

**ATTENDEES:** SWMAC: Paige Maz, Regina Majercak, Charles Boschen, Paul Burgmayer, Joe Schanne, Tim Sass, Heather Gill  
CH2M: Daniel Wible and Courtney Finneran

**PREPARED BY:** CH2M

**MEETING DATE:** June 9, 2016

**SUBJECT:** June 2016 meeting

**YouTube link:**

[https://www.youtube.com/watch?v=a9A2l\\_hMzkg&list=PLWSgQZEOK8cWuk\\_of0zq2i9J-kzoKsYZx&index=14](https://www.youtube.com/watch?v=a9A2l_hMzkg&list=PLWSgQZEOK8cWuk_of0zq2i9J-kzoKsYZx&index=14)

**Review of Previous Meeting Minutes**

- MAY 12, 2016 SWMAC meeting minutes – approved with inclusion of minor comments emailed by Joe on 6/8/16

**Public Comment**

- No public comment

**Update on Banbury/Francis Stormwater Project Status and Discussion of SWMAC’s Project Role**

- Daniel noted that the selection of T&M as the design engineer for this project is on the 6/13/16 Board of Commissioners (BOC) meeting agenda (*Note: the selection of T&M was formally approved by the BOC at that meeting*)
- Paige noted that per T&M’s scope of work, they will be providing several design updates to the SWMAC at regular SWMAC meetings
- Joe asked how soon until there is an updated construction cost estimate for this project; Daniel thought that would take another 2-3 months

**Township Wide Assessment (TWA) Update**

- Daniel provided an update on the progress of Task 1 – Identification of Flood Risk Locations in Radnor Township
  - Daniel quickly reviewed the first 10 slides of his presentation, which were repeats from the May 2016 SWMAC meeting
  - Daniel noted that the identification of high risk problem areas was based on both parcel-based flooding and right-of-way-based flooding
  - Several new slides showed zoomed-in views of the right-of-way-based flooding predicted by the model
  - Daniel noted that once the storm sewers are added to the model, the results will be more refined and may show less (or even more) localized flooding
  - The analysis now covers every problem location that was both previously documented and “validated” by the model; the number of problem area drainage areas roughly doubled from the previous month
  - For each problem area drainage area, the following metrics were analyzed (for the 25-year, 1-hour storm): flood volume, flooding extent, % of problem area flooded, and % of flood volume in right-of-way (ROW)
  - Daniel noted that the following areas would be further investigated in the subsequent phases of the TWA: A, B, G, I, J, K, T, U

- Heather noted that the areas selected for further investigation were not surprising; flooding concerns in those areas have been discussed extensively at previous SWMAC meetings
- General SWMAC consensus that any problem area identified by this analysis but not prioritized for further analysis should be adjudicated (i.e. identify potential future solutions or at least determine need for additional information about the specific problems); in addition, each problem area could also be matched with a flood mitigation “typology” that will be developed as part of Task 4 of the TWA
- Regina stated her discomfort with using the 25-year storm as the basis for the analysis, noting that roadway drainage is typically designed for the 10-year storm
  - Daniel noted that once the model is further refined, different storms can be analyzed in order to determine the specific thresholds for flooding at different locations
  - There is not much difference in the model-predicted flooding extents between the 10-year and 25-year storm events; however, using the 25-year storm makes the flooding extents slightly more apparent and this approach is consistent with the previously completed Ithan Creek analysis
- Regina asked whether the TWA would include all existing stormwater systems in each study area; Daniel noted that the analysis would include most if not all of the significant pipes in each study area, such that potential upstream flood mitigation projects could be hydraulically modeled and downstream flood reduction benefits determined
  - Courtney discussed her historic plan research effort for the N. Wayne study area; based on her findings of this “pilot” area, CH2M is recommending that field mapping of storm sewers, manholes, inlets, and outfalls be conducted to supplement the historic plans
  - The results of the field mapping would be provided in GIS format and would include all public storm sewers in the N. Wayne study area (even small diameter sewers)
  - Daniel stated that while there is still uncertainty related to the data gathering needs in the other proposed study areas outside of N. Wayne, CH2M will be working closely with the survey firm (Dawood) to develop a field mapping scope that fits the project budget; Daniel also stated that storm sewer mapping has benefits beyond the TWA, including asset management and MS4 reporting
  - Daniel noted that the budget for Task 2 of the TWA is around \$44k, while the field mapping fee for just the N. Wayne study area is \$8k; General SWMAC consensus is that only meaningful storm sewers should be mapped/surveyed
- Paul offered to develop a first draft of a flooding questionnaire for residents
- With respect to schedule, Daniel noted that the goal is to complete the data collection task for the various study areas by early August; results for the N. Wayne portion will likely be presented at the September SWMAC meeting (with an interim presentation of the existing conditions model at the August SWMAC meeting)
- Courtney presented several slides on project prioritization, including examples from other communities
  - Courtney noted that a prioritization workshop could take place in order to solicit public input on both selection criteria and their relative weights; Regina warned against prioritizing actual potential projects prematurely (i.e. without gathering public input on them first)
  - Initial prioritization could include project categories or typologies
  - The end goal of the prioritization process is a ranked list of potential projects
  - First step is to develop criteria; criteria must be measurable (e.g. yes/no, high/med/low, etc.)
  - Second step is to assign relative weights to criteria

- Estimated construction cost ranges could be used for potential projects prior to actual construction cost estimates being developed
- Once potential projects are developed and modeled, they will be entered into the prioritization tool and ranked
- CH2M will provide the SWMAC with a list of potential prioritization criteria prior to the July SWMAC meeting
- Regina noted that there could be different “tiers” of prioritization criteria (e.g. cost and public safety could be in a higher “tier” than public amenity)

### **Review of Stormwater Tracking Table**

- Paige noted that by early fall, updates to the stormwater budget should be completed; however, it is also understood that the TWA will likely still be in progress at that time and cost “placeholders” will be assigned
- Daniel noted that Steve was working on a repair project prioritization plan for distribution prior to the July SWMAC meeting
- Courtney presented several slides on the new PADEP MS4 permit requirements
  - CH2M recently helped the Township to complete and submit the annual MS4 report to PADEP
  - Every stream in the Township is considered impaired; all municipalities in PA that discharge stormwater into impaired stream are required to have a NPDES permit
  - On 6/3/16, the new permit requirements were released; one of the new requirements is for the development of a Pollutant Reduction Plan (PRP) and Pollution Control Measures (PCMs) to reduce pollutant loading for the causes of impairment
  - The PRP must show that the Township can achieve reductions within five years of permit approval; must include implementation schedule; requires public input and participation
  - There is overlap between the TWA and some of the new permit requirements (e.g. mapping of stormwater features)
  - CH2M is working on a proposal and schedule for MS4 permit reporting / implementation and will provide an update on progress at the July SWMAC meeting
  - Regina suggested focusing efforts on the requirements that are more defined and treading lightly for those that are still be worked out; Regina also noted that, since many municipalities will be facing similar challenges with respect to the required reporting and implementation, tools may emerge to help streamline these efforts and that it might be in the Township’s best interest to wait and see what others come up with

### **Old/New Business**

- 31 Highview Drive outfall: CH2M submitted a proposal for surveying, geotechnical, and design services (*Note: at the 6/27/16 BOC meeting, the BOC rejected the proposal on the grounds that CH2M, as the Township’s Stormwater Program Administrator, was not hired for design services*)
- Mill Dam – the Township Solicitor (John Rice) is reviewing the legal question about the responsible party for the repairs
- Radnor Middle School connector pipe – Gannett Fleming continues to coordinate with the potentially impacted utilities on S. Wayne Ave
- Daniel also provided updates on various other stormwater projects in the Township (see attached June 2016 Stormwater Tracking Table for detailed information)

**Next SWMAC meeting: 7/14/16 (Radnorshire room)**

### Action Items

- **CH2M** to provide a summary of the identified problem areas that were not prioritized for further analysis; this will include the documented source of the problem and a brief description
- **CH2M** to provide SWMAC with list of potential prioritization criteria (*completed on 6/15/16*)
- **Steve** to provide prioritized list of repair projects prior to July SWMAC meeting (*completed on 7/8/16*)



Project Description	Status	SWMAC approval	Type	Priority	Watershed	Consultant	Planning Cost	Estimated Expenditure FY 2016	YTD Expenditure FY 2016	June 2016 Update
<b>Earles Lane Culvert:</b> Gannett Fleming evaluation completed 2/4/16 including conceptual cost	Report completed	No	Repair/Maintenance	HIGH	Darby Creek		\$ 207,900			Steve Norcini to provide a 5-year prioritization plan by 6/30/16
<b>Eagle Road Culvert:</b> Gannett Fleming evaluation completed 2/4/16 including conceptual cost	Report completed	No	Repair/Maintenance	HIGH	Gulph Creek		\$ 266,300			Steve Norcini to provide a 5-year prioritization plan by 6/30/16
<b>South Devon Avenue Culvert:</b> Gannett Fleming evaluation completed 2/4/16 including conceptual cost	Report completed	No	Repair/Maintenance	HIGH	Darby Creek		\$ 200,300			Steve Norcini to provide a 5-year prioritization plan by 6/30/16
<b>Maplewood Ave Outfall/Odoriso Park</b>	Problem identified	No	Repair/Maintenance	HIGH	Darby Creek					Steve Norcini to provide a 5-year prioritization plan by 6/30/16
<b>Malin Road Culvert</b>	Report completed	No	Repair/Maintenance	HIGH	Darby Creek		\$400,000			Steve Norcini to provide a 5-year prioritization plan by 6/30/16
<b>Highview Road Outfall</b>	Problem identified	No	Repair/Maintenance	HIGH	Gulph Creek	CH2M	\$45,000			CH2M proposal for surveying, geotechnical analysis, and design is currently under review by the Township
<b>Maplewood Ave/Mill Dam Embankment</b>	Report completed	No	Repair/Maintenance	HIGH	Darby Creek		\$265,000.00			Steve Norcini to provide a 5-year prioritization plan by 6/30/16; on 5/18/16, Steve and Daniel requested from the Township Solicitor a legal opinion regarding who is ultimately responsible for repairing the abandoned pipe that is the apparent cause of road instability; the Township Solicitor is still reviewing this issue
<b>Chamounix Road Culvert:</b> Gannett Fleming evaluation completed 2/4/16 including conceptual cost	Report completed	No	Repair/Maintenance	MED-HIGH	Ithan Creek		\$ 333,500			---
<b>Sawmill Rd storm sewer replacement -replace +/- 250 LF, inlets.</b>	Problem identified	No	Repair/Maintenance	MEDIUM	Darby Creek		\$113,000.00			---
<b>Sawmill Road Culvert:</b> Gannett Fleming evaluation completed 2/4/16 including conceptual cost	Report completed	No	Repair/Maintenance	Medium	Darby Creek		\$ 55,100			---
<b>Septa Train Station -</b> Authorizing Gannett Fleming to provide design services for stormwater management at the N. Wayne Train Station (north side)	Design	No	Capital Improvement		Gulph Creek	Gannett Fleming		\$ 30,000		Gannett Fleming has been communicating with Amtrak to complete the Temporary Permit to Enter Upon Property submission. GF responded to their initial comments on 5/27/2016 and are awaiting their response. In addition, GF continues to work with SEPTA to address their comments regarding our Right-Of-Entry Application. After GF's initial submission, their reviewer asked for additional information. GF is working with the reviewer to compile all the outstanding issues.
<b>Banbury Way Flood Mitigation Project:</b> authorization for CH2M to Prepare a RFP for Professional Design Services, and Subsequent Authorization to Solicit for Proposals	RFP	Yes	Capital Improvement		Ithan Creek	Pending		\$ 607,000		Recommendation that T&M be awarded the design contract expected at the 6/13 BOC meeting
<b>RMS Connector -</b> West Wayne Ave: Authorizing Gannett Fleming, Inc to Provide Design, Permitting, and Bidding Documents for Storm Sewer Construction Running per recommendation of SWMAC	Design	Yes	Capital Improvement		Ithan Creek	Gannett Fleming	\$250,000.00	\$ 250,000	\$1,280.00	Gannett Fleming is currently drafting a memo to the Township regarding the utility conflicts that have been uncovered during their preliminary investigation. To date, GF has determined that there are at least 16 utility crossings between West Wayne Avenue to the RMS system along South Wayne Avenue. As GF continues to work with the affected utility owners, they are finding that many of them do not have sufficient historical records showing the depths and locations of their facilities. Additionally, there are potential existing site constraints that may prevent a pipe alignment to meet the existing SW inlet into the RMS system at minimum slope. They expect to have a draft completed by 6/14/16 that further details the status of the project. 05.27.16 Capital improvements expenditure of \$1,280 to Gannett Fleming.
<b>Township-wide SW Eng. Assessment:</b> Authorization for CH2M RFP & Approval for Professional Services for an Assessment of the Gulph Creek, Meadowbrook Run, and Darby Creek Watersheds	On-going	Yes	Eng & Admin		Various	CH2M	\$258,107.00	\$258,107.00		CH2M updated Task 1 flood mapping and analysis based on May SWMAC meeting comments; also began Task 2 (Data Gap Analysis) using N. Wayne as a "pilot" - this effort revealed that field surveying of storm sewers will likely be more efficiently and useful for the modeling effort, as well as future MS4 reporting requirements; new anticipated end date for the Township Wide Assessment is Oct or Nov 2016
<b>Stormwater Administrator:</b> Authorization to Contract for Program Billing, GIS, and Professional Eng. Services	On-going	Yes	Eng & Admin		Various	CH2M	\$202,400	\$80,840	\$34,893.42	---
<b>MS4 Progress Report -</b> Preparation of MS4 Progress Report for 3/2014 - 3/2016 due to PA DEP 5/13/16	On-going	No	Eng & Admin		Various	CH2M		\$ 5,037	\$110.00	CH2M finalized MS4 report and the Township submitted to DEP on 5/13/16; CH2M developing a proposal to prepare a plan for addressing forthcoming new MS4 permit requirements.05.27.16 Expenditure of \$110 to Gannett Fleming for "MS4 Information"
<b>Homeowner (SFR) Stormwater Facility Rebate Program</b>	On-going	Yes	Rebate/Credits/Grants		Various			\$ 50,525		---
<b>Mill Road Culvert:</b> Gannett Fleming, Inc. to Provide Permitting and Design Services for replacement	Bidding	Yes	Repair/Maintenance		Meadowbrook Run	Gannett Fleming		\$160,000.00	\$6,633.25	Bids for construction are due the week of 6/5/16; recommendation for contractor award anticipated for the 6/27 BOC meeting; construction could start as early as 7/5/16 and be completed by Labor Day. 05.27.16 Capital improvement expenditure of \$893.25 to Gannett Fleming.
<b>Cleaning, Televising, and Mapping</b> of Storm Sewer In Radnor Township	Bidding	Yes	Repair/Maintenance		Various	Pending		\$100,000.00		Township expecting sealed bids in June; Township plans to award contract at one of the July BOC meetings
<b>North Wayne Basin -</b> Inspect/Repair Existing SW System based on Township-wide Study results. Pending BOC approval	Problem identified	Yes	Repair/Maintenance		Gulph Creek			\$185,000.00		---
<b>Stormwater Management Ordinance Update</b>	On-going		Eng & Admin		n/a	Gannett Fleming			\$1,755.00	Gannett Fleming (Roger Phillips) appeared before the EAC to give a presentation on the SWM Ordinance Revisions on 05/26/2016. The next step is to present to the Planning Commission, tentatively at their July meeting. Gannett Fleming is will draft a memo to the SWMAC for their final comment regarding the revisions once comments are received and assembled from the other Boards.
<b>Valley Run Restoration - Villanova University</b>	Problem identified	No	Capital Improvement		Darby Creek					On March 29, 2016, Delaware Riverkeeper Network (DRN) conducted a site visit to the headwaters of Valley Run, which is located within an area of planned renovations by Villanova University. Maya van Rossum submitted a summary of DRN's observations during that site visit, including potential recommendations for tributary restoration during the planned Villanova University construction.
								Estimated	Actual YTD	
								Total Committed Cost	\$ 2,038,665	\$ 347,210
								Stormwater Fee Revenue	\$ 1,010,500	\$ 1,060,866
								Previous Year Balance	\$ 2,267,442	\$ 2,267,442
								Year-End Balance	\$ 1,239,277	\$ 2,981,098

