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3.16.17

2017 SWAC Meeting #2: Stormwater Detention

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Agenda

- Hydrology
- 2013 Stormwater Ordinance
- Other Municipalities
- WSMP: 25-year Detention Analysis
- Notice to Development Community
- Discussion

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Hydrology: The Basics

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Unit Hydrograph

- *River discharge* is the volume of water flowing through a river channel. This is the total volume of water flowing through a channel at any given point and is measured in cubic feet per second (cfs).
- *Storm hydrographs* can be used to illustrate discharge. They cover a relatively short time period, usually hours or days rather than weeks or months. Storm hydrographs allow us to investigate the relationship between a rainfall event and discharge.

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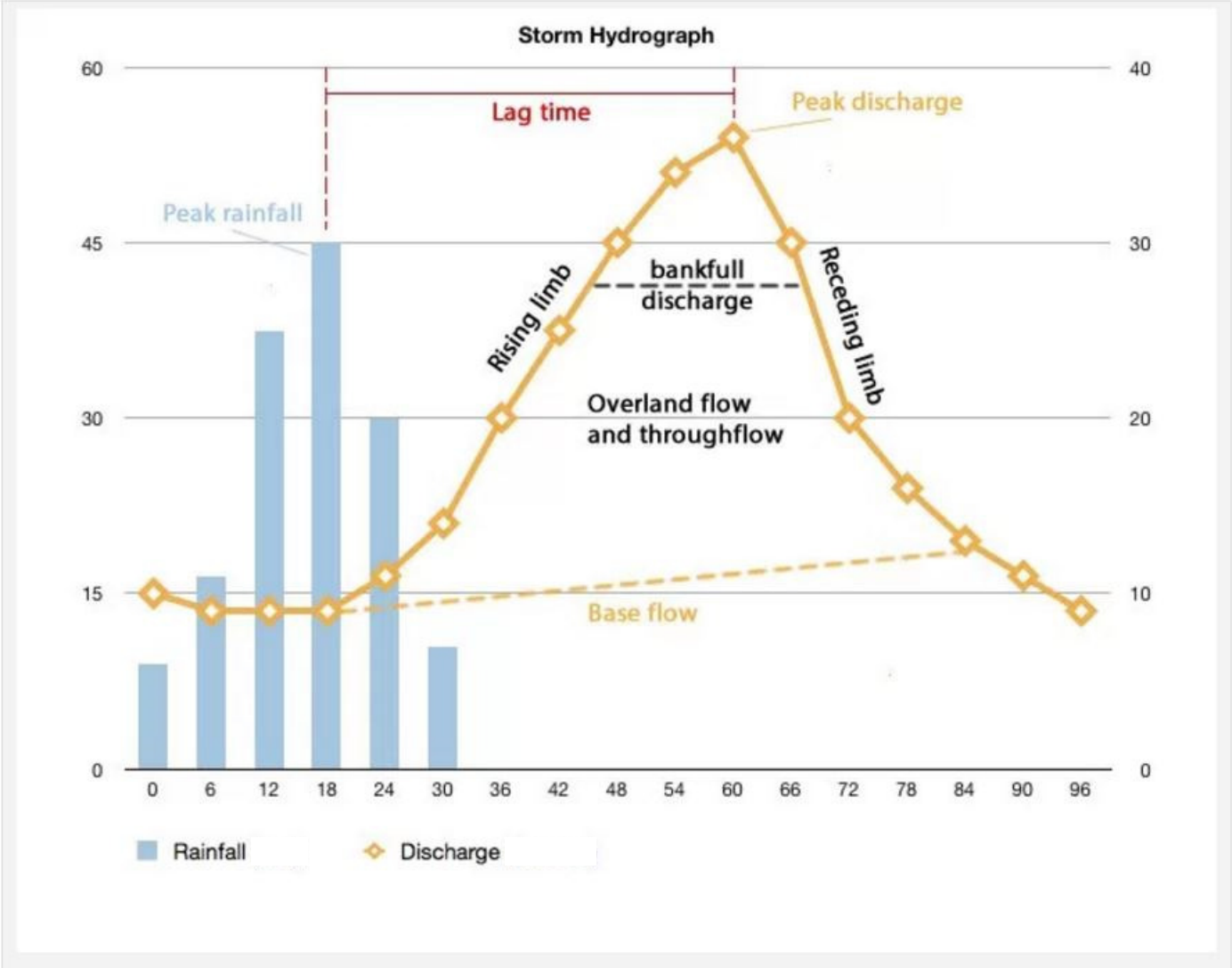
Hydrograph



