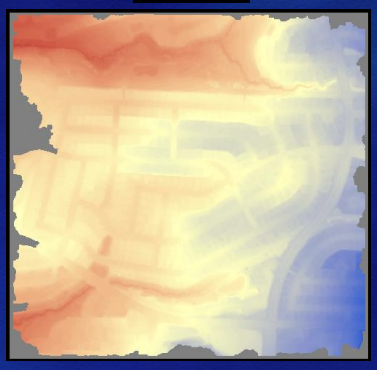
Impermeable / Permeable Lands

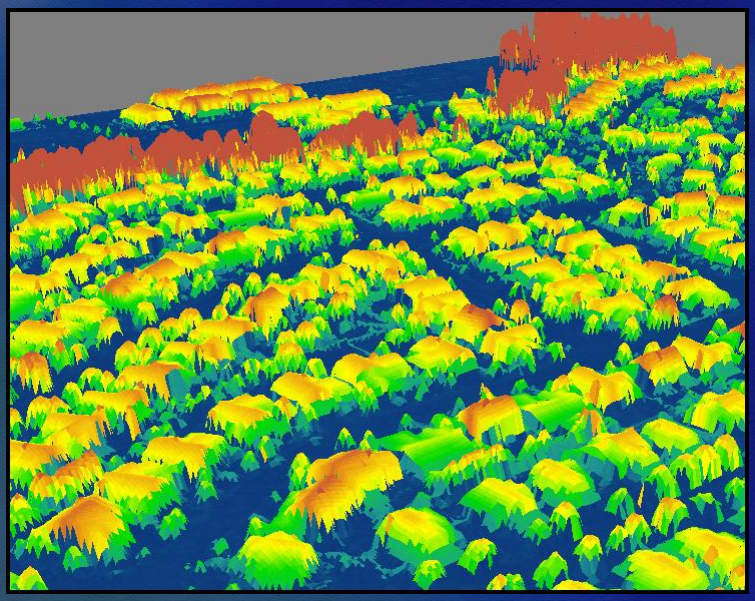
Pastels Colors are Different Types of Soil

Grey Represents the Impermeable Surfaces

DSM

DEM





Methods

- Approximating Surface Volumes

Multi-Criteria Assessment

- Weighted Considerations:
  - Sub-Catchment Surface Feature Areas
  - Average Catchment Slopes
  - Impermeable Surfaces
  - Permeable Surfaces
  - Unique Soil Infiltration Rates

Drainage Volume Formula

$$DV = \frac{(CA * P) - (CS * PIR) - ISR}{12}$$

Where: $ISR = SCA * SPR$ $PIR = SCA * 0.015$

And:

DV:	Drainage Volume
CA:	Catchment Area
P:	Precipitation Rate
CS:	Catchment Slope Average
PIR:	Permeable Surface Infiltration
ISR:	Impermeable Surface Restriction
12:	Conversion from Inches to Feet (per hour)
SCA:	Sub-Catchment Area
SPR:	Soil Permeability Rate
0.015:	Constant for Pavement Water Storage

Precipitation Test

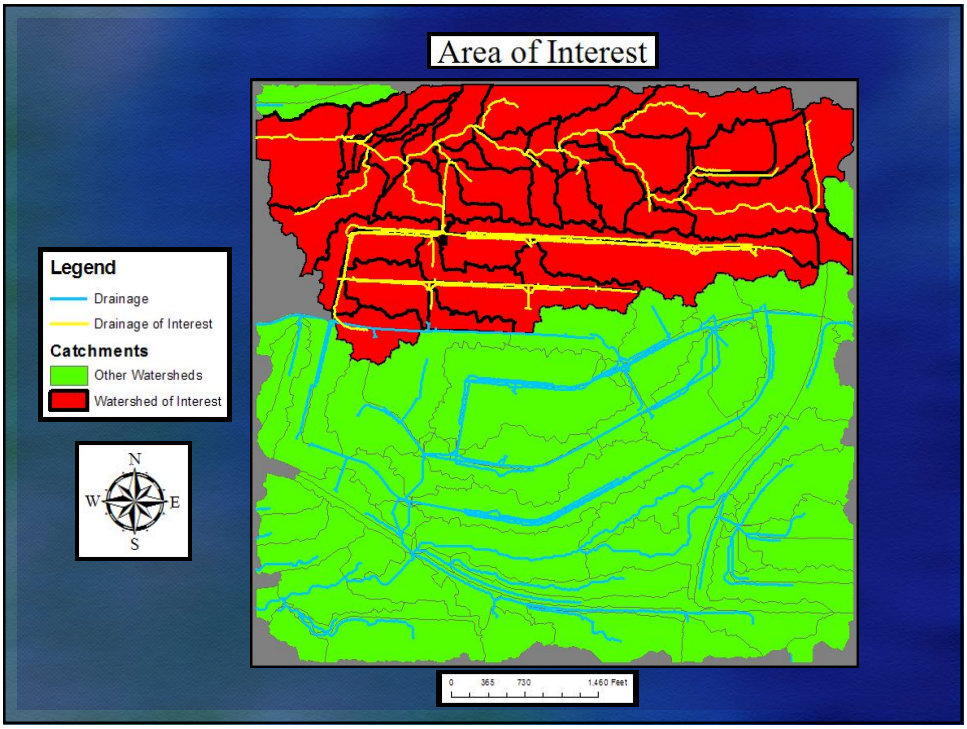
Goal: To Test a Rolling Increment of Values to Determine Potential Flooding Increments of the Drainage Wetlands

