Effective Impervious Area of Minnetonka Watersheds

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Introduction

- Effective Impervious Area (EIA)
  - "Connected" impervious area
  - Directly effects watershed's receiving water body
    - Pollutant levels

http://wataugaces.blogspot.com

Effective Impervious Area

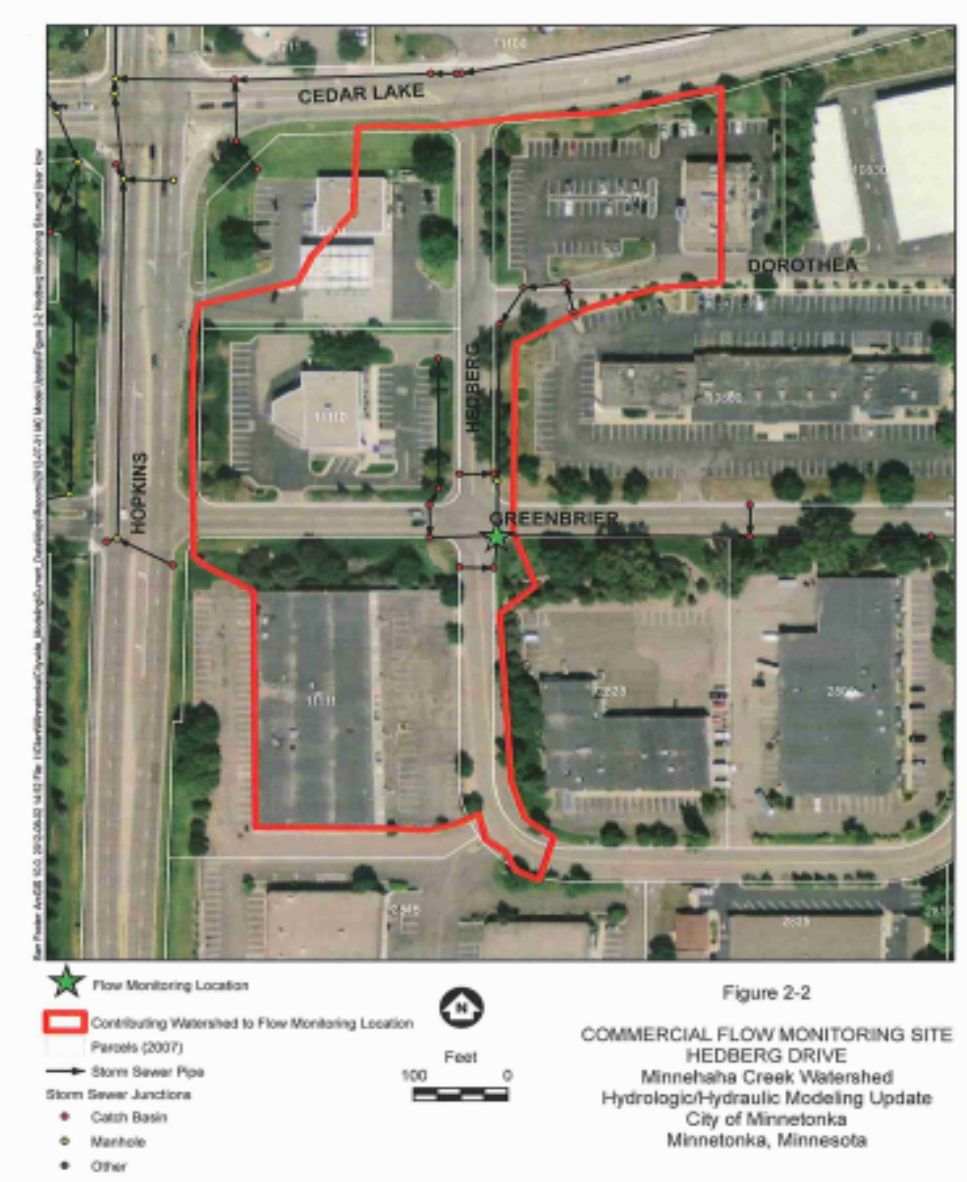
- Problem Surfaces
  - Streets
  - Rooftops
  - Parking lots
  - Driveways

