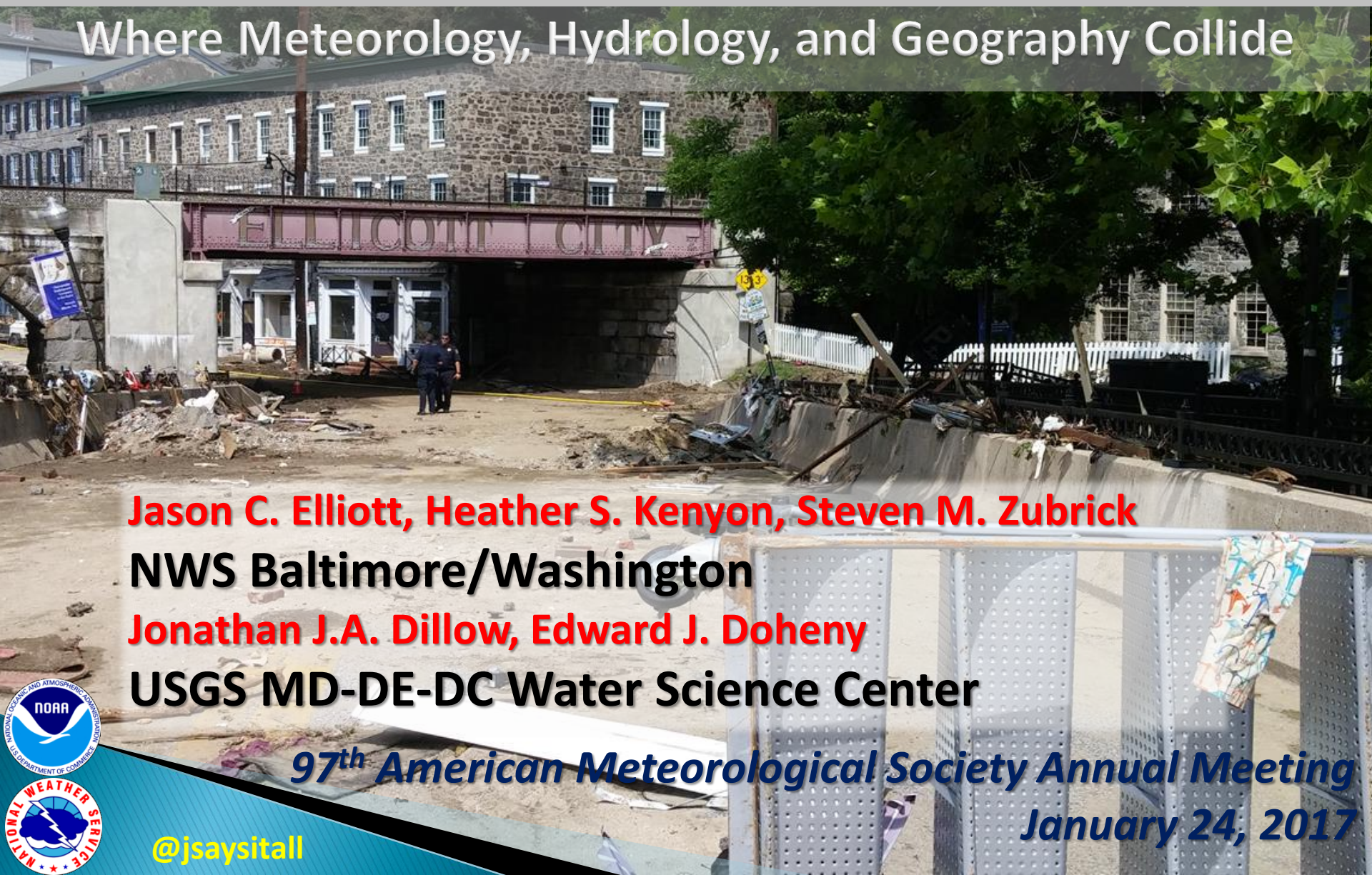


The Ellicott City, MD Flash Flood of 30 July 2016:

Where Meteorology, Hydrology, and Geography Collide



Jason C. Elliott, Heather S. Kenyon, Steven M. Zubrick

NWS Baltimore/Washington

Jonathan J.A. Dillow, Edward J. Doheny

USGS MD-DE-DC Water Science Center



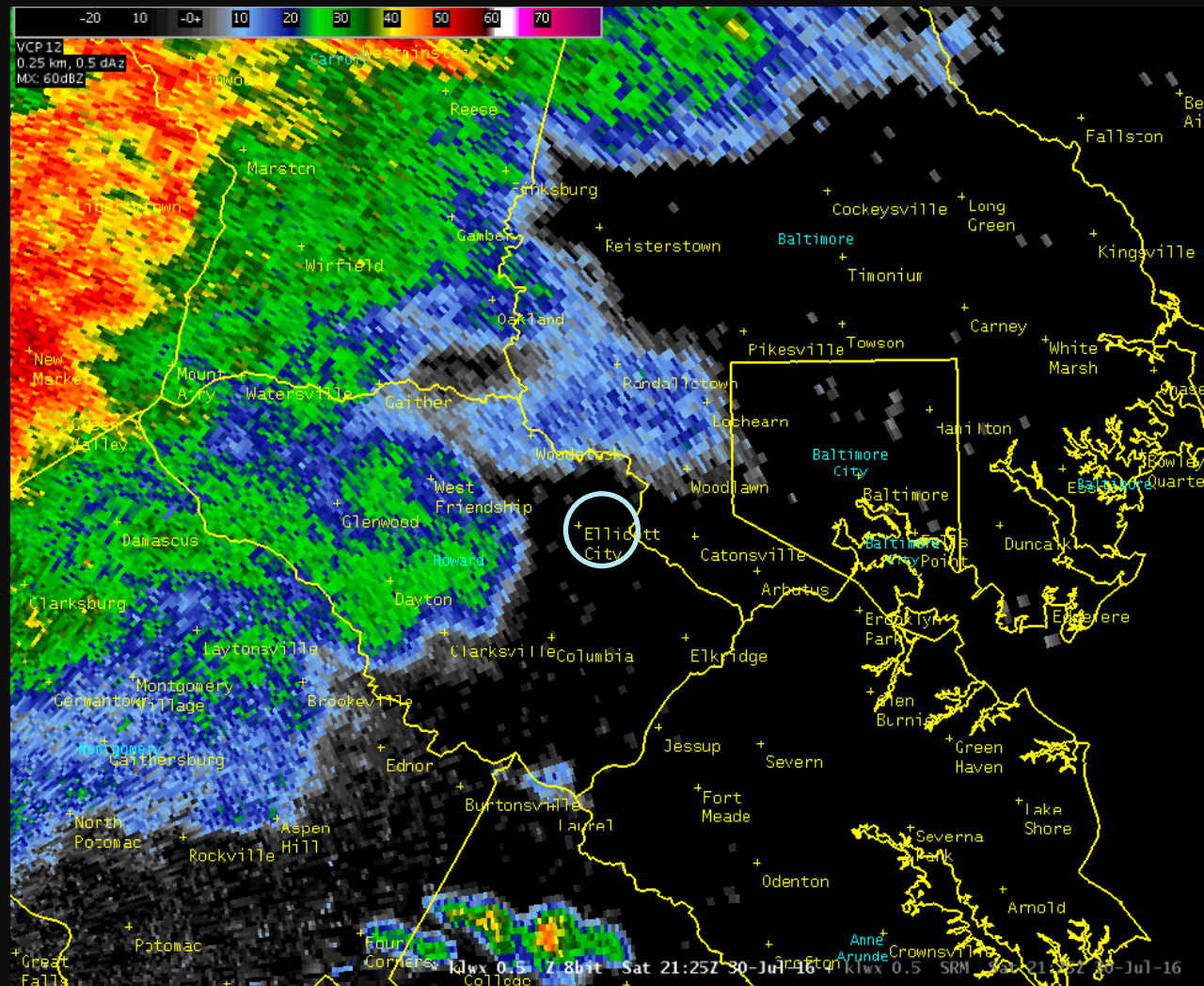
97th American Meteorological Society Annual Meeting
January 24, 2017

@jsaysitall

Overview

On the evening of July 30, 2016, heavy rain formed into a persistent band affecting a small multi-county area in central Maryland.