Values Tested:

- 0.01 – 0.20 in./hour at 0.01 Time Steps
- 0.25, 0.50, 1.00, and 2.00 in./hour

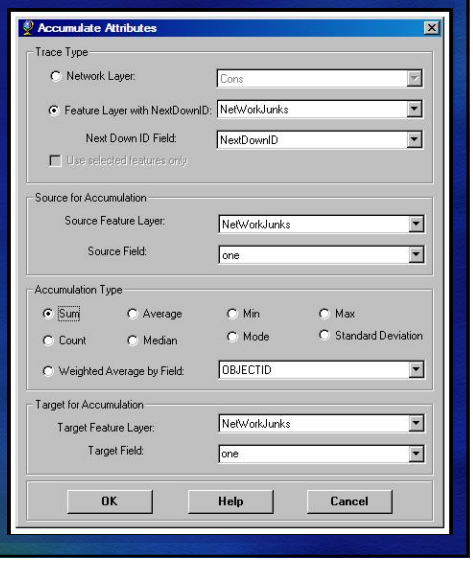
Testing Location:

- Northern Wetland / Riparian Habitat



Bug Found in ArcHydro!

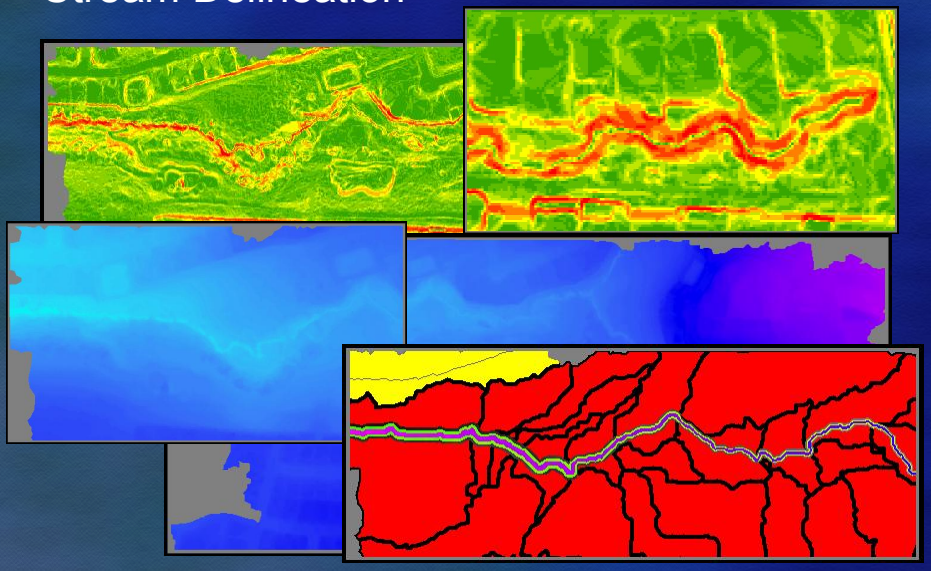
- When Accumulating your Values make sure that you DO NOT Re-Sort your Output Table
- This Tool Calculates the Accumulation Depending on the Current Arrangement of Table Values
- Check NextDownID's for Connection Variances