# Radnor Township Watersheds Assessment

Refined Identification of Flood Risk  
Locations in Radnor Township

June 9, 2016

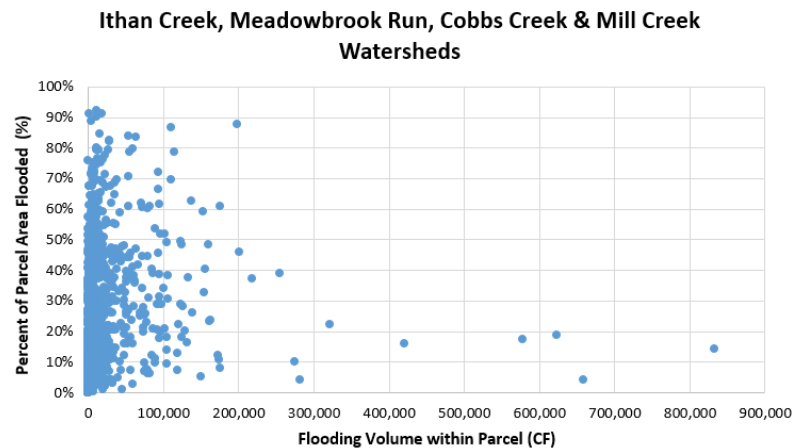
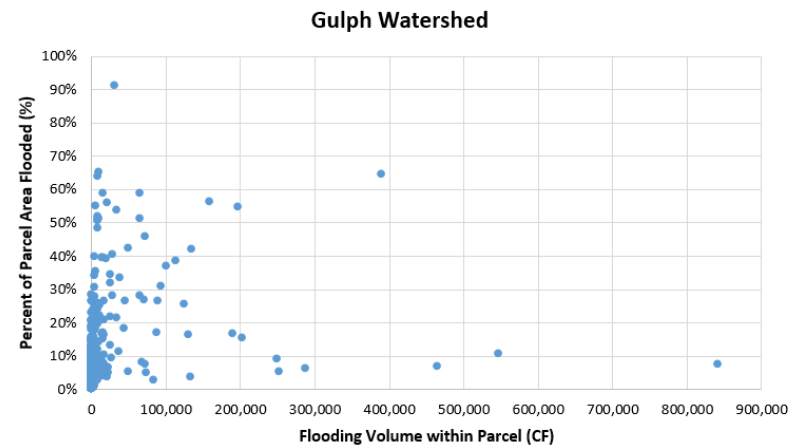
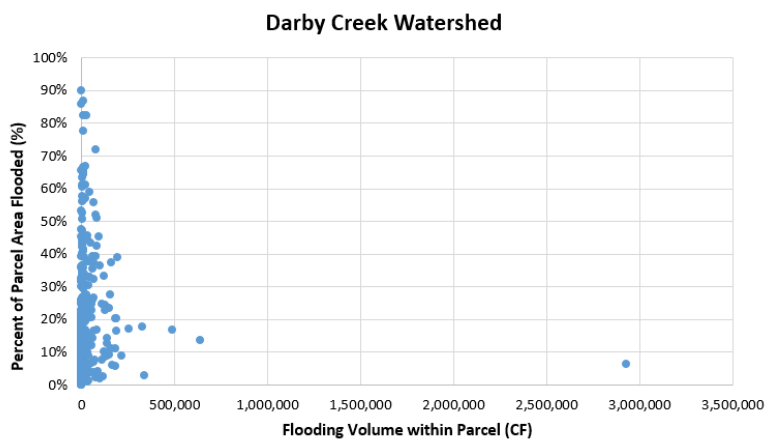


# Identifying Preliminary Problem Areas

- Based on documented flooding locations and refined/expanded Flood Modeller results
- Additional potential flood prone locations identified based on Flood Modeller 25-year, 1-hour event (2.38 inches) results
  - Included all four major watersheds within Radnor Township, as well as small portions of Cobbs Creek and Mill Creek watersheds
  - Included refined boundary conditions at the downstream ends of study areas (based on flood elevations documented in FEMA Flood Insurance Studies for Radnor and Merion Townships)
- Problem areas based on Flood Modeller results were identified by examination of parcel flooding and Right-of-Way (ROW) flooding outside of 100-year FEMA Flood Zones

# Preliminary Problem Areas Identification: Parcel Flooding Analysis

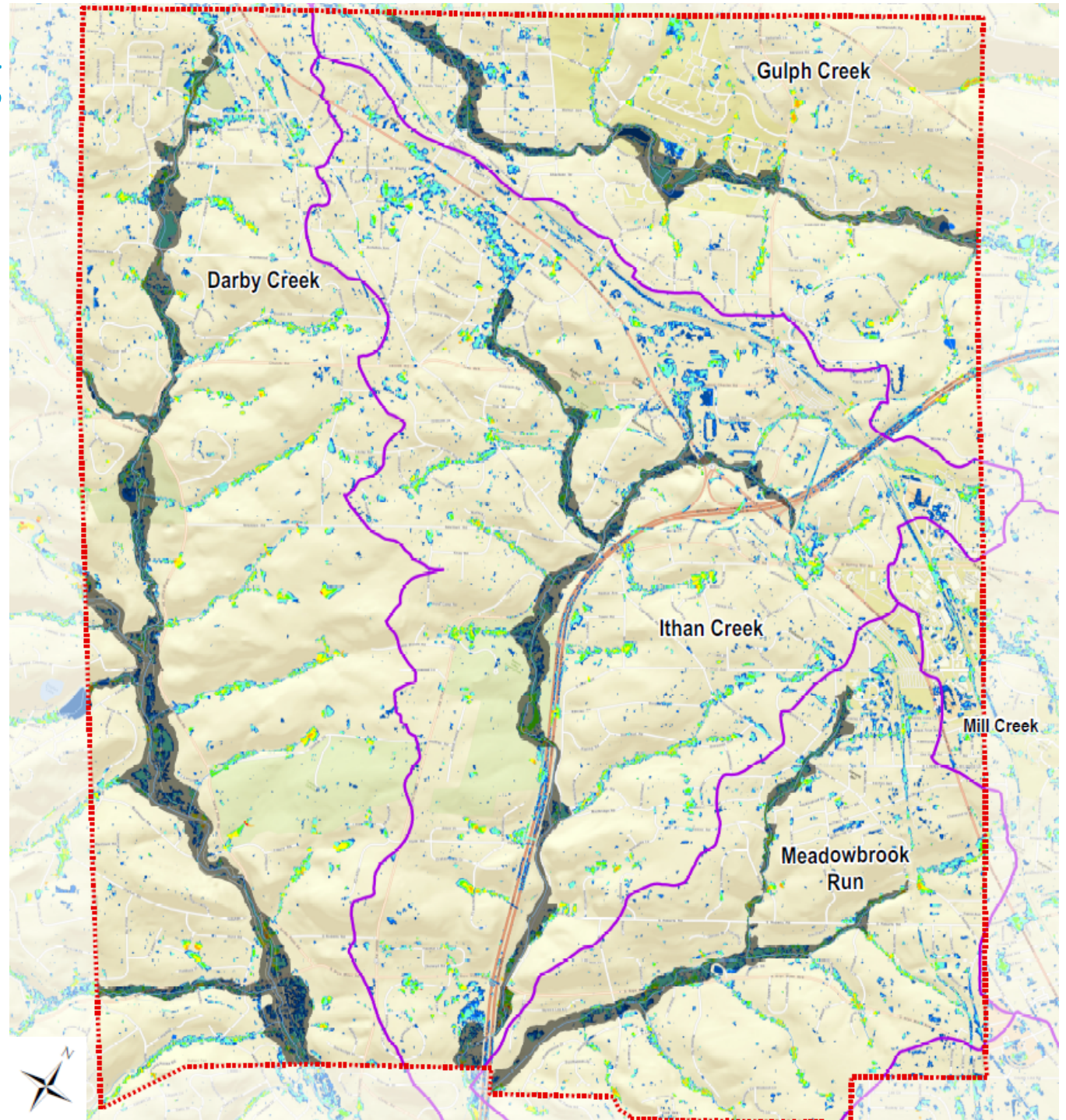
- Identified problem areas based on flooding volume, flooding area and engineering judgement within each parcel
- Looked for areas with high density of parcels with high flooding volume and percent of parcel area flooded



# Parcel Flooding Analysis: 25-year Results

## Legend

- Surface Waterways
  - ▤ Radnor Township Boundary
  - ▭ Radnor Township Watersheds
  - 100-year FEMA Flood Zone
- 25-year, 1-hour Flood Depth Results
- 0.1 - 0.5 ft
  - 0.5 - 1 ft
  - 1 - 3 ft
  - 3 - 5 ft
  - 5 - 10 ft
  - 10 - 25 ft
  - > 25 ft

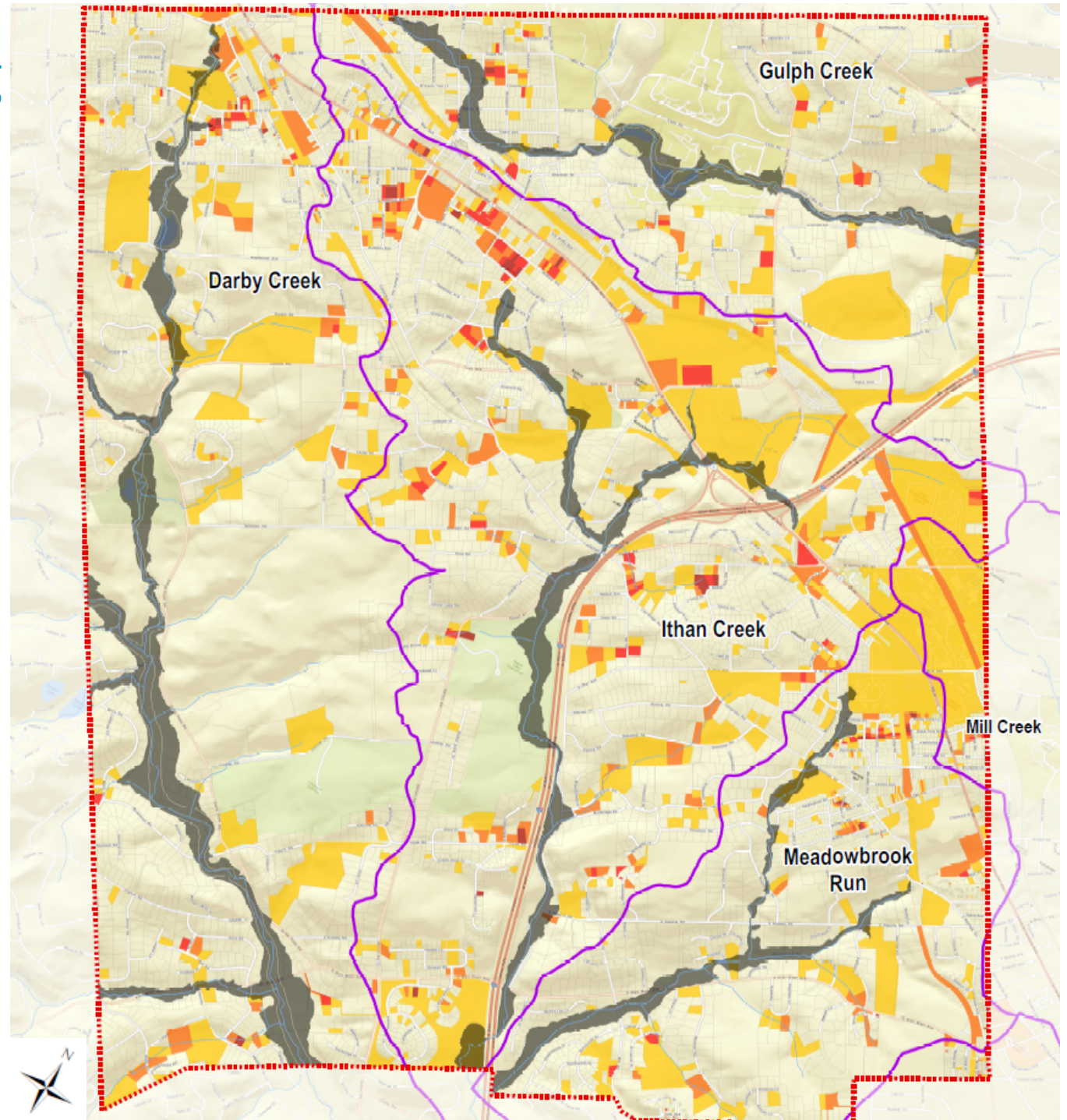




# Parcel Flooding Analysis: 25-year Parcel Flooding

## Legend

- Surface Waterways
  - ▤ Radnor Township Boundary
  - ▭ Radnor Township Watersheds
  - 100-year FEMA Flood Zone
- Radnor Township Parcels
- % of Total Parcel Area Flooded
- 0% - 10%
  - 10% - 30%
  - 30% - 50%
  - 50% - 70%
  - 70% - 100%