KLWX Radar loop from 2125 UTC 30 July to 0102 UTC 31 July

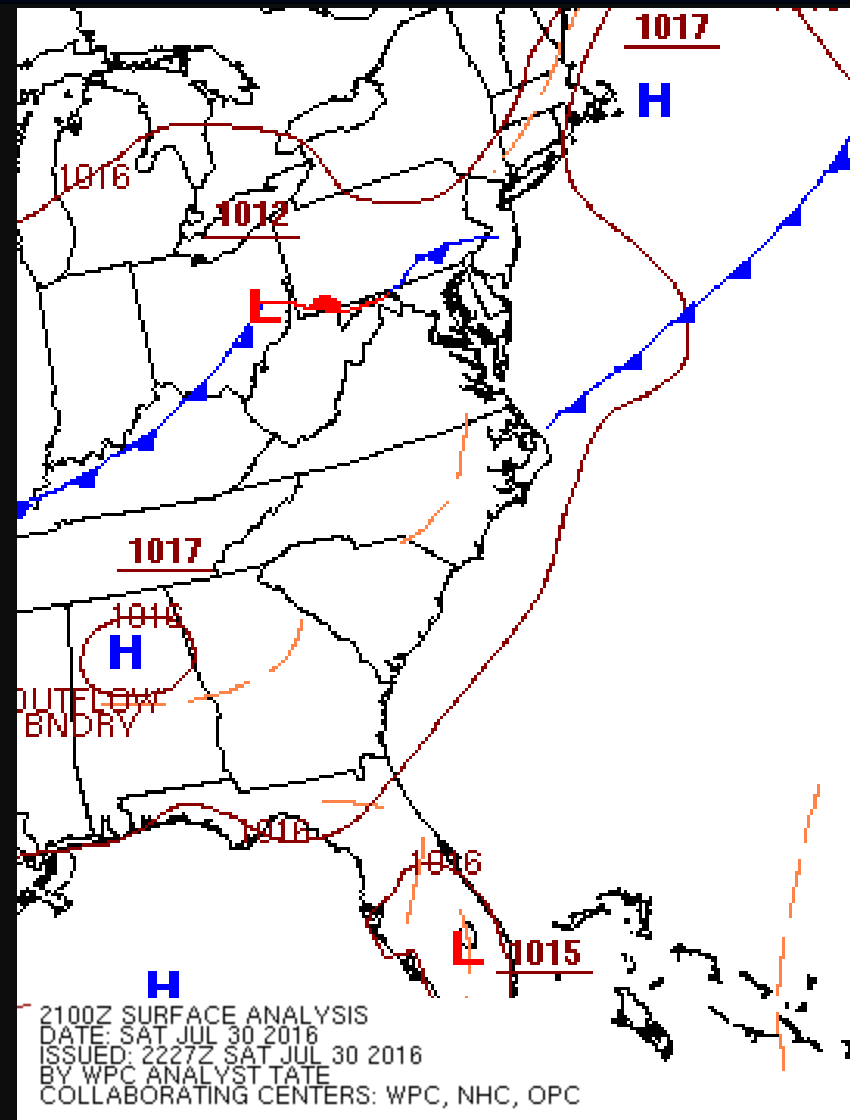
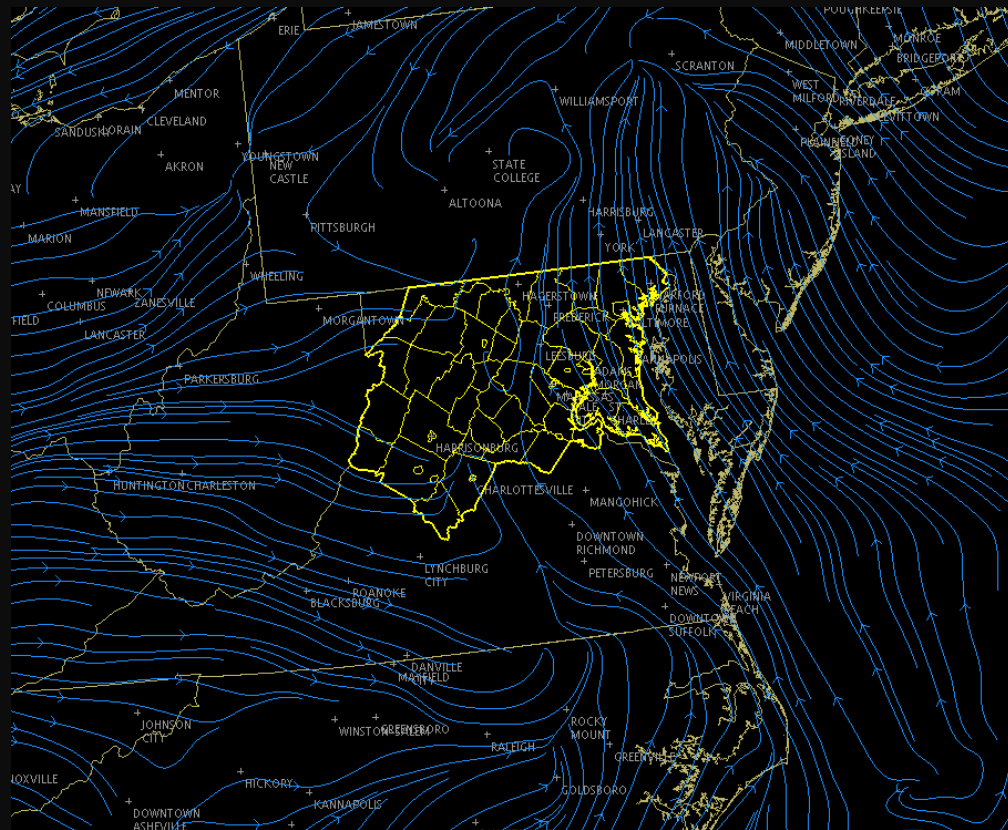