Methods

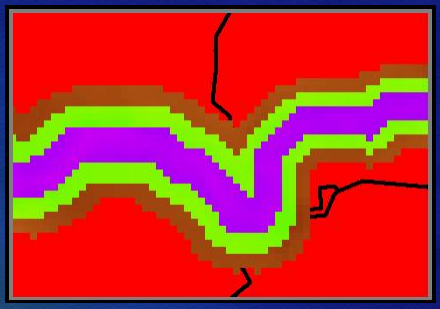
- Determining Wetland Water Levels

Stream Delineation



Channel and Flood Plane Delineation

Inside	=	Channel
Middle	=	2XChannel
Outer	=	3XChannel



Inside	=	Up To 490,588 cf
Middle	=	Up To 1,430,218 cf
Outer	=	Up To 2,559,487 cf

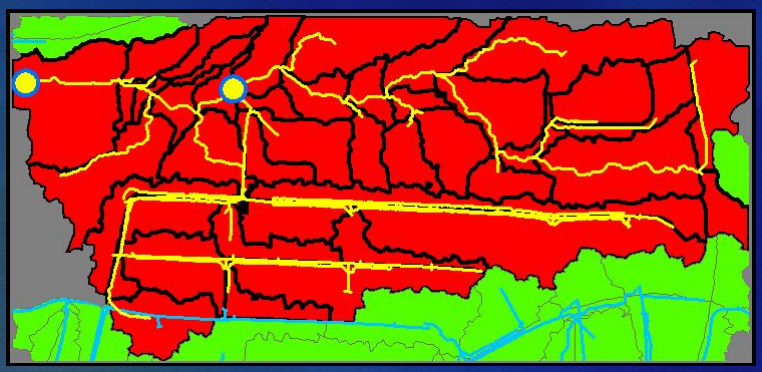
Restate Research Questions

- What are the Approximate Discharge Volumes of a Community Watershed?
- How does an Artificial Drainage System Affect the Local Watershed?
- At What Precipitation Rate does Flooding Occur?

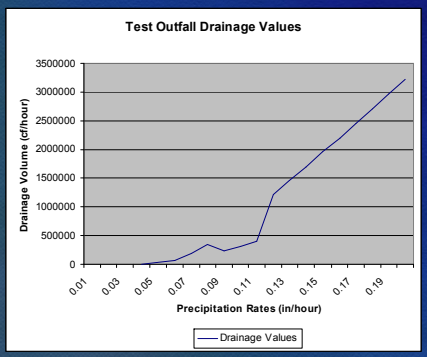
Results

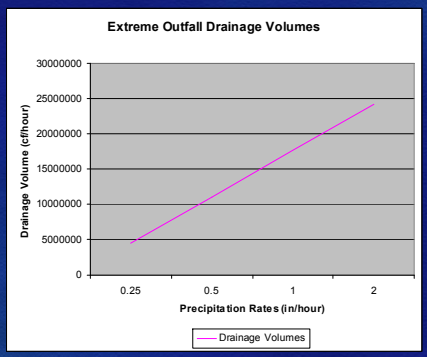
What are the Approximate Discharge Volumes of a Community Watershed?

Identify Areas of Interest



Outfall Drainage Volumes





Results

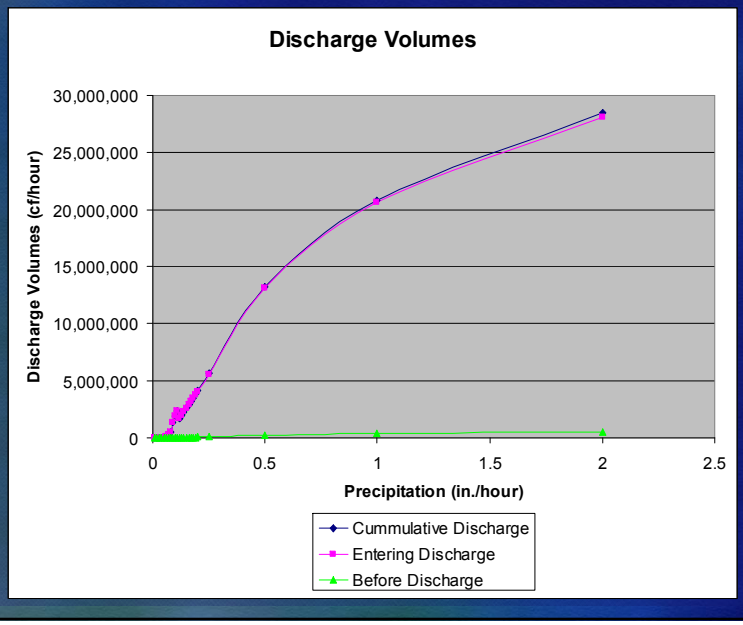
How does an Artificial Drainage System Affect the Local Watershed?