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Factors That Impact Run-off

- Size of drainage basin
- Topography (slope)
- Land Use
- Soil Type

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Factors That Impact Run-off

- Rainfall intensity
- Rainfall amount
- Rainfall duration
- Distribution of rainfall over the watershed

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Storm Events

- 2-year, 24 hr (50% chance/year, 3.8” rainfall)
- 5-year, 24 hr (20% chance/year, 4.9” rainfall)
- 10-year, 24 hr (10% chance/year, 5.8” rainfall)
- 25-year, 24 hr (4% chance/year, 7.2” rainfall)
- 50-year, 24 hr (2% chance/year, 8.5” rainfall)
- 100-year, 24 hr (1% chance/year, 9.8” rainfall)

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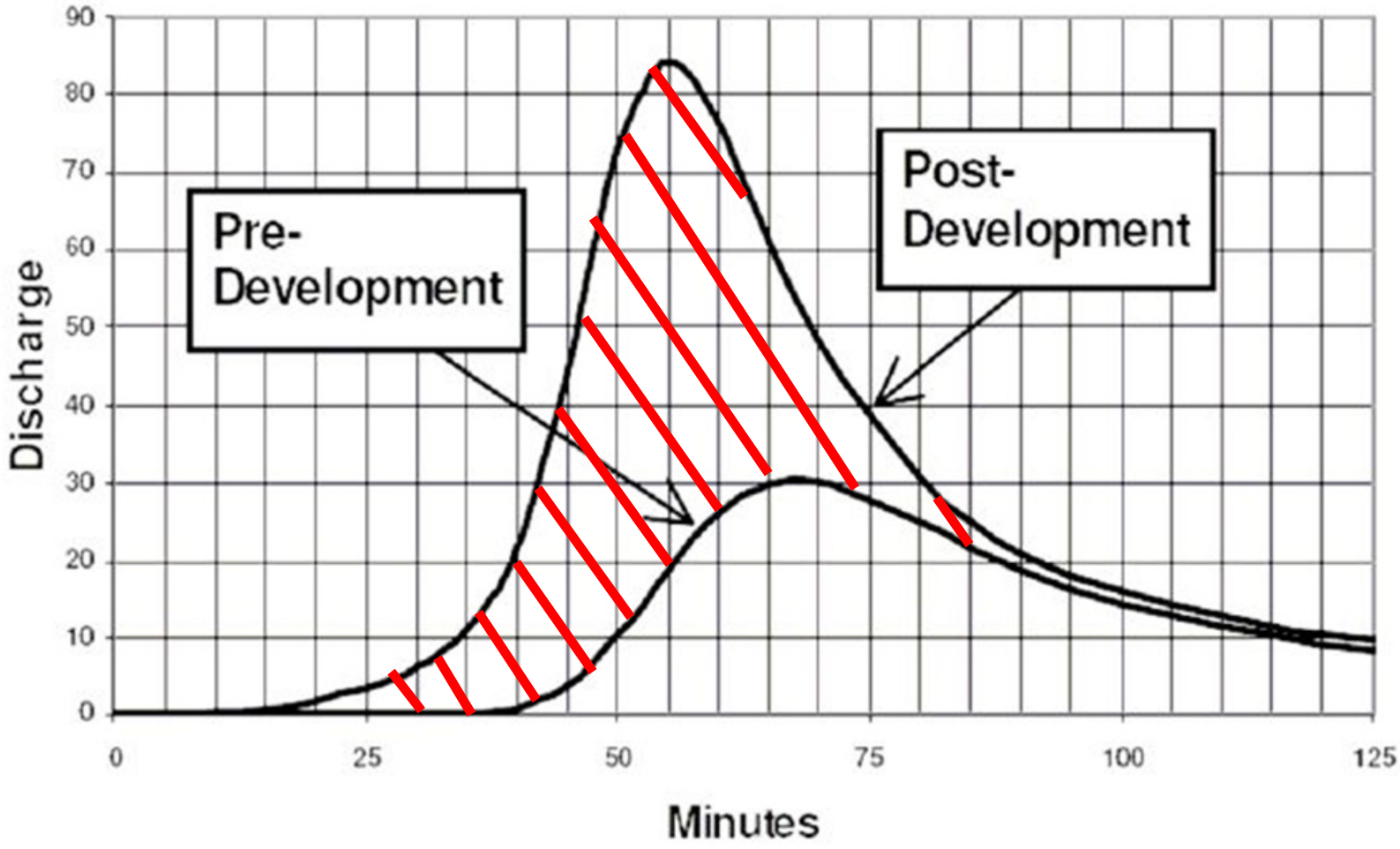
Hydrograph