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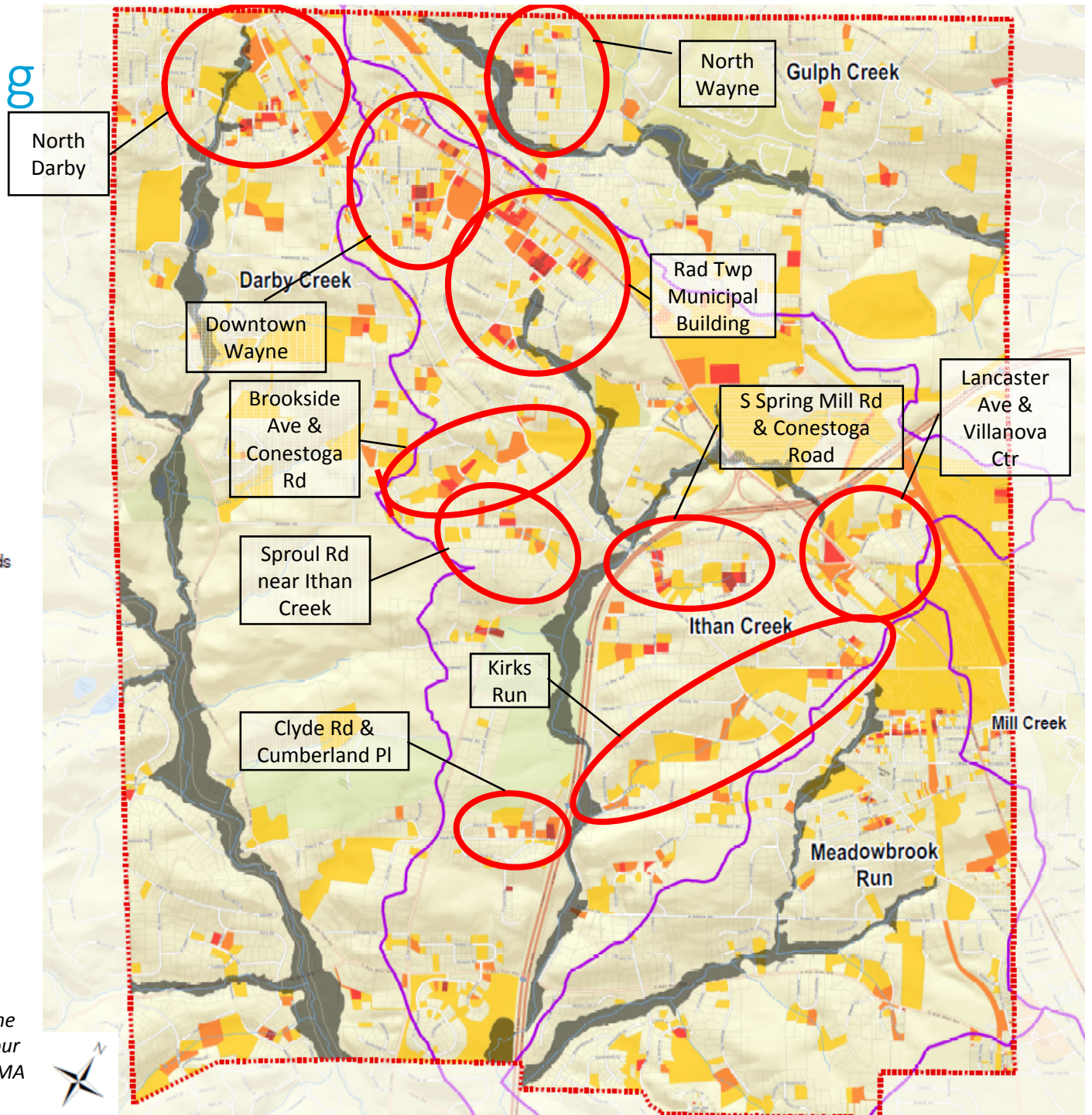
*\*Parcel flooding only considers the flooding during the 25-year, 1-hour event outside of the 100-year FEMA Flood Zones*



# Parcel Flooding Analysis: 25-year Parcel Flooding & Identified Problem Areas

## Legend

-  Surface Waterways
-  Radnor Township Boundary
-  Radnor Township Watersheds
-  100-year FEMA Flood Zone
- Radnor Township Parcels
- % of Total Parcel Area Flooded**
-  0% - 10%
-  10% - 30%
-  30% - 50%
-  50% - 70%
-  70% - 100%
-  Clusters of high density parcel flooding



\*Parcel flooding only considers the flooding during the 25-year, 1-hour event outside of the 100-year FEMA Flood Zones

# Preliminary Problem Areas Identification: ROW Flooding Analysis

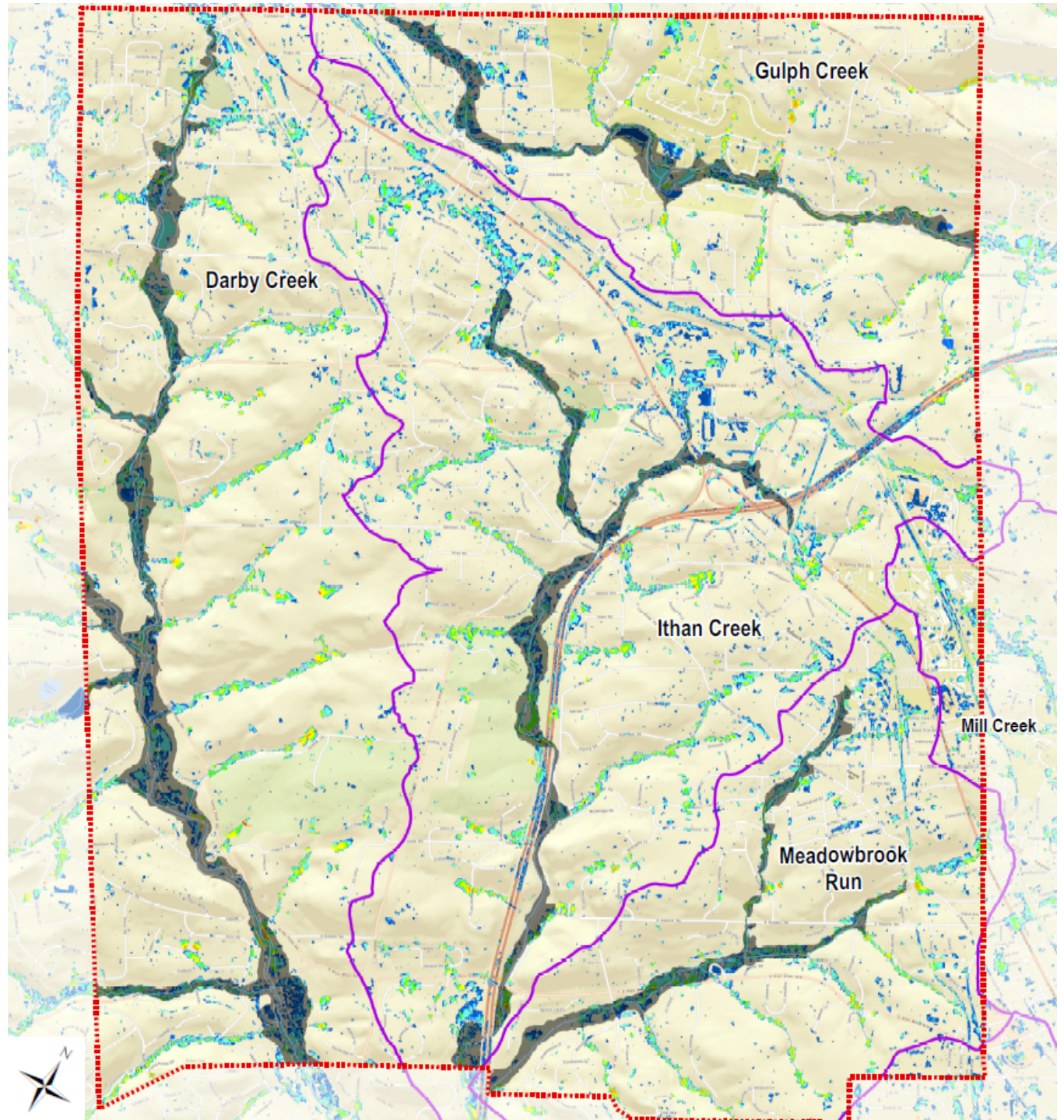
- Identified problem areas based on flooding extent, flood depth and engineering judgement within ROW
- Examined the flood depth grid results only within ROW to locate areas with a high density of ROW flooding



# ROW Flooding Analysis: 25-year Results

## Legend

- Surface Waterways
- Radnor Township Boundary
- Radnor Township Watersheds
- 100-year FEMA Flood Zone
- 25-year, 1-hour Flood Depth Results
  - 0.1 - 0.5 ft
  - 0.5 - 1 ft
  - 1 - 3 ft
  - 3 - 5 ft
  - 5 - 10 ft
  - 10 - 25 ft
  - > 25 ft





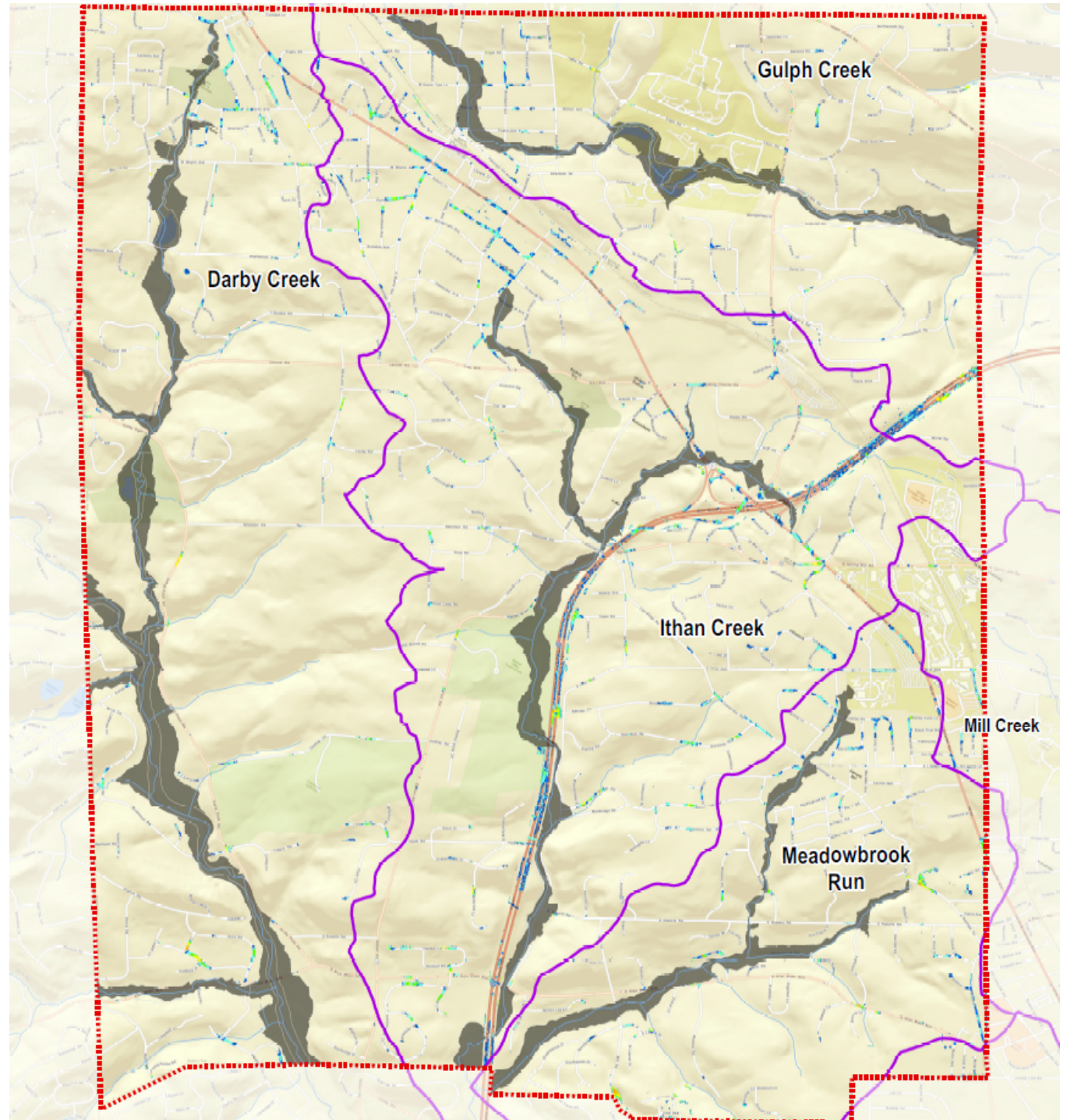
# ROW Flooding Analysis: 25-year ROW Flooding

## Legend

- Surface Waterways
- ▤ Radnor Township Boundary
- ▭ Radnor Township Watersheds
- 100-year FEMA Flood Zone

## 25-year, 1-hour Flood Depth Results

- 0.1 - 0.5 ft
- 0.5 - 1 ft
- 1 - 3 ft
- 3 - 5 ft
- 5 - 10 ft
- 10 - 25 ft
- > 25 ft