Erosion Potentials (Derived by Slope)

Post System	
Section 1	16.82804
Section 2	16.45022
Section 3	13.46951
Mean	15.58259

Pre System	
Section 4	12.67212
Section 5	8.339904
Section 6	9.227605
Section 7	13.09589
Section 8	13.7755
Mean	11.4222

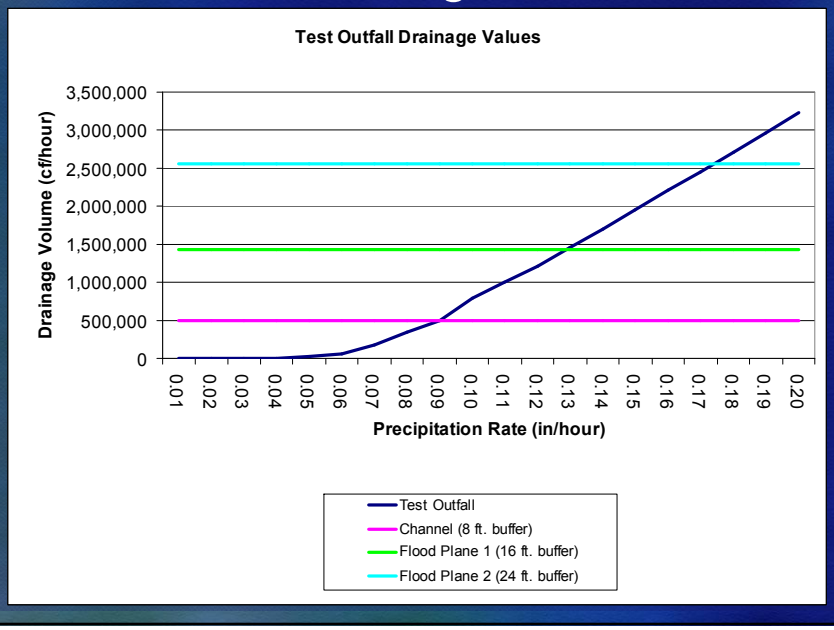
Comparative Discharge Volumes



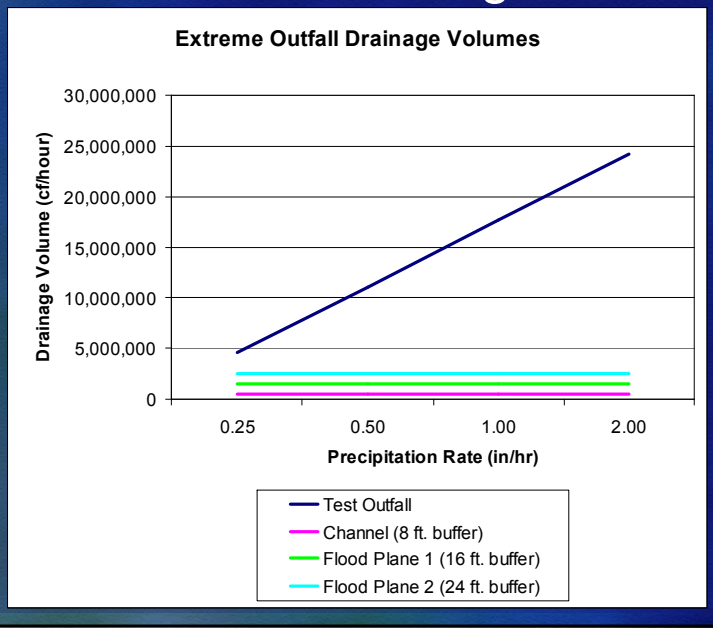
Results

At What Precipitation Rate does Flooding Occur?

Test Outfall Drainage Values



Extreme Outfall Drainage Volumes



Conclusions

Limitations

- Does not take into consideration Groundwater Hydrology
- Precipitation Values are Manually Entered
- Stream Delineation was not measured On Site
- Requires Field Data for Calibration and Accuracy Assessment
- Does not measure Previous Conditions
- Bug in ArcHydro

Questions

Master background slide