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Synoptic Setup

SFC boundary near Mason-Dixon Line
Strong low-level inflow off Atlantic



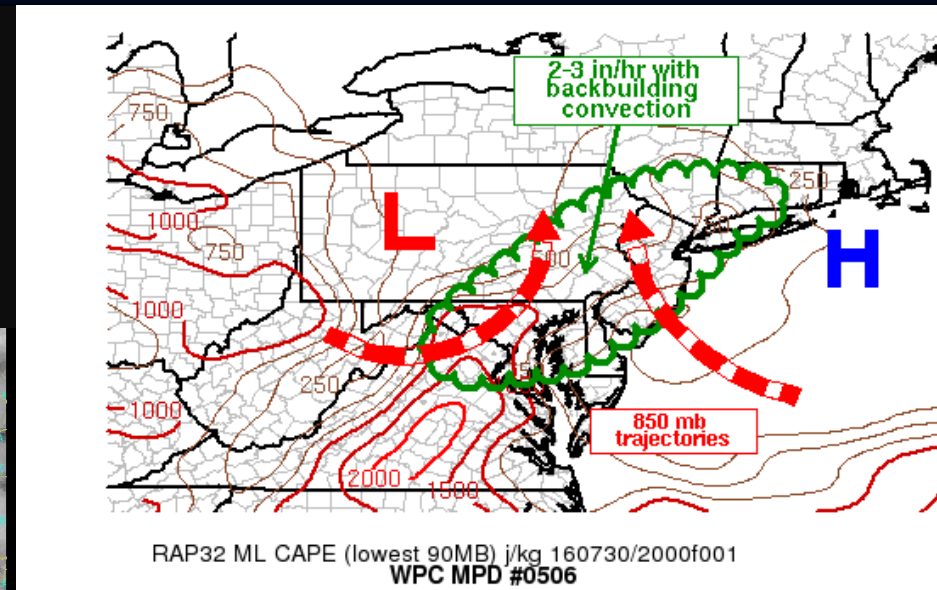
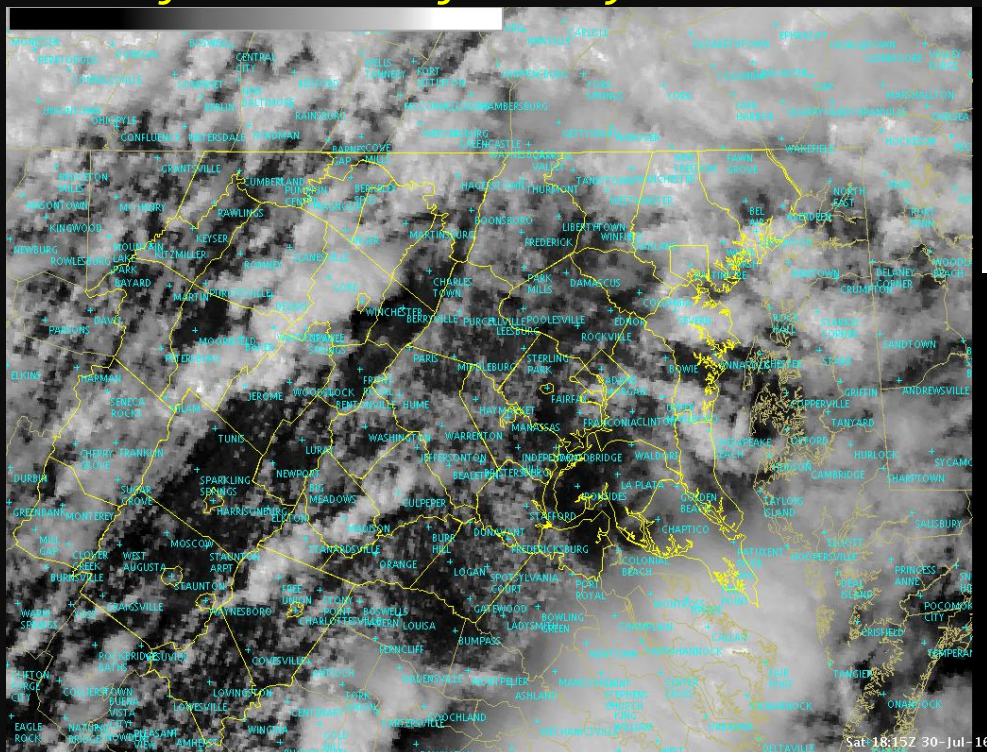
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Mesoscale Setup