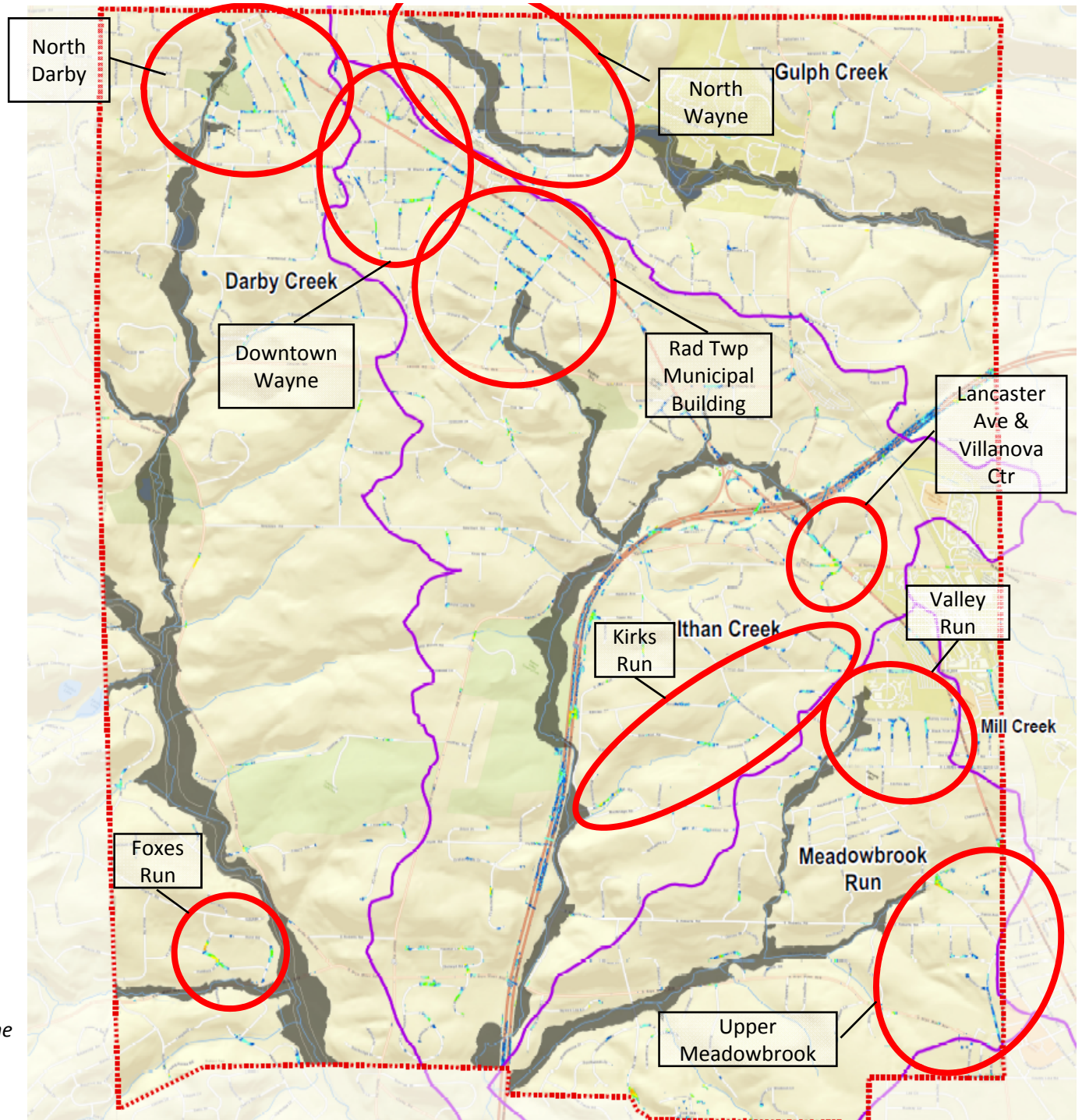


# ROW Flooding Analysis:

## 25-year ROW Flooding & Identified Problem Areas

### Legend

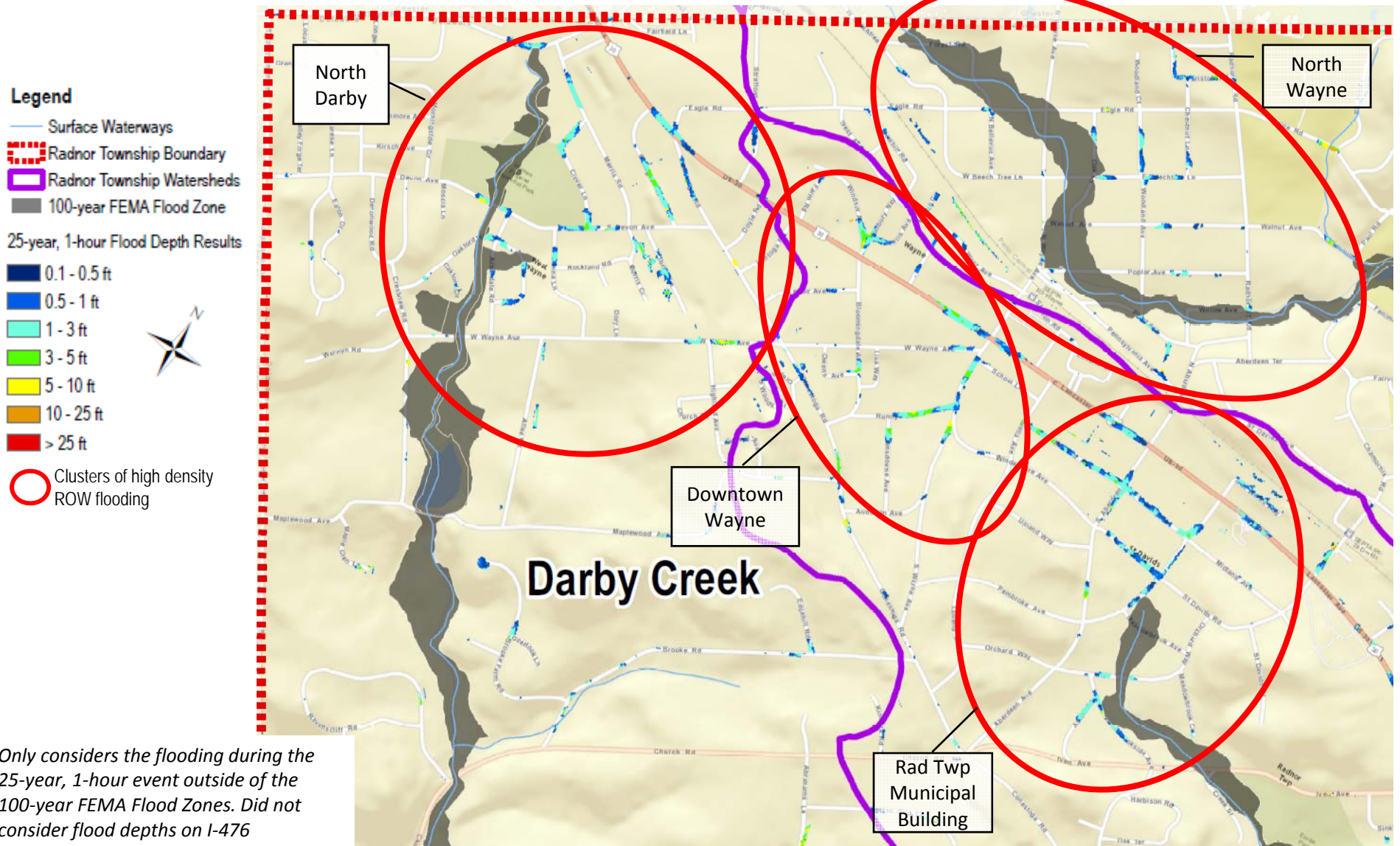
-  Surface Waterways
  -  Radnor Township Boundary
  -  Radnor Township Watersheds
  -  100-year FEMA Flood Zone
- 25-year, 1-hour Flood Depth Results
-  0.1 - 0.5 ft
  -  0.5 - 1 ft
  -  1 - 3 ft
  -  3 - 5 ft
  -  5 - 10 ft
  -  10 - 25 ft
  -  > 25 ft
-  Clusters of high density ROW flooding



10 Only considers the flooding during the 25-year, 1-hour event outside of the 100-year FEMA Flood Zones. Did not consider flood depths on I-476

# ROW Flooding Analysis:

25-year ROW Flooding & Identified Problem Areas ZOOM-INS  
(North Wayne, North Darby Creek and North Ithan Creek)















Only considers the flooding during the 25-year, 1-hour event outside of the 100-year FEMA Flood Zones. Did not consider flood depths on I-476

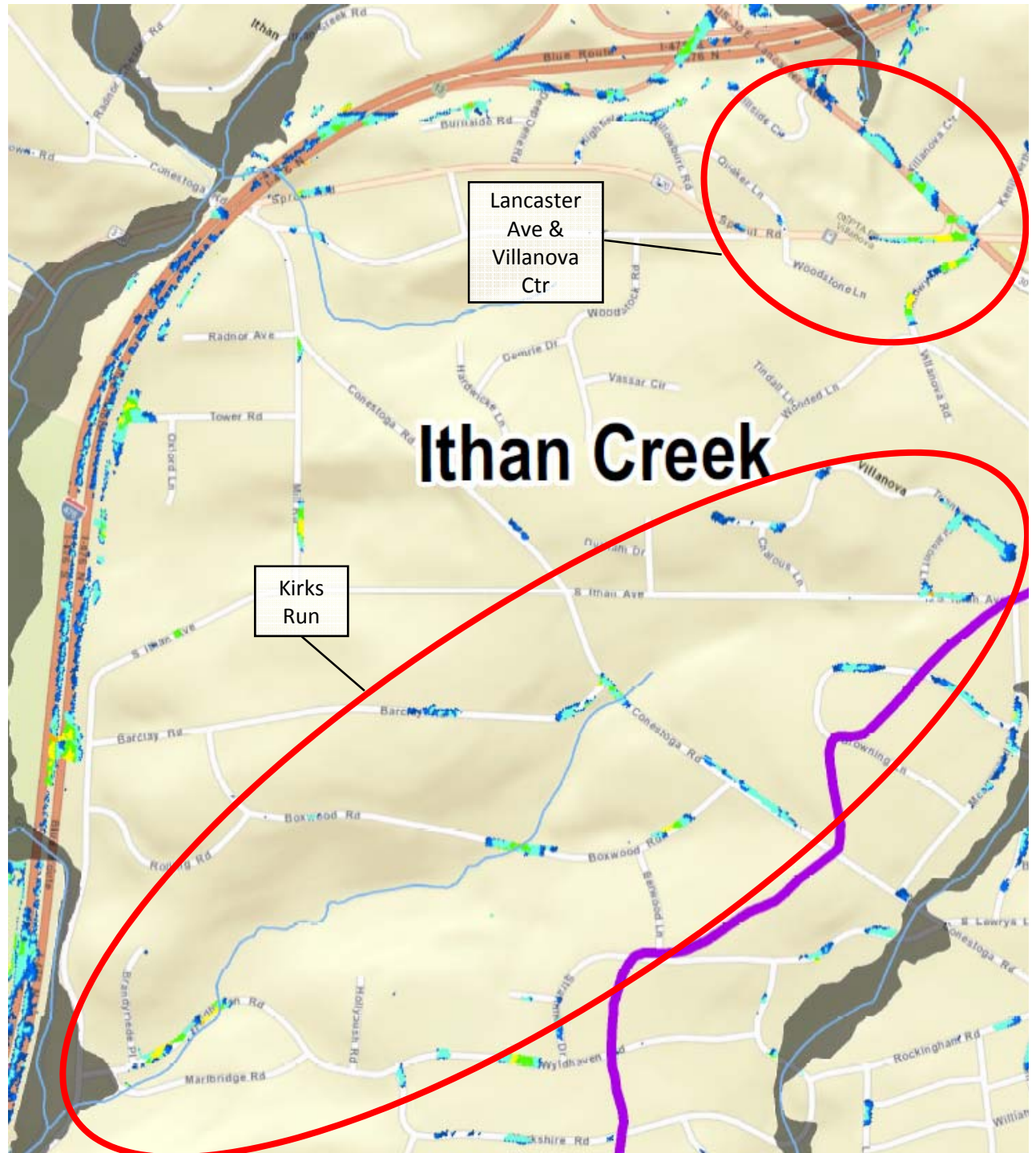


# ROW Flooding Analysis:

## 25-year ROW Flooding & Identified Problem Areas ZOOM-INS (Ithan Creek)

### Legend





-  Surface Waterways
  -  Radnor Township Boundary
  -  Radnor Township Watersheds
  -  100-year FEMA Flood Zone
- 25-year, 1-hour Flood Depth Results
-  0.1 - 0.5 ft
  -  0.5 - 1 ft
  -  1 - 3 ft
  -  3 - 5 ft
  -  5 - 10 ft
  -  10 - 25 ft
  -  > 25 ft
-  Clusters of high density ROW flooding










Only considers the flooding during the 25-year, 1-hour event outside of the 100-year FEMA Flood Zones. Did not consider flood depths on I-476


# ROW Flooding Analysis: 25-year ROW Flooding & Identified Problem Areas ZOOM-INS (Meadowbrook Run)

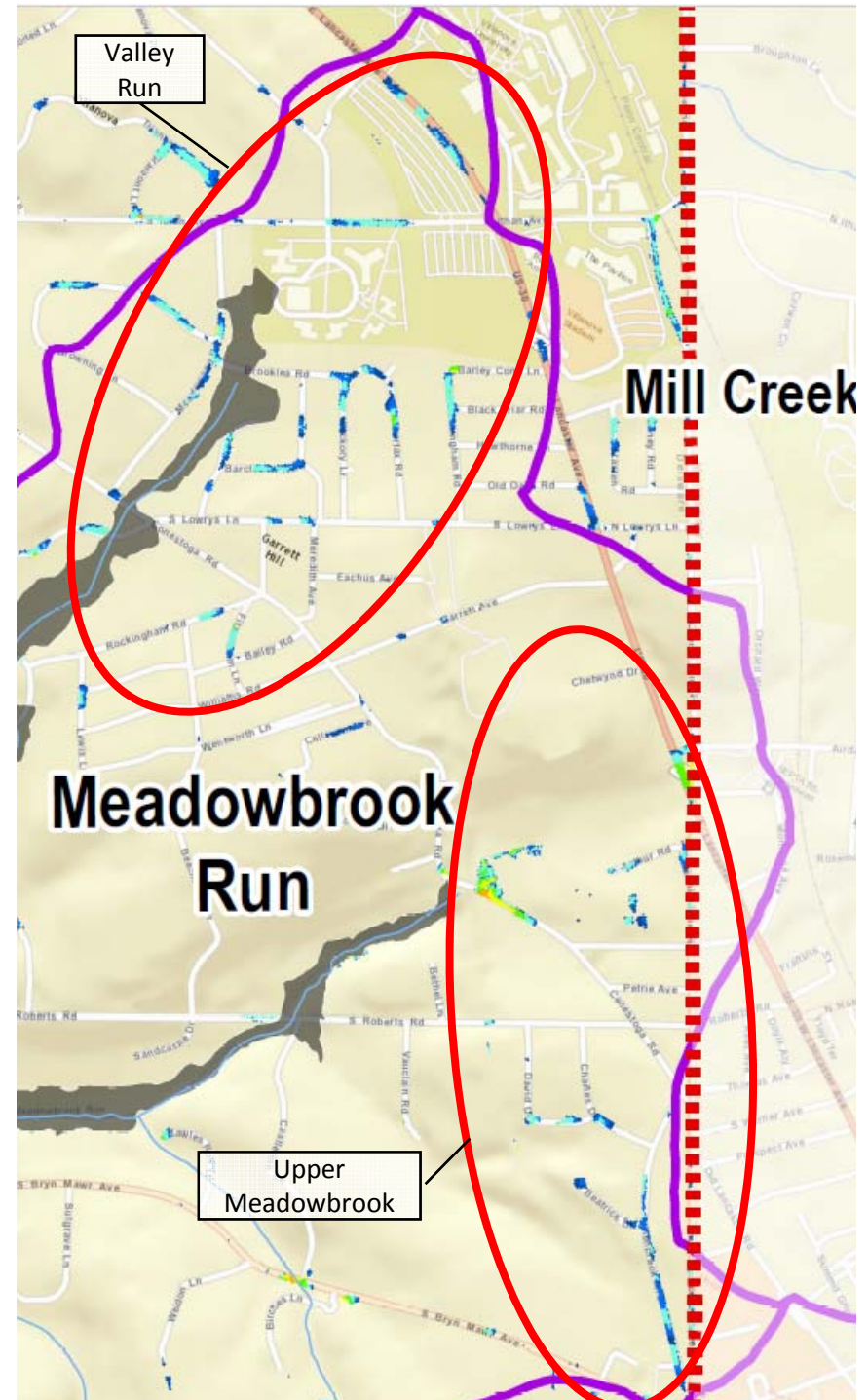
## Legend

-  Surface Waterways
-  Radnor Township Boundary
-  Radnor Township Watersheds
-  100-year FEMA Flood Zone

## 25-year, 1-hour Flood Depth Results

-  0.1 - 0.5 ft
-  0.5 - 1 ft
-  1 - 3 ft
-  3 - 5 ft
-  5 - 10 ft
-  10 - 25 ft
-  > 25 ft

-  Clusters of high density ROW flooding



Only considers the flooding during the 25-year, 1-hour event outside of the 100-year FEMA Flood Zones. Did not consider flood depths on I-476