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Detention

- Benefits:
  - Reduced peak (mimics pre-development),
  - Reduced water surface elevation (flooding), and
  - Reduces erosive velocities.
- Challenges can include:
  - Offsetting the peak enough so that it doesn't contribute to the peak of the stream, and
  - Minimizing extended exposure of already unstable stream banks to water can expedite erosion.

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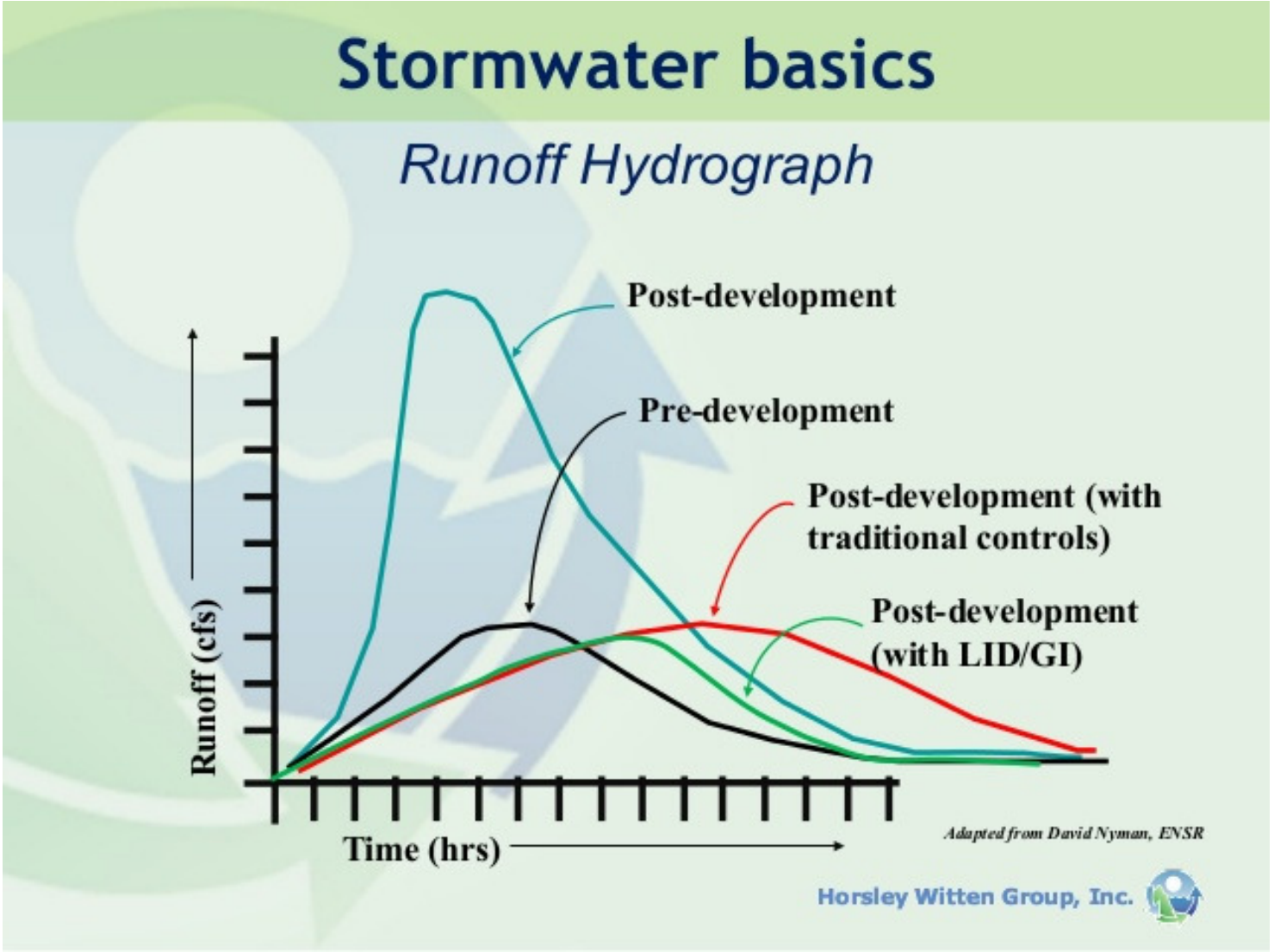
Hydrograph (Detention)