- Mainly cement and asphalt surfaces cause problematic EIA

Objective

- Determine EIA for Minnetonka Watersheds
  - Commercial Area
  - Residential Area
  - Extended Application
- Used for watershed analysis
  - Input variable for engineers
  - EIA a factor in runoff water quality

Commercial Area



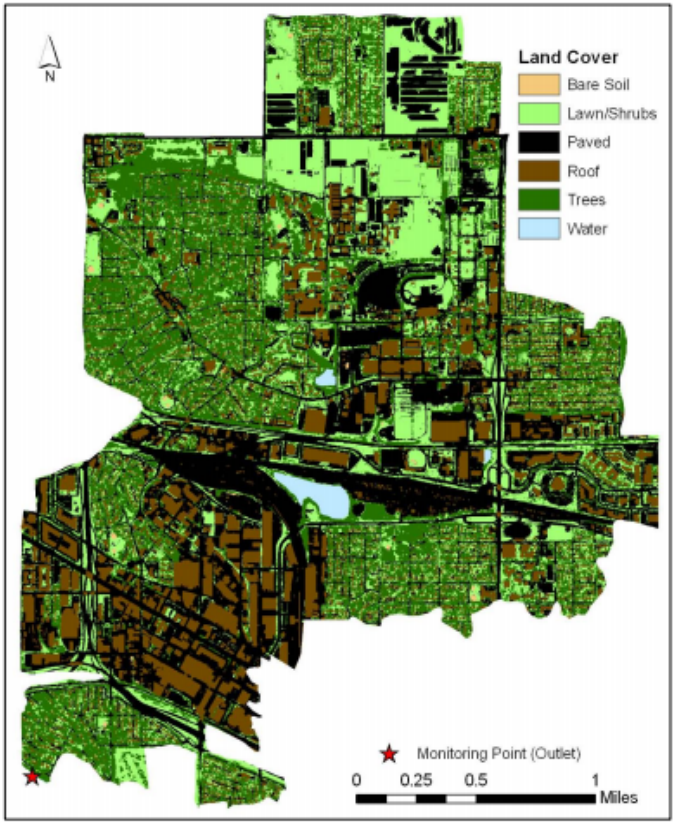
Residential Area

Methods

- Boyd et al. (1993)
  - Compares monitored data
    - Uses rainfall volume and runoff depth
    - 7 storms for each area (Commercial, Residential)
  - Best fit line describes EIA
    - Points 2mm above line disregarded
  - Does not account for other water losses

Methods

- Han and Burian, 2009
  - GIS based approach
  - Estimates EIA
    - Utilizes satellite images
    - Shows total impervious, rather than connected



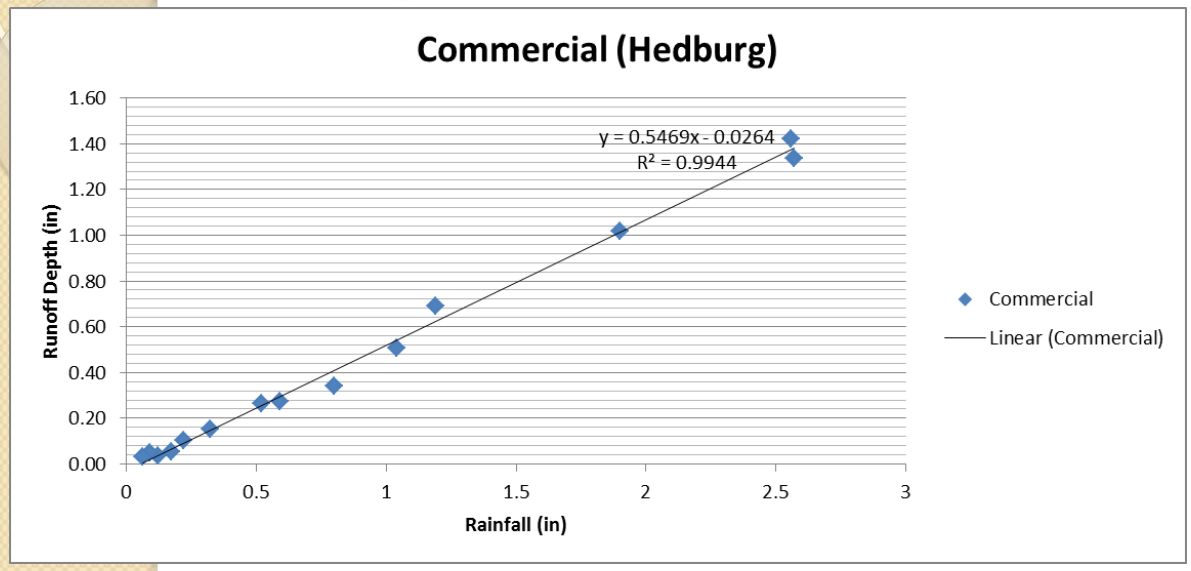
Development to Quantify Effective Impervious Cover; Janke, Gulliver