# ROW Flooding Analysis:

## 25-year ROW Flooding & Identified Problem Areas ZOOM-INS (South Darby Creek)

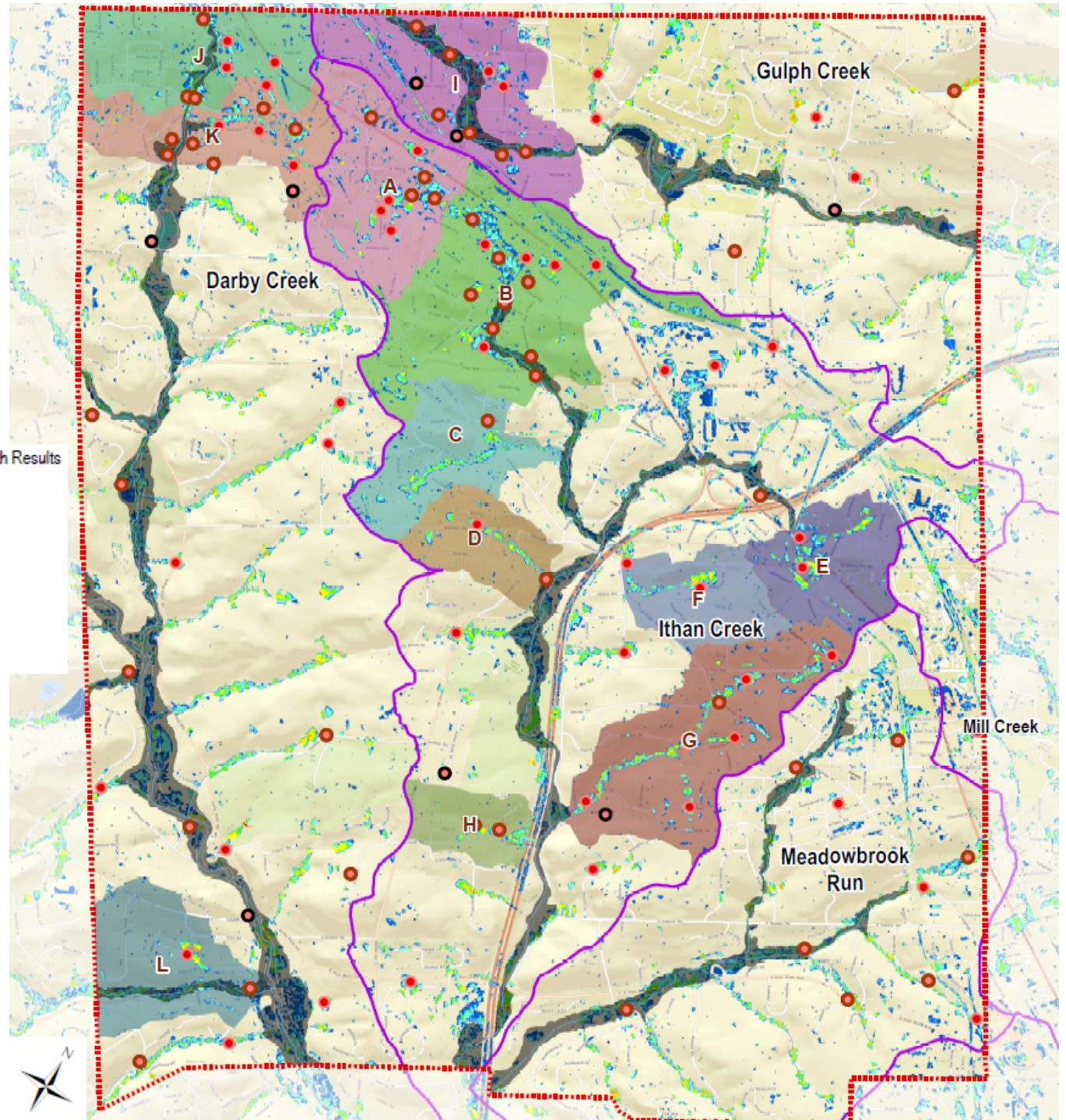


Only considers the flooding during the 25-year, 1-hour event outside of the 100-year FEMA Flood Zones. Did not consider flood depths on I-476

# Preliminary Problem Area Drainage Area Delineation

## Legend

- Documented Flooding Locations
  - Potential Flood Prone Locations (from Model)
  - Flooding Locations (Documented & Model Overlap)
  - Surface Waterways
  - ▭ Radnor Township Boundary
  - ▭ Radnor Township Watershed
  - ▭ 100-year FEMA Flood Zone
- | 25-year, 1-hour Flood Depth Results |              |
|-------------------------------------|--------------|
| ▭ 0.1 - 0.5 ft                      | ▭ 1 - 3 ft   |
| ▭ 0.5 - 1 ft                        | ▭ 3 - 5 ft   |
| ▭ 1 - 3 ft                          | ▭ 5 - 10 ft  |
| ▭ 3 - 5 ft                          | ▭ 10 - 25 ft |
| ▭ 5 - 10 ft                         | ▭ > 25 ft    |
- 
- Problem Area Drainage Areas
- (A) Downtown Wayne
  - (B) Radnor Township Municipal Building
  - (C) Brookside Ave/Conestoga Rd
  - (D) Sproul Rd near Ithan Creek
  - (E) Lancaster Ave/Villanova Ctr
  - (F) S Spring Mill Rd/Conestoga Rd
  - (G) Kirks Run
  - (H) Clyde Rd/Cumberland Pl
  - (I) North Wayne
  - (J) North Darby U/S
  - (K) North Darby D/S
  - (L) Foxes Run





# Refined Problem Areas Drainage Area Delineation

## Legend

- Documented Flooding Locations
- Documented Erosion Locations
- Potential Flood Prone Locations (from Model)
- Flooding Locations (Documented & Model Overlap)
- Surface Waterways

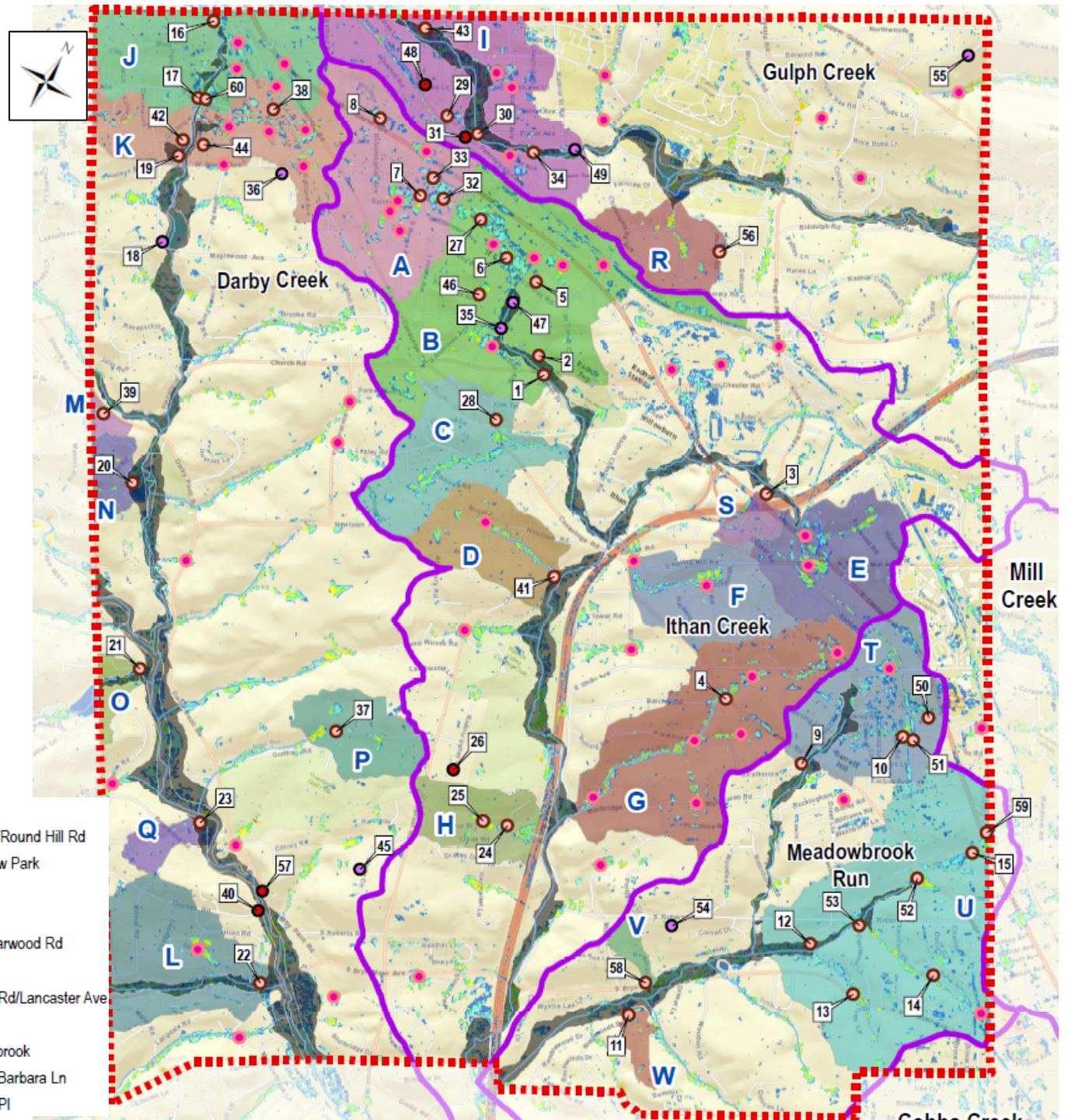
- ▬ Radnor Township Boundary
- ▬ Radnor Township Watersheds
- ▬ 100-year FEMA Flood Zone

### 25-year, 1-hour Flood Depth Results

- 0.1 - 0.5 ft
- 0.5 - 1 ft
- 1 - 3 ft
- 3 - 5 ft
- 5 - 10 ft
- 10 - 25 ft
- > 25 ft

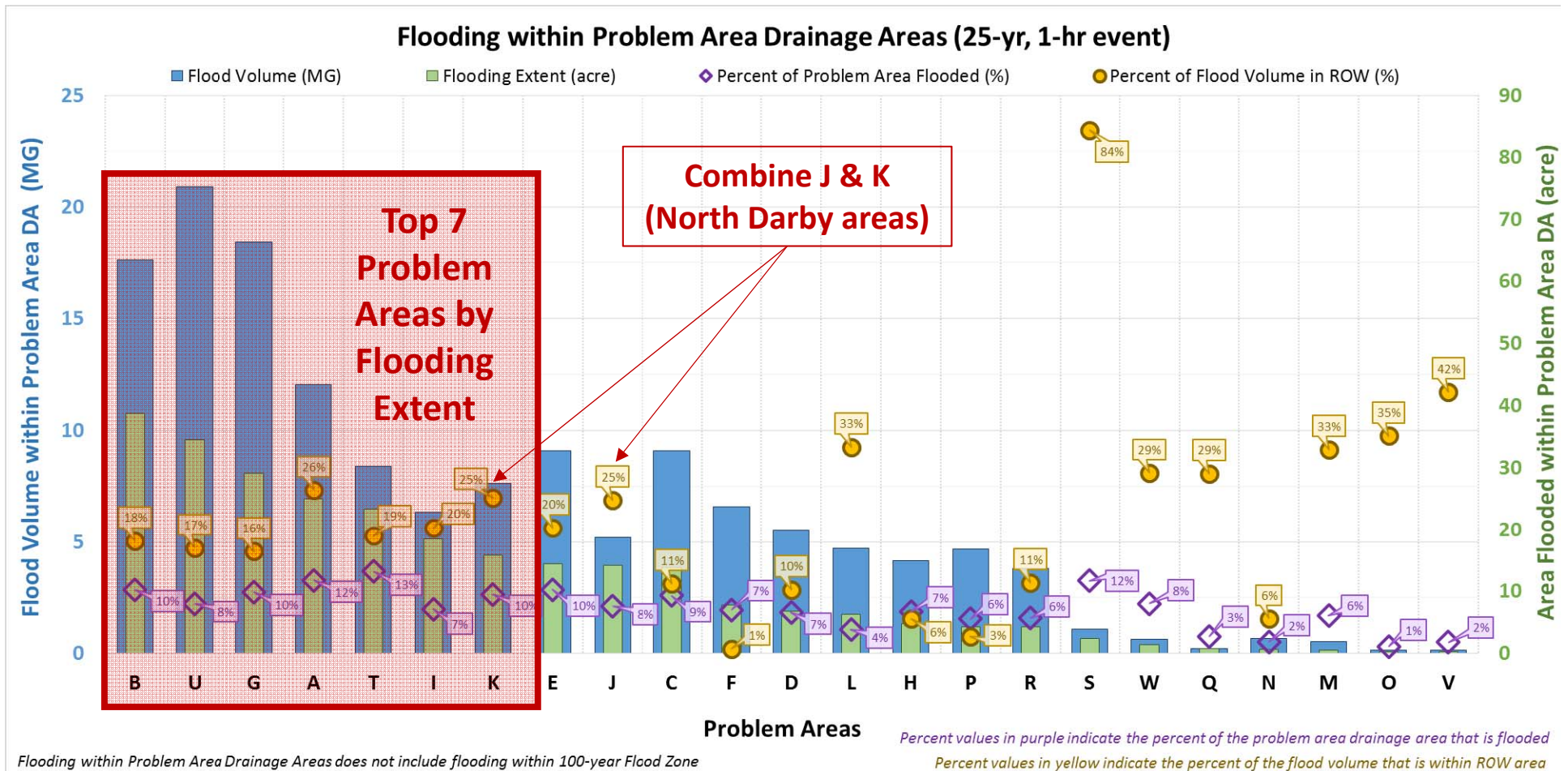
### Problem Area Drainage Areas

- |                                     |  |
|-------------------------------------|--|
| ■ (A) Downtown Wayne                | ■ (L) Foxes Run                        |
| ■ (B) Radnor Township Muni Bldg     | ■ (M) Darby Paoli Rd/Round Hill Rd     |
| ■ (C) Brookside Ave/Conestoga Rd    | ■ (N) Willow Rd/Willow Park            |
| ■ (D) Sproul Rd near Ithan Creek    | ■ (O) Saw Mill Run                     |
| ■ (E) Lancaster Ave/Villanova Ctr   | ■ (P) Godfrey Road                     |
| ■ (F) S Spring Mill Rd/Conestoga Rd | ■ (Q) Amherst Cir/Briarwood Rd         |
| ■ (G) Kirks Run                     | ■ (R) Belrose Lane                     |
| ■ (H) Clyde Rd/Cumberland Pl        | ■ (S) King of Prussia Rd/Lancaster Ave |
| ■ (I) North Wayne                   | ■ (T) Valley Run                       |
| ■ (J) North Darby U/S               | ■ (U) Upper Meadowbrook                |
| ■ (K) North Darby D/S               | ■ (V) Bryn Mawr Ave/Barbara Ln         |
|                                     | ■ (W) Mill Rd/Laurier Pl               |





# Problem Areas Identification Results: Flooding Volume and Area Summary Figure



Flooding within Problem Area Drainage Areas does not include flooding within 100-year Flood Zone