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2013 Stormwater Management Ordinance

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Quality Requirements
(Mandated by Tar-Pam Rules)

- New Development
  - Total N export ≤ 4.0 lbs/ac/yr
  - Total P export ≤ 0.4 lbs/ac/yr
- Re-development
  - Total N export ≤ 70% pre-development export
  - Total P export ≤ pre-development export
- May be met by BMPs controls and/or mitigation payments

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Quantity Requirements

- At a minimum, no net increase in peak flow leaving the site from pre-development conditions for the 1-year, 5-year and 10-year, 24-hour storm events.
- In areas at special risk with well documented water quantity problems as determined by the City Engineer, no net increase in peak flow leaving the site from pre-development conditions for the 25-year, 24-hour storm event.

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Applies to…

- New or Re-development that
  - Disturbs >0.5 acres (non-single family res.)
  - Disturbs >1 acre (single family res.)
  - Increases net impervious area
- Quality requirements do not apply within the designated Redevelopment Area

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Exemptions

- The increase in peak flow between pre- and post-development conditions does not exceed 10% (note that this exemption makes it easier to conduct redevelopment activities); or
- The development occurs in a part of a drainage basin where stormwater detention can aggravate local flooding problems as determined by the city.

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Vesting

- Sites that are final platted as part of an approved development plan before September 10, 2004 which drain directly (contiguously) to a mapped floodway.
- Final platted lots within valid previously approved preliminary plans which address stormwater requirements and are demonstrated upon the plat.

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Detention Requirements for Other Municipalities

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Raleigh

- Subject to:
  - Neuse Nutrient Sensitive Waters (NSW),
  - Falls Lake NSW,
  - Water Supply Watershed,
  - NPDES Phase 1
- Requirement:
  - No net increase in 2yr/24hr storm.