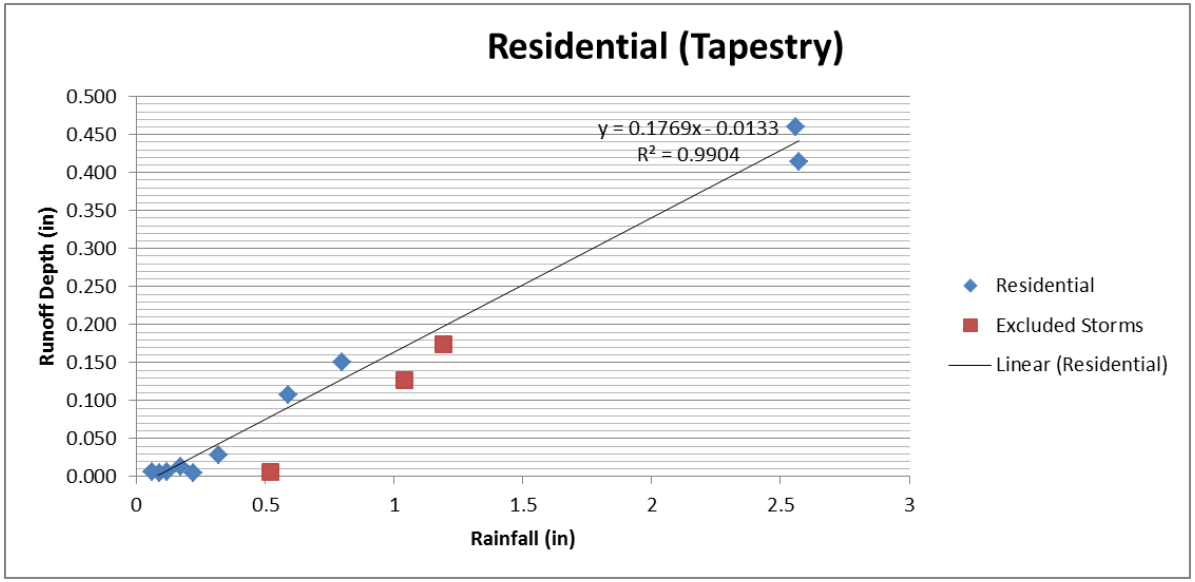
Different polygons for impervious or pervious runoff

Methods

- Extended application
  - Boyd method used to calibrate GIS method
    - GIS method uses total pervious runoff
    - Boyd method compares water depth from precipitation to runoff water depth
    - Difference is connected impervious runoff
  - Extended to pertinent larger Minnetonka watersheds
    - Commercial
    - Residential