- |                                 |                                   |                                  |                                      |                              |
|---------------------------------|-----------------------------------|----------------------------------|--------------------------------------|------------------------------|
| (A) Downtown Wayne              | (F) S Spring Mill Rd/Conestoga Rd | (K) North Darby D/S              | (P) Godfrey Road                     | (U) Upper Meadowbrook        |
| (B) Radnor Township Muni Bldg   | (G) Kirks Run                     | (L) Foxes Run                    | (Q) Amherst Cir/Briarwood Rd         | (V) Bryn Mawr Ave/Barbara Ln |
| (C) Brookside Ave/Conestoga Rd  | (H) Clyde Rd/Cumberland Pl        | (M) Darby Paoli Rd/Round Hill Rd | (R) Belrose Lane                     | (W) Mill Rd/Laurier Pl       |
| (D) Sproul Rd near Ithan Creek  | (I) North Wayne                   | (N) Willow Rd/Willow Park        | (S) King of Prussia Rd/Lancaster Ave |                              |
| (E) Lancaster Ave/Villanova Ctr | (J) North Darby U/S               | (O) Saw Mill Run                 | (T) Valley Run                       |                              |

# Problem Areas Identification Results: Flooding Volume and Area Summary Table

Combine J & K (North Darby areas)

Top 7 Problem Areas by Flooding Extent

Drainage Area ID	Watershed	Name	Drainage Area (acre)	Flooding Extent (acre)	Flood Volume (MG)	Percent of Problem Area Flooded (%)	# of Impacted Parcels	Percent of Flood Volume in ROW (%)	Average Flood Depth within ROW (ft)	# of Documented Flooding Locations within DA	# of Documented Flooding Locations within 100-year Flood Zone	# of Potential Flood Prone Locations (from Model) within DA
B	Ithan	(B) Radnor Township Municipal Building	376	38.7	17.6	10%	681	18%	1.3	6	5	5
U	Meadowbrook	(U) Upper Meadowbrook	430	34.5	20.9	8%	691	17%	2.0	7	5	1
G	Ithan	(G) Kirks Run	295	29.1	18.4	10%	339	16%	1.7	1	1	6
A	Ithan	(A) Downtown Wayne	212	24.9	12.1	12%	548	26%	1.6	4	4	4
T	Meadowbrook	(T) Valley Run	177	23.4	8.4	13%	448	19%	1.0	4	4	1
I	Gulph	(I) North Wayne	259	18.4	6.3	7%	800	20%	1.1	6	3	3
K	Darby	(K) North Darby D/S	166	15.8	7.6	10%	636	25%	1.5	4	3	6
E	Ithan	(E) Lancaster Ave & Villanova Ctr	141	14.5	9.1	10%	170	20%	2.1	0	0	2
J	Darby	(J) North Darby U/S	187	14.2	5.2	8%	560	25%	1.2	3	3	3
C	Ithan	(C) Brookside Ave & Conestoga Rd	148	13.9	9.1	9%	178	11%	2.9	1	1	0
F	Ithan	(F) S Spring Mill Rd & Conestoga Rd	111	7.8	6.6	7%	202	1%	0.8	0	0	2
D	Ithan	(D) Sproul Rd near Ithan Creek	103	6.8	5.5	7%	104	10%	2.2	1	0	1
L	Darby	(L) Foxes Run	165	6.3	4.7	4%	160	33%	3.3	1	0	1
H	Ithan	(H) Clyde Rd & Cumberland Pl	72	4.8	4.2	7%	89	6%	1.4	2	2	0
P	Darby	(P) Godfrey Road	77	4.3	4.7	6%	7	3%	2.4	1	1	0
R	Gulph	(R) Belrose Lane	75	4.3	3.8	6%	131	11%	1.7	1	1	0
S	Ithan	(S) King of Prussia Rd/Lancaster Ave	21	2.5	1.1	12%	31	84%	1.4	1	1	0
W	Meadowbrook	(W) Mill Rd/Laurier Pl	18	1.4	0.6	8%	35	29%	2.0	1	1	0
Q	Darby	(Q) Amherst Cir/Briarwood Rd	26	0.7	0.2	3%	36	29%	1.0	1	0	0
N	Darby	(N) Willow Rd/Willow Park	34	0.6	0.7	2%	31	6%	1.7	1	0	0
M	Darby	(M) Darby Paoli Rd/Round Hill Rd	10	0.6	0.5	6%	13	33%	2.4	1	1	0
O	Darby	(O) Saw Mill Run	23	0.3	0.1	1%	21	35%	1.1	1	0	0
V	Meadowbrook	(V) Bryn Mawr Ave/Barbara Ln	14	0.3	0.2	2%	22	42%	2.8	1	1	0

<sup>18</sup>Note: Flooding within Problem Area Drainage Areas does not include flooding within 100-year Flood Zone



# Recommended Problem Areas

## Legend

- Documented Flooding Locations
- Documented Erosion Locations
- Potential Flood Prone Locations (from Model)
- Flooding Locations (Documented & Model Overlap)
- Surface Waterways
- Storm Sewers (line)
- Storm Sewers (polygon)
- Radnor Township Boundary
- Radnor Township Watersheds
- 100-year FEMA Flood Zone

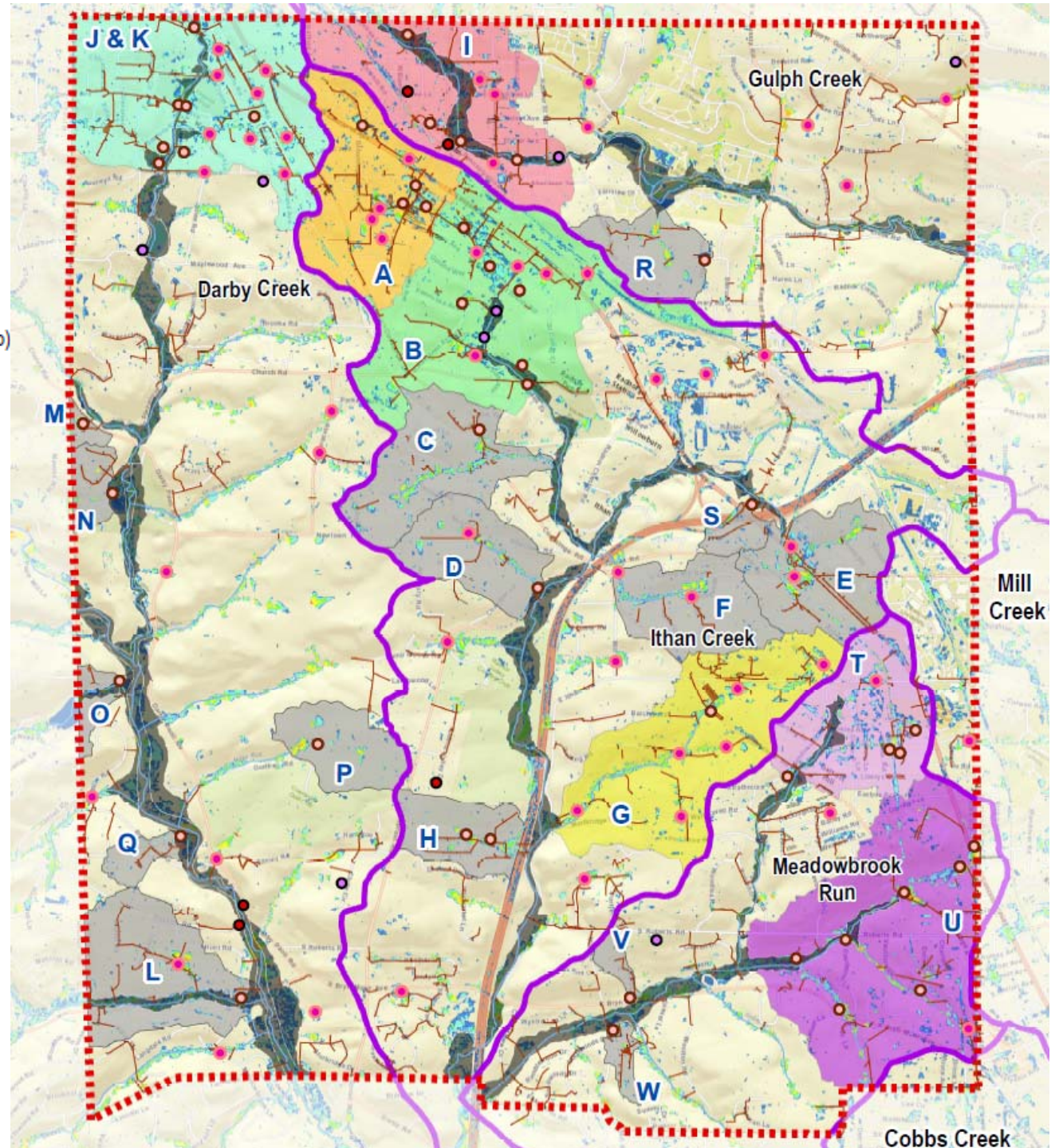
## Recommended Problem Area Drainage Areas

- (A) Downtown Wayne
- (B) Radnor Township Muni Bldg
- (G) Kirks Run
- (I) North Wayne
- (J/K) North Darby
- (T) Valley Run
- (U) Upper Meadowbrook

## Other Problem Area Drainage Areas

## 25-year, 1-hour Flood Depth Results

- 0.1 - 0.5 ft
- 0.5 - 1 ft
- 1 - 3 ft
- 3 - 5 ft
- 5 - 10 ft
- 10 - 25 ft
- > 25 ft



# Flood Modeller FAST Model Results



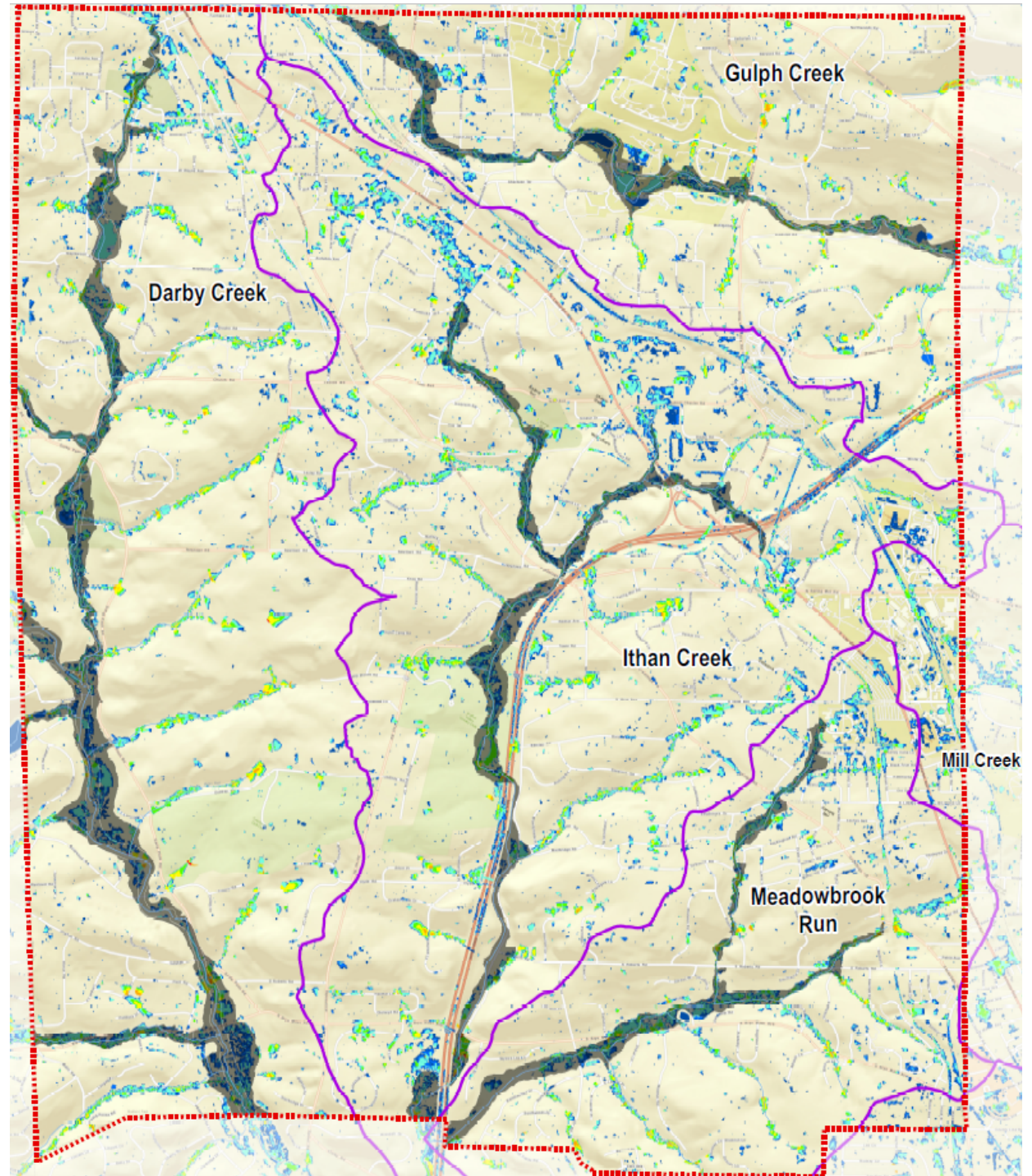
# Flood Modeller Results: 25-year, 1-hour Event (2.38")

## Legend

- Surface Waterways
- ▤ Radnor Township Boundary
- ▭ Radnor Township Watersheds
- 100-year FEMA Flood Zone

## 25-year, 1-hour Flood Depth Results

- 0.1 - 0.5 ft
- 0.5 - 1 ft
- 1 - 3 ft
- 3 - 5 ft
- 5 - 10 ft
- 10 - 25 ft
- > 25 ft





# Flood Modeller Results: 10-year, 1-hour Event (2.05")

## Legend

— Surface Waterways

▤ Radnor Township Boundary

▭ Radnor Township Watersheds

■ 100-year FEMA Flood Zone

10-year, 1-hour Flood Depth Results

■ 0.1 - 0.5 ft

■ 0.5 - 1 ft

■ 1 - 3 ft

■ 3 - 5 ft

■ 5 - 10 ft

■ 10 - 25 ft

■ > 25 ft





# Flood Modeller Results: 1-year, 1-hour Event (1.19")

## Legend

- Surface Waterways
- ▤ Radnor Township Boundary
- ▭ Radnor Township Watersheds
- 100-year FEMA Flood Zone

## 1-year, 1-hour Flood Depth Results

- 0.1 - 0.5 ft
- 0.5 - 1 ft
- 1 - 3 ft
- 3 - 5 ft
- 5 - 10 ft
- 10 - 25 ft
- > 25 ft





Thank You

**ch2m.**<sup>SM</sup>

# Township Assessment Project

## Task Overview / Schedule Update

- Task 1 – ID Flood Locations (complete)
- Task 2 – Data Collection
  - May: File review at Township
  - June: Survey for North Wayne Priority Problem Area to generate GIS data
  - June/July: Survey to create GIS Data for remaining 6 priority Problem Areas
- Task 3 – Enhanced Modeling Existing Conditions
  - June/July: North Wayne
  - July/Aug: Remaining 6 priority Problem Areas (after survey data comes in)
- Task 4 – Develop and Model Conceptual Solutions
  - Sept/Oct: Prepare Projects (and costs) and Develop prioritization criteria

*\*\*Workshop to share first round of potential projects and get public input on priorities \*\**
- Task 5 – Prioritization of Projects
  - Oct/Nov: Prioritized list; Final report; Present at SWMAC.