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Durham

- Subject to:
  - Neuse NSW,
  - Falls Lake NSW,
  - Water Supply Watershed,
  - NPDES Phase 1
- Requirement:
  - No net increase in 1yr/24hr storm.
  - Downstream analysis required. May require controls for 2, 5, 10, 25, & even 100yr/24hr storms

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Fayetteville

- Subject to:
  - Water Supply Watershed,
  - NPDES Phase 1
- Requirement:
  - No net increase in 1 & 10yr/24hr storms.
  - May require controls 25yr/24hr storms

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Wilmington

- Subject to:
  - Coastal Area Management Act (CAMA),
  - NPDES Phase 2
- Requirement:
  - No net increase in 1, 2, 10, & 25yr/24hr storms for all densities of new and re-development.

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Jacksonville

- Subject to:
  - CAMA,
  - NPDES Phase 2
- Requirement:
  - No net increase in 10yr/24hrs storm for high density development.

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Rocky Mount

- Subject to:
  - Tar-Pam NSW,
  - NPDES Phase 2
  - Water Supply Watershed
- Requirement:
  - No net increase in 1, 10, & 25yr/24hr storms

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Wilson

- Subject to:
  - Neuse NSW,
  - NPDES Phase 2
  - Water Supply Watershed
- Requirement:
  - 20% reduction in 1, & 2yr/24hr storms.
  - 10% reduction in 10, & 25yr/24hr storms.

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Summary Table

Peak Flow Regulation (X yr/24hr storm)							
Rank	Municipality	Regulations	1	2	5	10	25
2	Raleigh	Neuse, Falls, Water Supply, Phase 1		No Increase			
5	Durham	Neuse, Falls, Water Supply, Phase 1	No Increase	May require address impact	May require address impact	May require address impact	May require address impact
6	Fayetteville	Water Supply, Phase I	No Increase			No Increase	May require
8	Wilmington	Phase 2, CAMA	No Increase	No Increase		No Increase	No Increase
10	Greenville	Tar-Pam, Water Supply, Phase 2	No Increase		No Increase	No Increase	May require
14	Jacksonville	Phase 2, CAMA				No Increase	
15	Rocky Mount	TarPam, Phase 2, Water Supply	No Increase			No Increase	No Increase
18	Wilson	Neuse, Water Supply	20% reduction	20% reduction		10% reduction	10% reduction

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WSMP: 25-year Detention Recommendations

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Recommendations – 25-yr Detention

1. Well documented water quantity problems. Defined as:
    a. validated historical structural flooding, or
    b. model results indicate structural or roadway flooding.

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Recommendations – 25-yr Detention

2. 25-year detention considered if;

    a. areas upstream of documented water quantity problems increase future flows by more than 10%,

    b. proposed capital projects are not feasible or cost effective for providing the required level of service based on future land use conditions, or

    c. cost differential between designing for existing and future conditions is significant and/or a significant number of structures become floodprone during the 25-year design storm under future conditions.

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Greens Mill Run

- Water quantity problems:
  - City employees validated historical structural flooding
  - Model results indicate structural or roadway flooding under existing conditions for 14 out of 33 crossings
  - 3 of the 14 exhibit such severe LOS violations that no feasible solutions exist

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Greens Mill Run

- 25-year detention considered because:
  - Future flows are increased by greater than 10% over existing flows
  - For all crossings along GMR which exhibit level of service violations, either a reduced LOS is proposed or there is no feasible solution
  - Future condition flows for the 25-year event result in 142 additional structures being classified as "floodprone"

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Greens Mill Run

The estimated cost savings in capital projects, should the 25-year requirement be implemented, is approximately $3,430,000.

The following projects would not be needed:

- Hooker Road on GMR
- Dalebrook Circle on Fornes Run, and
- Williams Road on the Unnamed Tributary to GMR

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Meetinghouse Branch

- Water quantity problems:
  - Citizens validated historical structural flooding
  - Model results indicate structural or roadway flooding under existing conditions for 7 out of 13 crossings
- 25-year detention considered because:
  - 39 structures are floodprone during the 25-year storm under existing conditions, future conditions will increase this number