Boyd Method Results

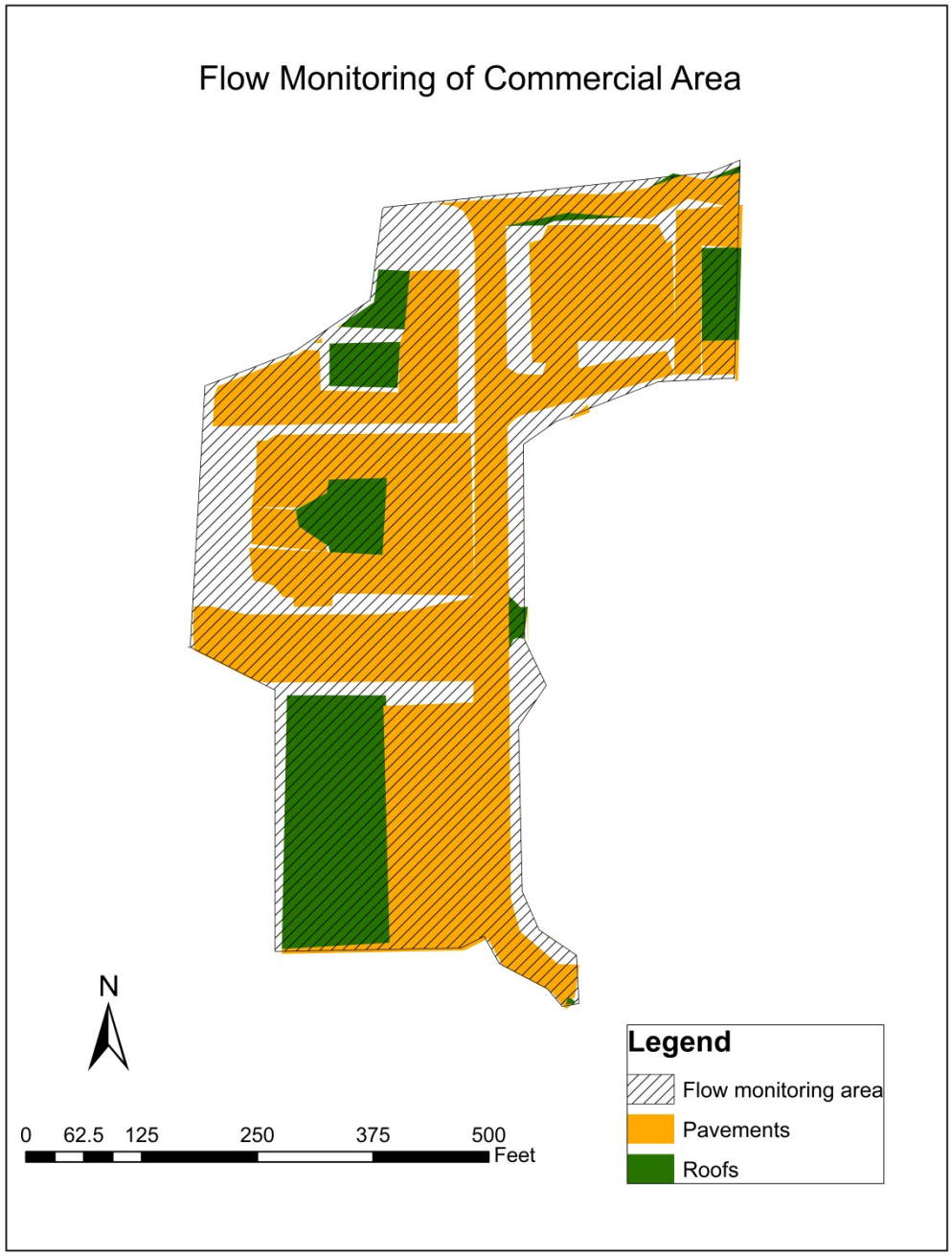




Excluding Storms
7/17/2010
8/31/2010
9/2/2010

Results

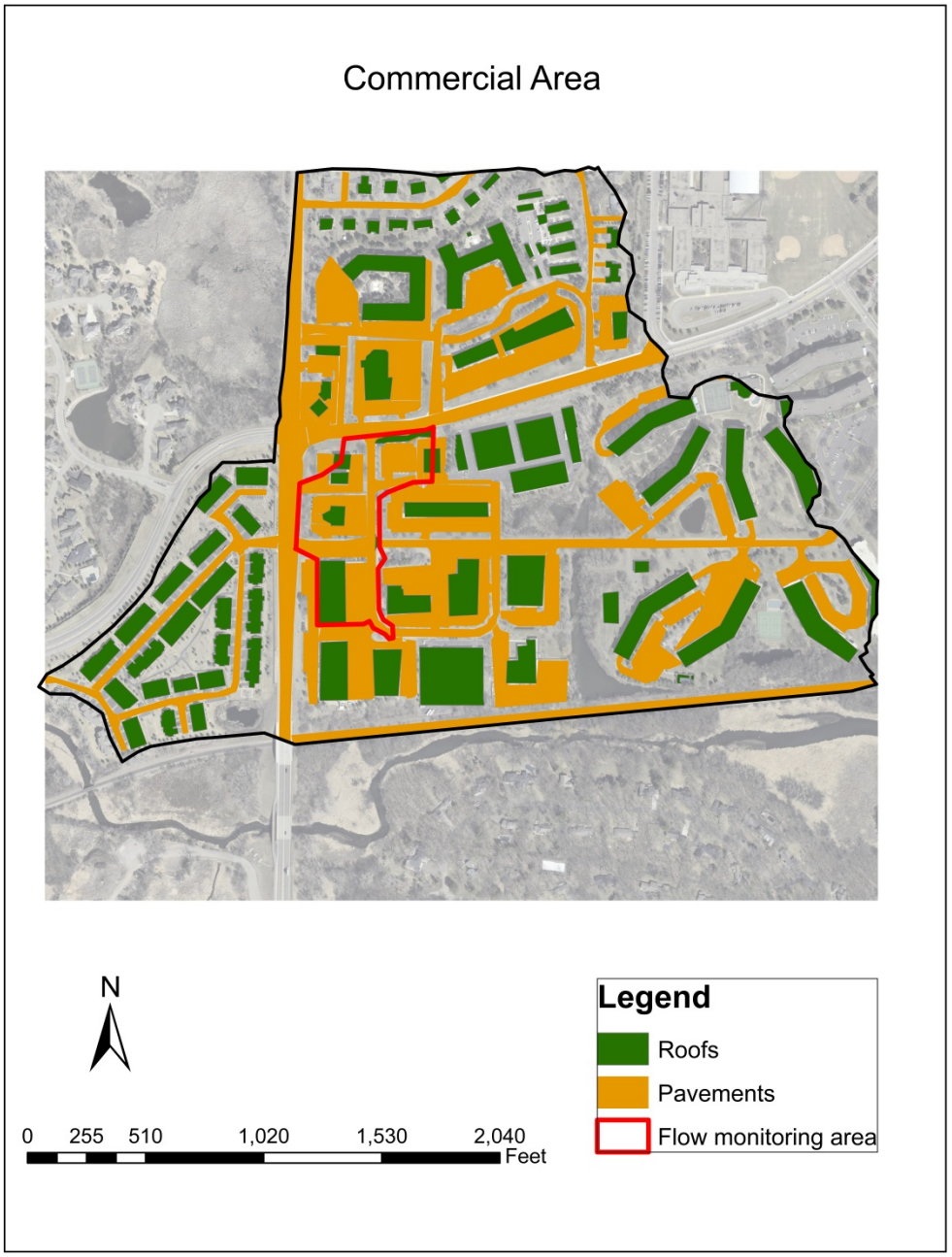
Commercial Area	
Surface	Area(ft^2)
Roof	61670
Pavement	198930
Impervious	260600
Total	297160
Boyd EIA(%)	54.7
GIS Percent Impervious(%)	87.7



Boyd EIA(%)	54.7
Percent Impervious(%)	87.7
Ratio	0.62373

Extended Area	
Surface	Area(ft^2)
Roof	561620
Pavement	919950
Impervious	1481560
Total	2644760