# Task 5 Project Prioritization

- Using the project solutions list developed under Task 4, the goal of Task 5 is to develop a prioritized list of projects that reflects the values of the SWMAC and community.
  - Prioritized list becomes the basis for CIP and annual budgeting
- SWMAC and community to develop **priority criteria** which become the metrics by which we score each project.
  - Each Criteria has to have a performance measure – High/Medium/Low or Y/N
- **Criteria is weighted** by relative importance
  - EX: Long-term O&M needs may be more important (higher weight) then cost sharing or partnership potential (lower weight)
- **Projects are ranked** – can be grouped by problem area or township-wide

# Step 1. Develop the Project list and cost estimates

Project Number	Project Name (Please limit project name to the following width)	Category/Fund Type	Capital Cost	Cumulative Project Cost
1	YL01 N 12th St Green Street Option A	YL-01	\$167,000	\$167,000
2	YL01 N 12th St Green Street Option B	YL-01	\$168,000	\$335,000
3	YL01 N 12th St Green Street Option C	YL-01	\$133,000	\$468,000
4	YL04 Yorktown CuldeSac Typology Option A - West	YL-04	\$201,000	\$669,000
5	YL04 Yorktown CuldeSac Typology Option B - West	YL-04	\$182,000	\$851,000
6	YL04 Yorktown CuldeSac Typology Option C - West	YL-04	\$192,000	\$1,043,000
7	YL09 Vacant Lot at Hutchinson St Option A	YL-09	\$169,000	\$1,212,000
8	YL09 Vacant Lot at Hutchinson St Option B	YL-09	\$164,000	\$1,376,000
9	YL09 Vacant Lot at Hutchinson St Option C	YL-09	\$179,000	\$1,555,000
10	YL14 Oxford St Green Street Option A	YL-14	\$188,000	\$1,743,000
11	YL14 Oxford St Green Street Option B	YL-14	\$218,000	\$1,961,000
12	YL14 Oxford St Green Street Option C	YL-14	\$170,000	\$2,131,000
13	YL16 Cruz Recreation Center Option A	YL-16	\$160,000	\$2,291,000
14	YL16 Cruz Recreation Center Option B	YL-16	\$177,000	\$2,468,000
15	YL16 Cruz Recreation Center Option C	YL-16	\$137,000	\$2,605,000
16	YL04 Yorktown CuldeSac Typology Option A - East	YL-04	\$209,000	\$2,814,000
17	YL04 Yorktown CuldeSac Typology Option B - East	YL-04	\$198,000	\$3,012,000
18	YL04 Yorktown CuldeSac Typology Option C - East	YL-04	\$169,000	\$3,181,000

Step 2. Develop the Evaluation Criteria & Performance Measure;  
 Step 3. Weight the Criteria 0-100

Criteria No.	Evaluation Criteria Name	Weight (0 - 100 Scale)	Criteria Performance Measure Description
1	Greened Acres (Impervious DA Capture)	100	Score applied based on the area of capture calculated for each project option. Higher scores indicate higher drainage area capture and are preferred
2	Tree Canopy	33	Score based on number of trees and the equivalent canopy increase associated with each project option; high canopy potential is preferred
3	Cost per Greened Acre	67	Score based on the cost (as calculated using CH2M HILL methodology) per Greened Acres; lower costs are preferred
4	Cost sharing and Partnership opportunities	33	Rated based on potential for all or portion of the project to be paid for by entity other than PWD (i.e. Parks, Streets, Private); This criteria may be updated after stakeholder outreach has occurred. High potential for cost sharing is preferred
5	Operations & Maintenance needs per project	67	Low maintenance needs are preferred
6	Public amenity/community asset	33	Scored based on meeting a number of the following criteria: 1) is highly visible, 2) provides potential for creation of public amenity or community assets through site improvements, 3) engages in complimentary programming, 4) increase in usage and 5) positive impact on public safety; Higher scores are preferred.

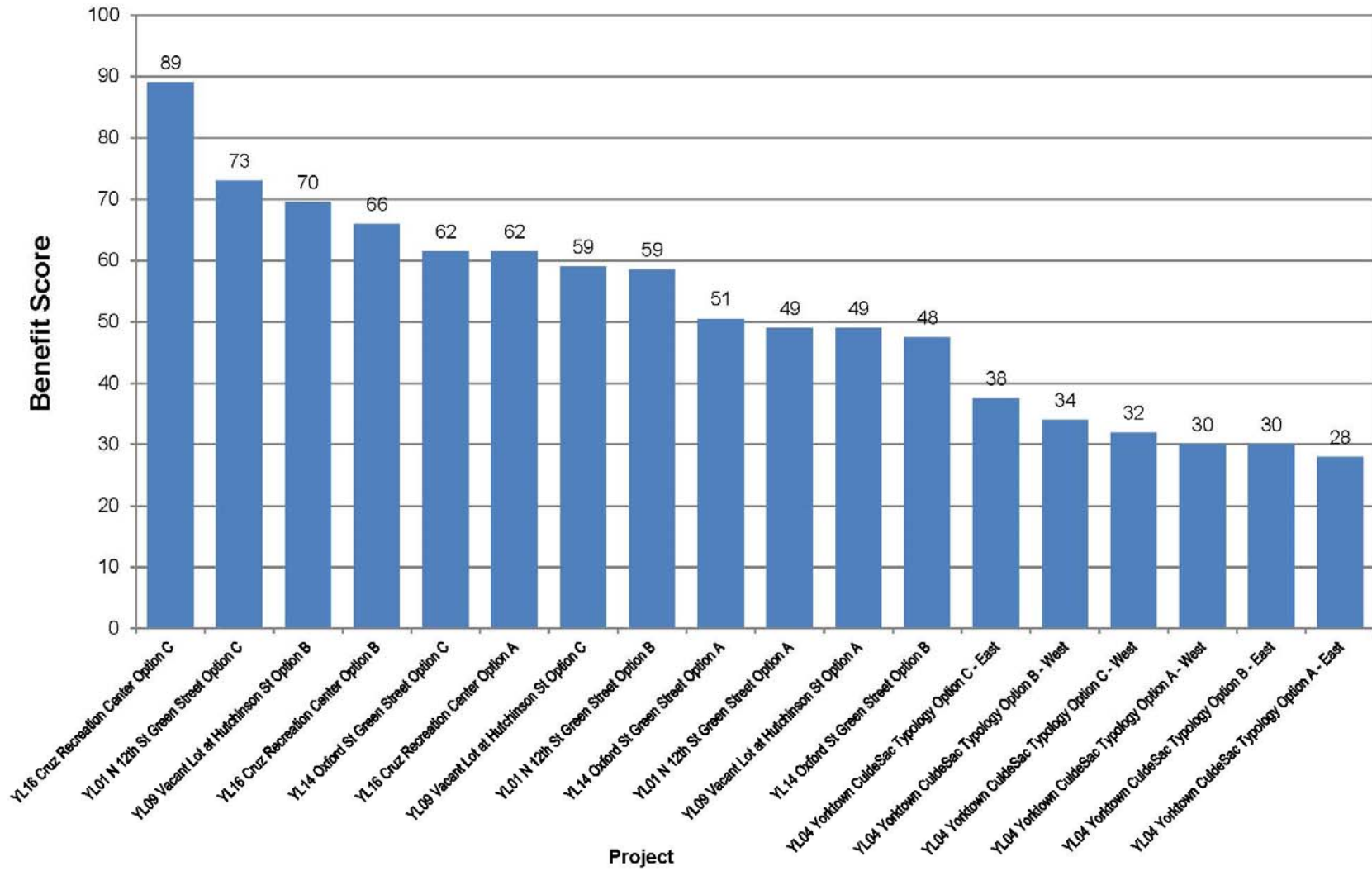
# Example Criteria and Performance Measures

Criteria	Rank/Score		Application of Criteria
Greened Acres opportunity / Potential drainage area	Low/Med/High (0/5/10)	0 = Low impervious area capture potential consisting of immediately adjacent streets/other impervious (1-2 streets).	Score applied based on the ability of project to manage adjacent streets and other impervious areas. Higher score when project able to capture street and adjacent private/public impervious outside of ROW. In some cases reasonable and minor infrastructure improvements were assumed to increase drainage areas (conveyance).
		5 = Moderate impervious area capture potential consisting of adjacent areas and additional areas draining towards project (3-4 streets).	
		10 = High impervious area capture potential consisting of onsite and offsite areas that may be captured with or without the use of conveyance structures (>4 streets).	
Potential for cost sharing and partnering opportunities and/or potential for GSI Adoption	Low/Med/High (0/5/10)	0 = No potential for cost sharing and/or GSI adoption.	Rated based on potential for all or portion of the project to be paid for by entity other than PWD (i.e. Parks, Streets, Private) and/or potential to shift maintenance/ownership of GSI to entity other than PWD (e.g. Parks & Rec, neighborhood organization).
		5 = Moderate potential for cost sharing and/or GSI adoption (at least one partner).	
		10 = High potential for cost sharing and/or GSI adoption (more than one partner).	
Presence of significant structural issues and constructability	Low/Med/High (10/5/0)	0 = Many major structures or constructability issues	Score based on amount of existing structures or infrastructure on project site (e.g. pavements, curbs, walls, infrastructure conflicts) with larger score assigned when less structure present on site or when minimal demolition and regrading required.
		5 = Moderate amount of major structures or constructability issues	
		10 = No major structures or constructability issues	
Potential for creation of public amenity/community assets through site improvements, complimentary programming, increase in usage and positive impact on public safety	Yes/No (10/0)	0 = No potential for creation of public amenity/community asset	Positive score indicates that project is high visibility, provides potential for creation of public amenity/community assets through site improvements, complimentary programming, increase in usage and positive impact on public safety
		10 = Potential for creation of public amenity/community asset.	

## Step 4. Score and rank by Total Benefit Score

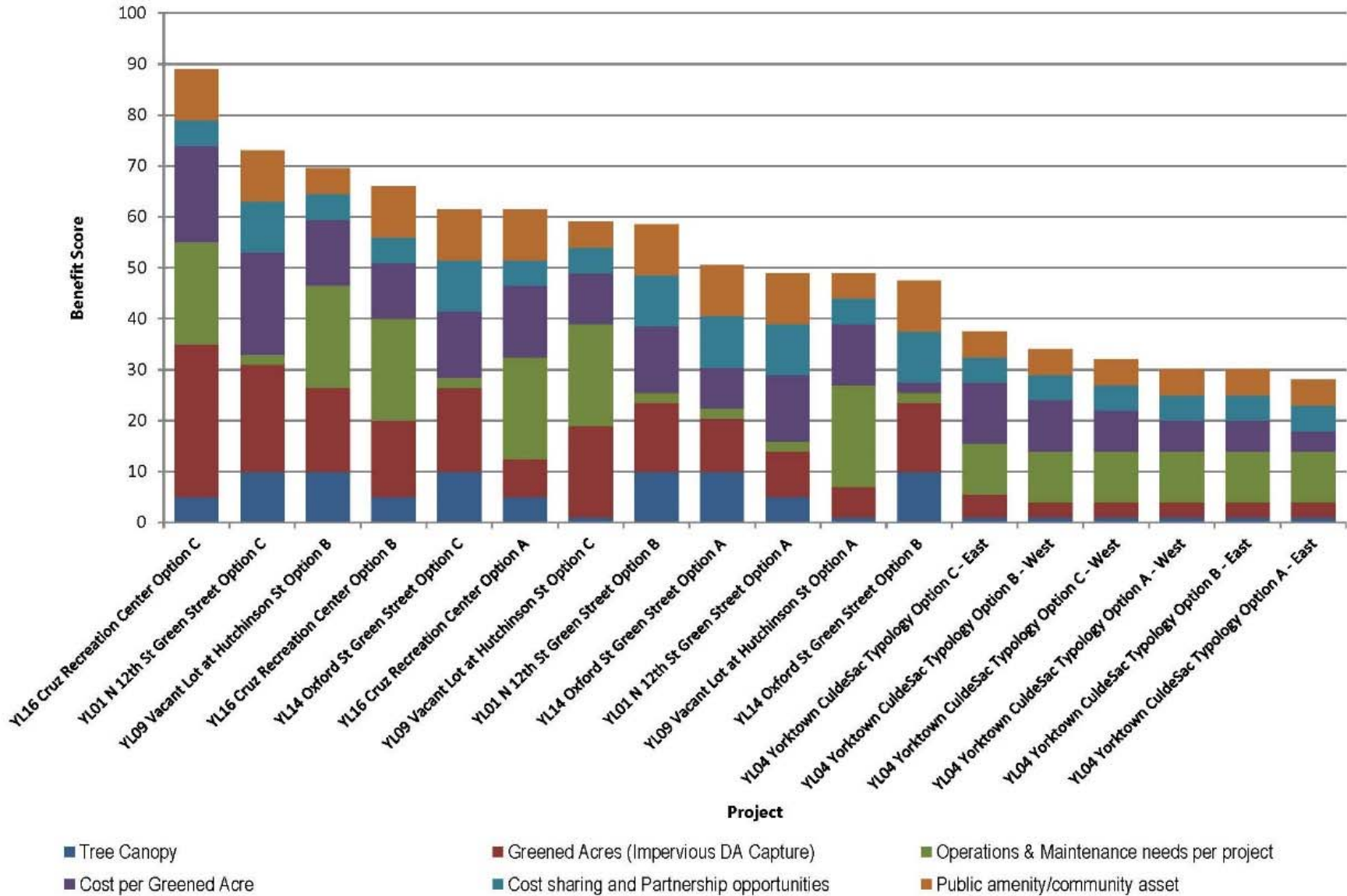
Project Number	Project Description	Category/Fund Type	Capital Cost	Cumulative Capital Cost	Total Benefit Score
15	YL16 Cruz Recreation Center Option C	YL-16	\$137,000	\$137,000	89.00
3	YL01 N 12th St Green Street Option C	YL-01	\$133,000	\$270,000	73.00
8	YL09 Vacant Lot at Hutchinson St Option B	YL-09	\$164,000	\$434,000	69.50
14	YL16 Cruz Recreation Center Option B	YL-16	\$177,000	\$611,000	66.00
12	YL14 Oxford St Green Street Option C	YL-14	\$170,000	\$781,000	61.50
13	YL16 Cruz Recreation Center Option A	YL-16	\$160,000	\$941,000	61.50
9	YL09 Vacant Lot at Hutchinson St Option C	YL-09	\$179,000	\$1,120,000	59.00
2	YL01 N 12th St Green Street Option B	YL-01	\$168,000	\$1,288,000	58.50
10	YL14 Oxford St Green Street Option A	YL-14	\$188,000	\$1,476,000	50.50
1	YL01 N 12th St Green Street Option A	YL-01	\$167,000	\$1,643,000	49.00
7	YL09 Vacant Lot at Hutchinson St Option A	YL-09	\$169,000	\$1,812,000	49.00
11	YL14 Oxford St Green Street Option B	YL-14	\$218,000	\$2,030,000	47.50
18	YL04 Yorktown CuldeSac Typology Option C - East	YL-04	\$169,000	\$2,199,000	37.50