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Fork Swamp

- Water quantity problems:
  - Citizens validated historical flooding
  - Model results indicate structural or roadway flooding under existing conditions for 13 out of 16 crossings
- 25-year detention considered because:
  - Future flows are increased by greater than 10% over existing flows
  - Cost differential between designing for existing and future conditions is significant

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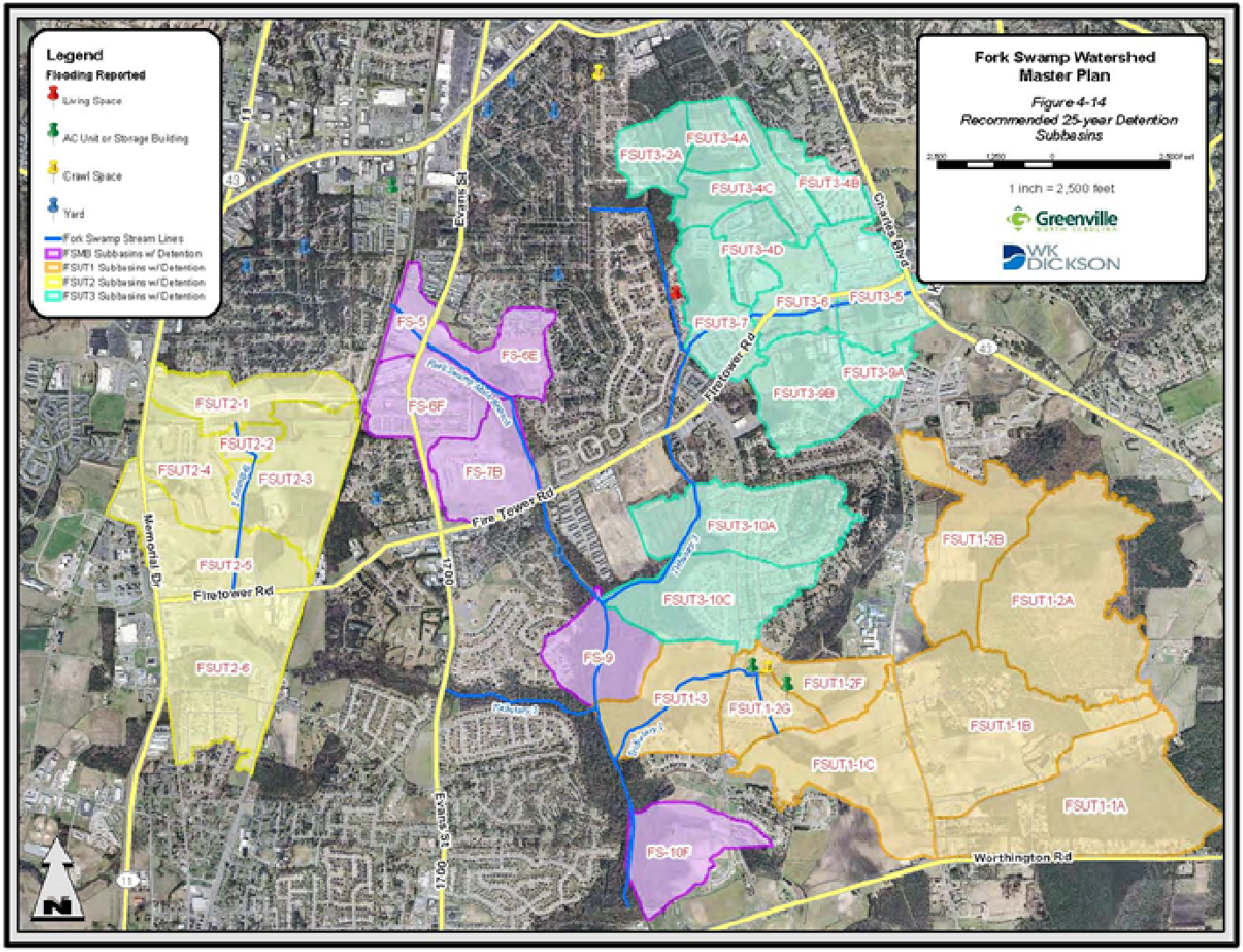

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Fork Swamp

The City could significantly reduce the size of the Corey Road Regional Detention Area to effectively ensure no net increase in the 25-year peak flow.