GIS Percent Impervious(%)	56.0
Corrected GIS for EIA(%)	34.9
Ratio	0.62373



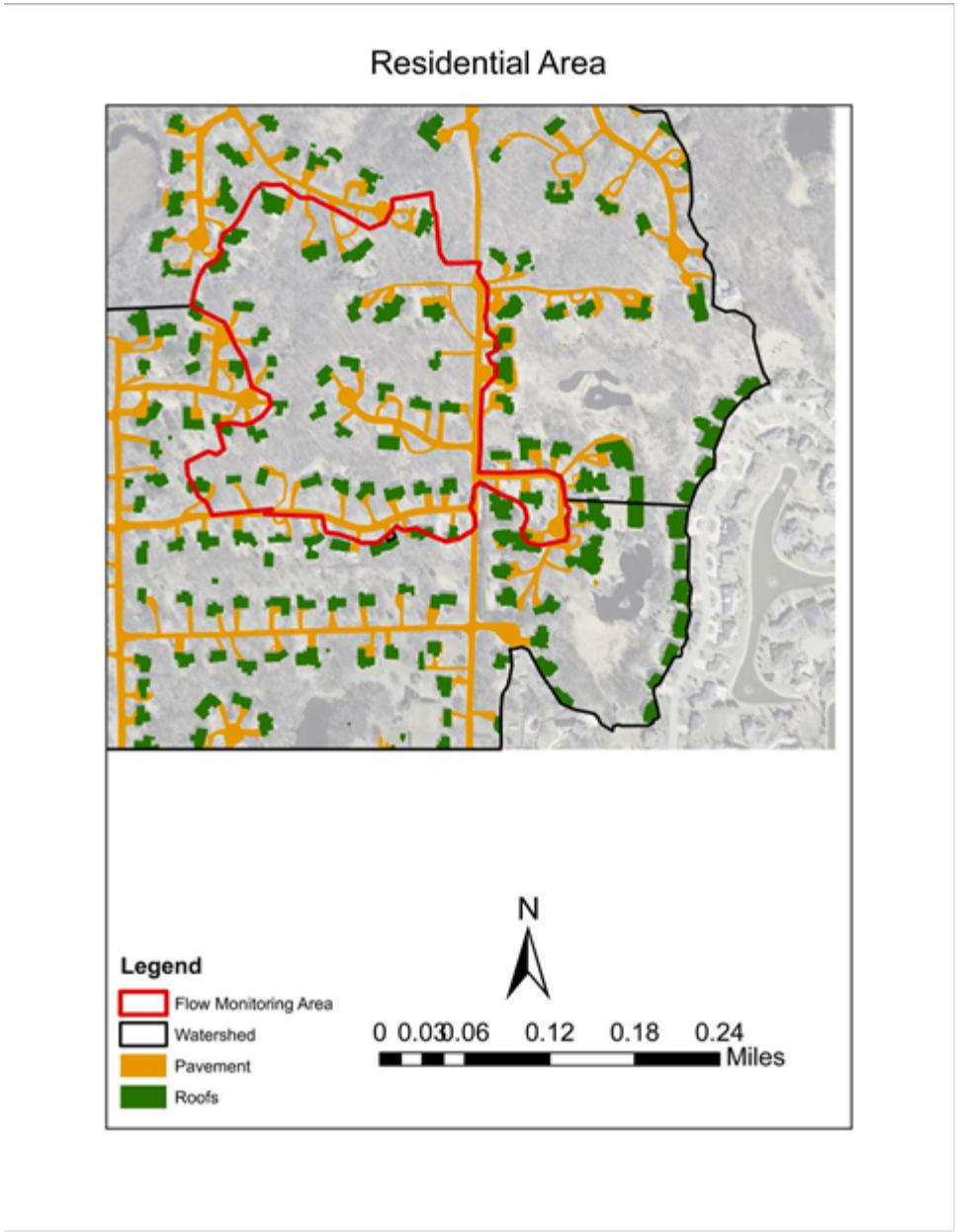
Results

Residential	
Surface	Area(ft^2)
Road	163440
Rooftop	118340
Total Impervious	281780
Total Area	1190580
Boyd EIA(%)	17.7
GIS Percent Impervious(%)	23.7

Boyd EIA(%)	17.7
Percent Impervious(%)	23.7
Ratio	0.74744

Extended Area	
Surface	Area(ft^2)
Roof	473070
Pavement	446970
Impervious	920040
Total	4134790

GIS Percent Impervious(%)	22.2
Corrected GIS for EIA(%)	16.6
Ratio	.74744



Conclusions

- Boyd method
  - Approximation of EIA
  - Simple to use
  - Requires flow monitoring data
- GIS method
  - Approximation of total impervious area
  - Good if flow monitoring data not available
  - Only satellite images needed
  - Subjective

Recommendations

- Increase monitored locations
  - Allows for use of Boyd method in more areas
- Collect data for more storms
  - Better approximation using Boyd method
  - Accounts for connected impervious
- Determine EIA with more storm events
  - Useful as input variable for watershed analysis

Use GIS method if monitored data not available

References

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