**FIGURE 2**  
Total Benefit Score





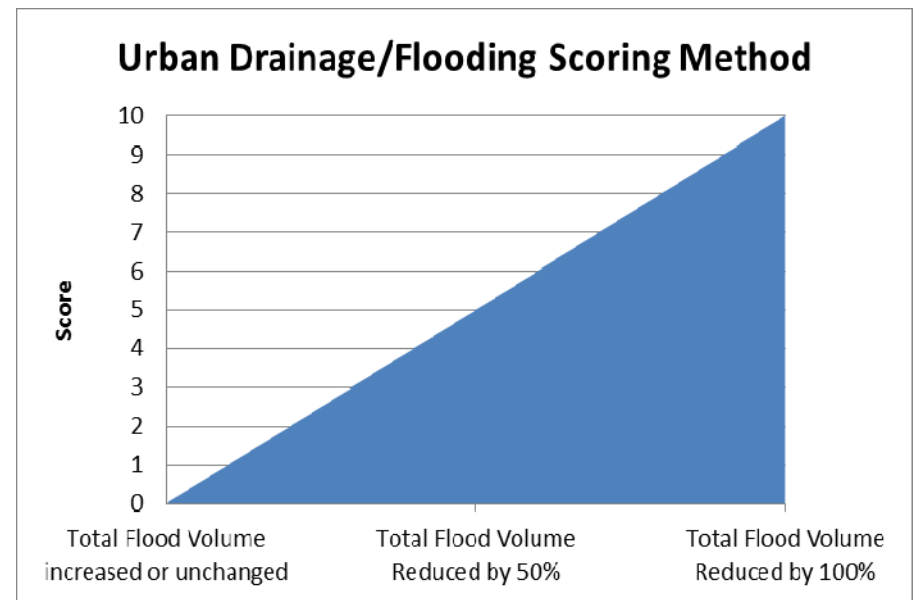
**FIGURE 1**  
Benefit Score by Criteria Weight Composition



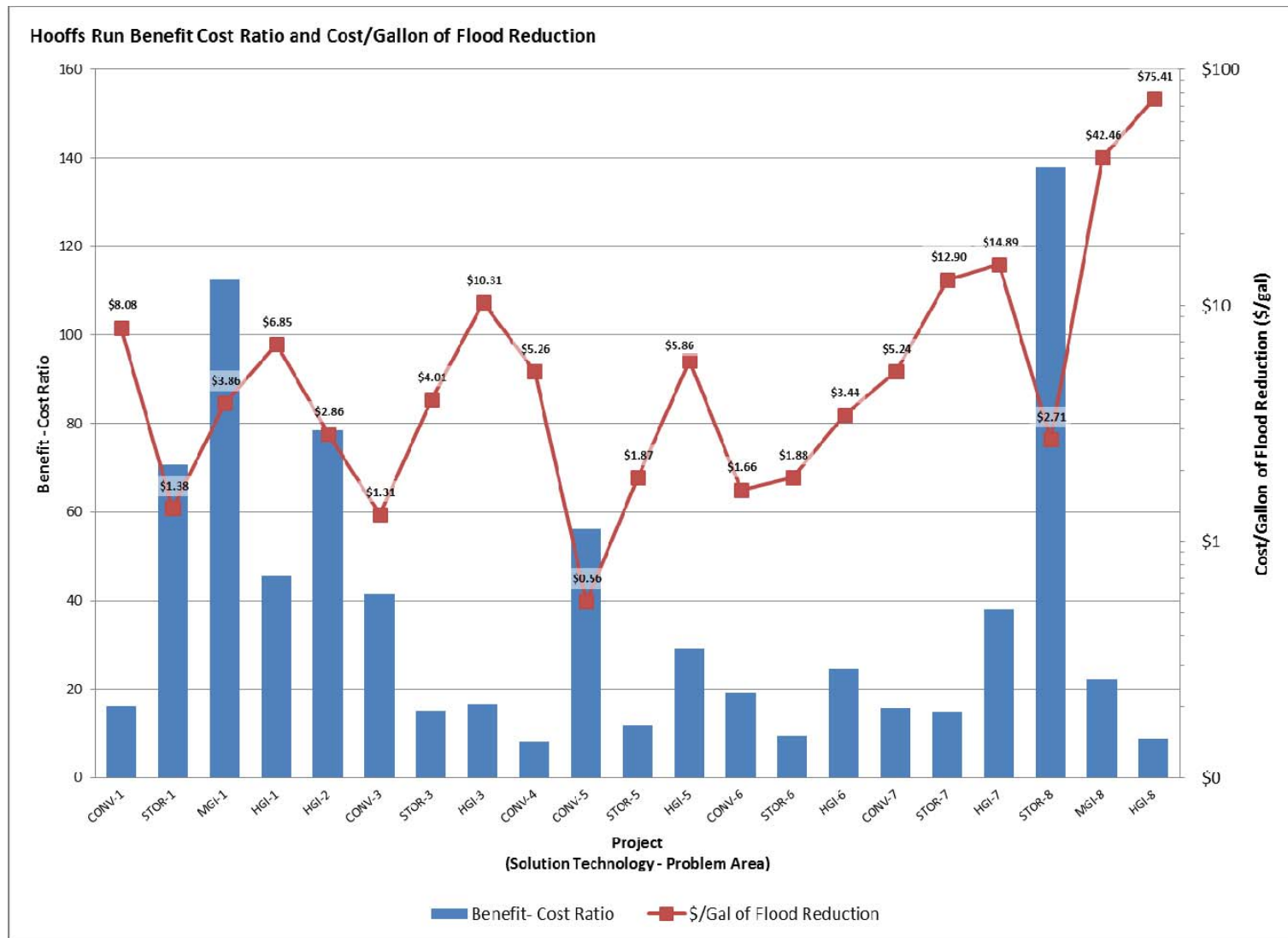
# Solution Evaluation Criteria

- Eight evaluation criteria were selected with city staff input
- Weights and a scoring method were developed and documented for each criterion

Solution Evaluation Criteria	Weight
Urban Drainage/Flooding	95
Environmental Compliance	93
EcoCity Goals/Sustainability	50
Social Benefits	40
Integrated Asset Management	73
City-wide Maintenance Implications	90
Constructability	60
Public Acceptability	53



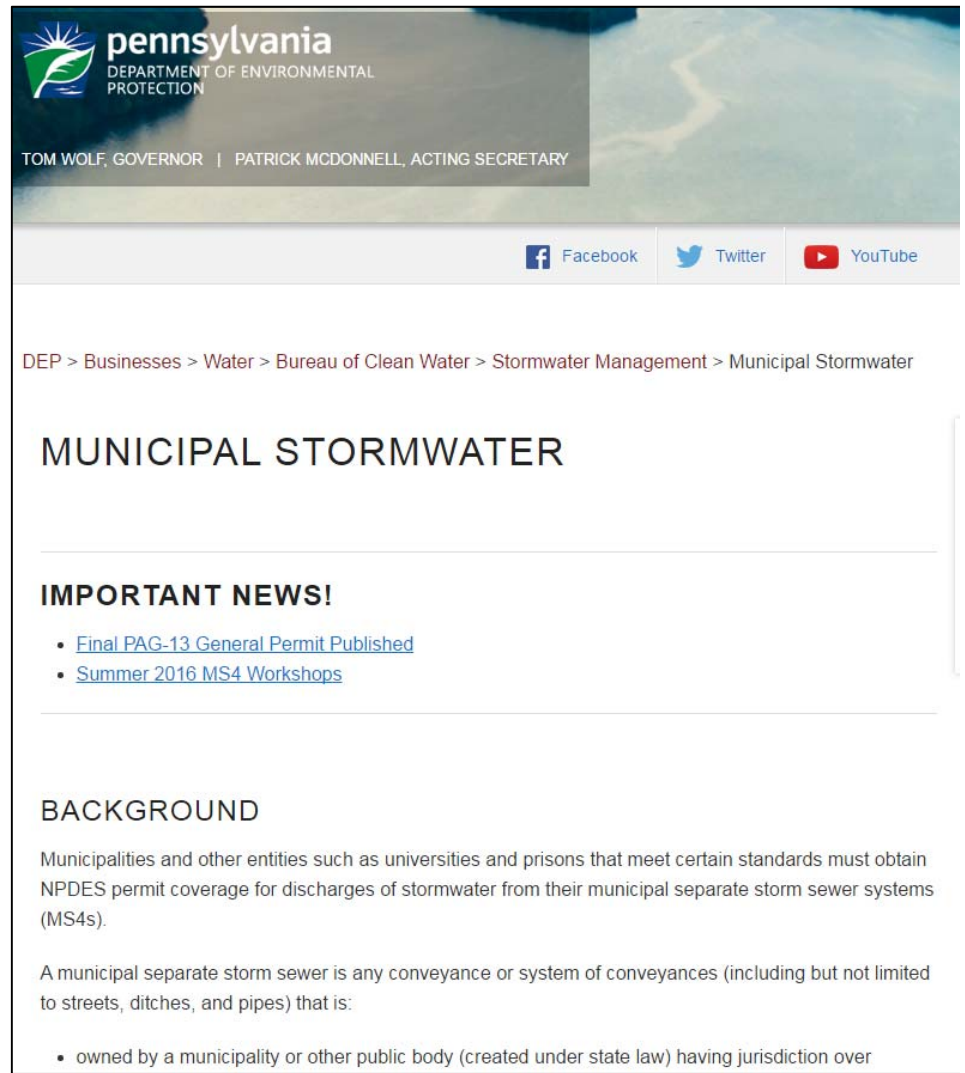
# Benefit-Cost Results





# Updates to the PADEP Stormwater Permit PAG-13

- Municipalities discharging stormwater into impaired streams are required to have a NPDES Permit
- Updated PAG-13 released on June 3, 2016 has new requirements in addition to the existing requirements
- NEW: Development of Pollution Reduction Plan (PRP) and Pollution Control Measures (PCMs) to **reduce pollutant loading for the causes of impairment**



The screenshot shows the Pennsylvania Department of Environmental Protection website. The header includes the state logo and the text "pennsylvania DEPARTMENT OF ENVIRONMENTAL PROTECTION". Below the header, it lists "TOM WOLF, GOVERNOR | PATRICK MCDONNELL, ACTING SECRETARY". There are social media icons for Facebook, Twitter, and YouTube. The breadcrumb trail reads: "DEP > Businesses > Water > Bureau of Clean Water > Stormwater Management > Municipal Stormwater". The main heading is "MUNICIPAL STORMWATER". Underneath, there is a section titled "IMPORTANT NEWS!" with two bullet points: "Final PAG-13 General Permit Published" and "Summer 2016 MS4 Workshops". Below that is a section titled "BACKGROUND" with two paragraphs of text. The first paragraph states that municipalities and other entities must obtain NPDES permit coverage for discharges of stormwater from their municipal separate storm sewer systems (MS4s). The second paragraph defines a municipal separate storm sewer as any conveyance or system of conveyances (including but not limited to streets, ditches, and pipes) that is:

- owned by a municipality or other public body (created under state law) having jurisdiction over

# Sources of Impairment in Radnor's streams and requirements under new Permit

Impaired Downstream Waters or Applicable TMDL Name	Requirement(s)	Other Cause(s) of Impairment
Gulph Creek	Appendix E-Siltation (5)	Water/Flow Variability (4c)
Saw Mill Run	Appendix C-PCB (5)	Cause Unknown (5), Water/Flow Variability (4c)
Foxes Run	Appendix C-PCB (5), Appendix E-Siltation (5)	Cause Unknown (5), Other Habitat Alterations, Water/Flow Variability (4c)
Hardings Run	Appendix C-PCB (5), Appendix E-Siltation (5)	Cause Unknown (5), Other Habitat Alterations, Water/Flow Variability (4c)
Ithan Creek	Appendix C-PCB (5), Appendix E-Siltation (5)	Cause Unknown (5), Other Habitat Alterations, Water/Flow Variability (4c)
Miles Run	Appendix C-PCB (5)	Cause Unknown (5), Water/Flow Variability (4c)
Finn Run	Appendix C-PCB (5), Appendix E-Siltation (5)	Cause Unknown (5), Other Habitat Alterations, Water/Flow Variability (4c)
Julip Run	Appendix C-PCB (5)	Cause Unknown (5), Water/Flow Variability (4c)
Meadowbrook Run	Appendix C-PCB (5), Appendix E-Siltation (5)	Cause Unknown (5), Other Habitat Alterations, Water/Flow Variability (4c)
Little Darby Creek	Appendix C-PCB (5)	Cause Unknown (5), Water/Flow Variability (4c)
Valley Run	Appendix C-PCB (5), Appendix E-Siltation (5)	Cause Unknown (5), Other Habitat Alterations, Water/Flow Variability (4c)
Schuylkill River	Appendix C-PCB (4a)	
Kirks Run	Appendix C-PCB (5), Appendix E-Siltation (5)	Cause Unknown (5), Other Habitat Alterations, Water/Flow Variability (4c)
Mill Creek	Appendix E-Nutrients, Siltation (5)	Water/Flow Variability (4c)
Cobbs Creek	Appendix B-Pathogens (5), Appendix C-PCB (5), Appendix E-Siltation (5)	Cause Unknown (5), Other Habitat Alterations, Water/Flow Variability (4c)
Doom Run	Appendix C-PCB (5), Appendix E-Siltation (5)	Cause Unknown (5), Other Habitat Alterations, Water/Flow Variability (4c)
Camp Run	Appendix C-PCB (5)	Cause Unknown (5), Water/Flow Variability (4c)
Darby Creek	Appendix C-PCB (5), Appendix E-Siltation (5)	Cause Unknown (5), Other Habitat Alterations, Water/Flow Variability (4c)
Abrahams Run	Appendix C-PCB (5)	Cause Unknown (5), Water/Flow Variability (4c)
Browns Run	Appendix C-PCB (5), Appendix E-Siltation (5)	Cause Unknown (5), Other Habitat Alterations, Water/Flow Variability (4c)

## Development of a PRP to limit pollution in impaired streams

- Pathogens, Priority Organic Compounds, and Nutrients and/or Sediments
- PRP must show that the Township can achieve reductions within five-years of permit approval
- PRP must include implementation schedule
- Requires public input and participation
- Progress to be reported in annual reports to PADEP



## Existing Requirements of the Permit include 6 Minimum Control Measures (MCMs)

MCM #1 Public Education and Outreach on Stormwater Impacts

MCM #2 Public Involvement / Participation

MCM #3 Illicit Discharge Detection and Elimination (IDD&E)

MCM #4 Construction Site Stormwater Runoff Control

MCM #5 Post-Construction Stormwater Management (PCSM) in New and Re-Development Activities

MCM #6 Pollution Prevention/Good Housekeeping for Municipal Operations

# Next Steps

- Update Plans, Data and Monitoring Programs
  - Public Education and Outreach Program (PEOP)
  - Public Involvement and Participation Program (PIPP)
  - Illicit Discharge Detection and Elimination (IDD&E) Plan
    - Map of all outfalls; dry weather field screening and sampling
  - BMP Inventory (Map and Database)
  - Prepare Pollutant Reduction Plan