The size of the detention area could be reduced saving approximately $5,000,000.

Swift Creek

- Water quantity problems:
  - City employees validated historical flooding
  - Model results indicate structural or roadway flooding under existing conditions for 6 out of 6 crossings

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Swift Creek

- 25-year detention considered because:
  - Future flows are increased by greater than 10% over existing flows
  - Cost differential between designing for existing and future conditions is significant
  - Future condition flows for the 25-year event result in a number of structures being classified as “floodprone”

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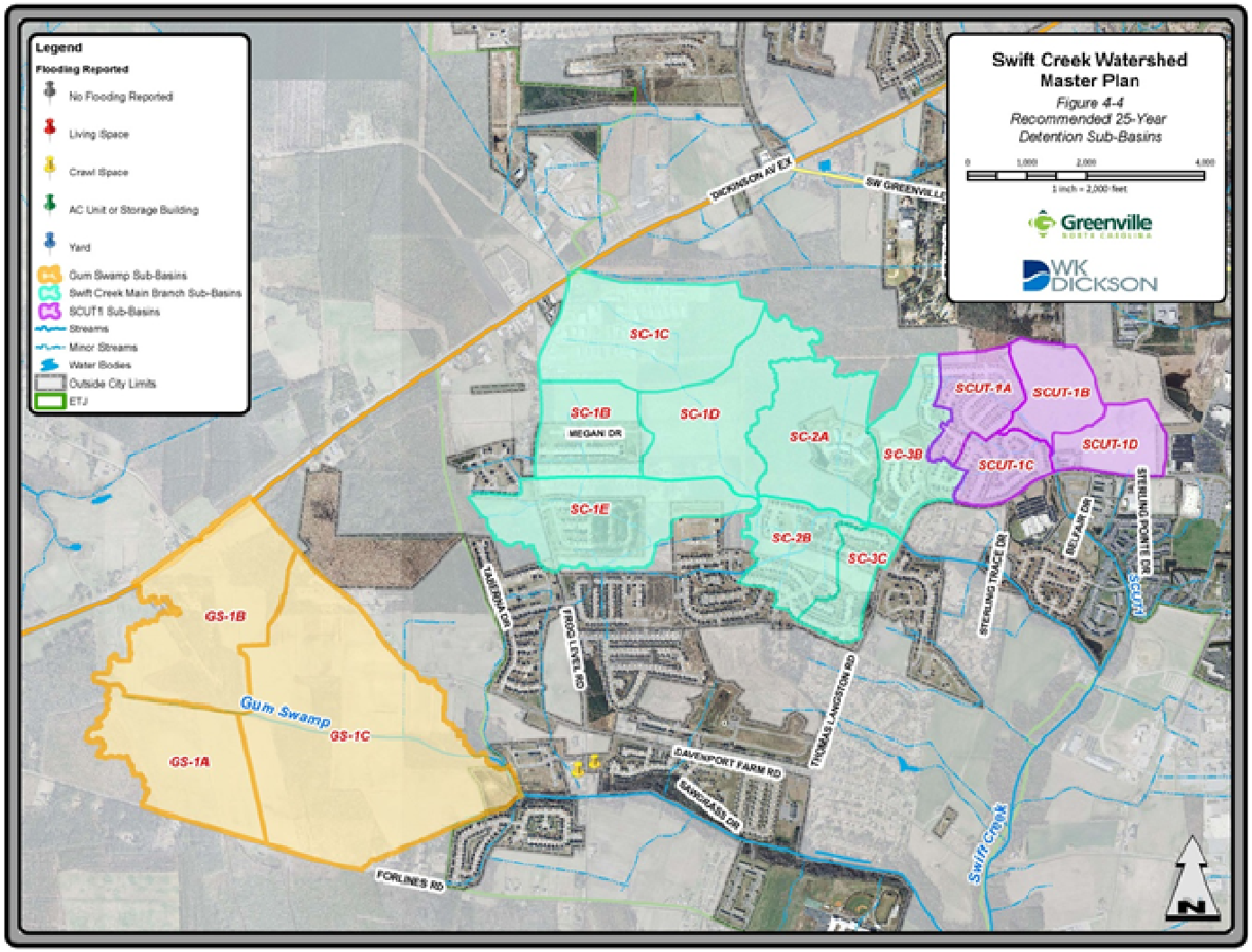

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Swift Creek

The Megan Drive detention pond would be eliminated and estimated savings for the City would be approximately $930,000.

Pitt County Community College Regional Detention Area could be significantly reduced to twenty acres which would result in a cost savings of approximately $6,850,000.

Total $7,780,000

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Additional Benefit

While 25-year detention will not eliminate the need for culvert improvements in many areas, the size of the culverts could be reduced in some cases which offers some cost savings but is particularly valuable given the tight constraints in a lot of locations.

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Hardee Creek

- Portertown Road and East 10th Street do not meet the required LOS based on model results.
  - Based on interviews with City employees and residents they were not considered well documented water quantity problems as a history of overtopping at these crossings has not been observed.
- Future 25-year flows within the primary streams are a maximum of 8% higher than existing flows.

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Parkers Creek / Johnsons Mill Run

- N. Greene Street, Memorial Road and Staton Road do not meet the required LOS based on model results.
  - Based on interviews with City employees and residents they were not considered well documented water quantity problems as a history of overtopping at these crossings has not been observed.

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Parkers Creek / Johnsons Mill Run

- Future 25-year flows within the primary streams are a maximum of 17% higher than existing flows.
  - Since the above culvert improvements are required to provide a 50-year level of service, it is assumed that 25-year detention upstream would not result in substantial cost savings.

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Harris Mill Run / Schoolhouse Branch

- W. 5th Street does not meet the required LOS based on model results.
  - Based on interviews with City employees and residents they were not considered well documented water quantity problems as a history of overtopping at these crossings has not been observed.

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Harris Mill Run / Schoolhouse Branch

- Future 25-year flows within the primary streams are a maximum of 17% higher than existing flows.
  - Since the above culvert improvement is required to provide a 50-year level of service, it is assumed that 25-year detention upstream would not result in substantial cost savings.

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Notice to Development Community

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Requirements

- At a minimum, no net increase in peak flow leaving the site from pre-development conditions for the one-year, five-year and ten-year, 24-hour storm events.
- In areas at special risk with well documented water quantity problems as determined by the City Engineer, no net increase in peak flow leaving the site from pre-development conditions for the 25-year, 24-hour storm event.

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How they apply…

- Special risk areas subject to detaining the 25-year, 24-hour storm event are identified as:
  - Entire Greens Mill Run Watershed (source to Tar River)
  - Entire Meetinghouse Branch Watershed (source to Tar River)
  - Fork Swamp Watershed (Highlighted areas shown on Figure 4-14 of the master plan)
  - Swift Creek Watershed (Highlighted areas shown on Figure 4-4 of the master plan)

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How they apply…

- Effective for all plans submitted after the date of this memorandum (2/21/2017)
- Both new development and redevelopment activities, as described in § 9-9-3

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Exemptions (Existing)

- The increase in peak flow between pre- and post-development conditions does not exceed 10% (note that this exemption makes it easier to conduct redevelopment activities); or
- The development occurs in a part of a drainage basin where stormwater detention can aggravate local flooding problems as determined by the city.

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Exemptions
(Clarification)

- Stormwater detention from a site that may cause a slight rise in peak flows for the overall watershed or drainage basin does not constitute, in and of itself, an aggravation of local flooding problems.

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Discussion