WPC issued MPD #0506 at 5:00pm EDT indicating area was in region of convergent low-level flow

...but focus much of the day was on PA



Boundary appears on satellite prior to convective initiation in the vicinity of the ultimate heavy rain axis

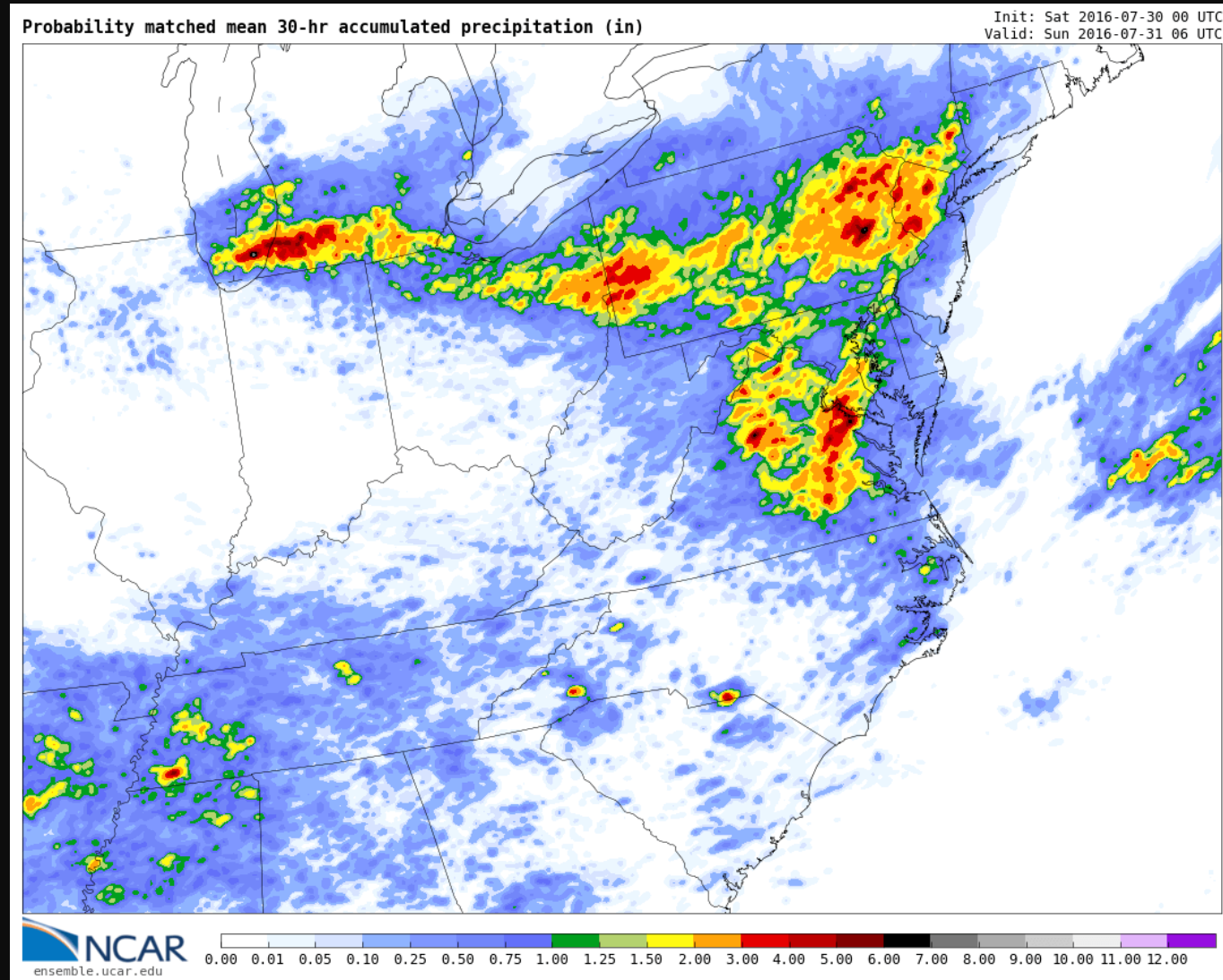


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CAM Output

What is becoming a “classic case” – a strong signal exists but it occurs in a *slightly* different location than CAMs



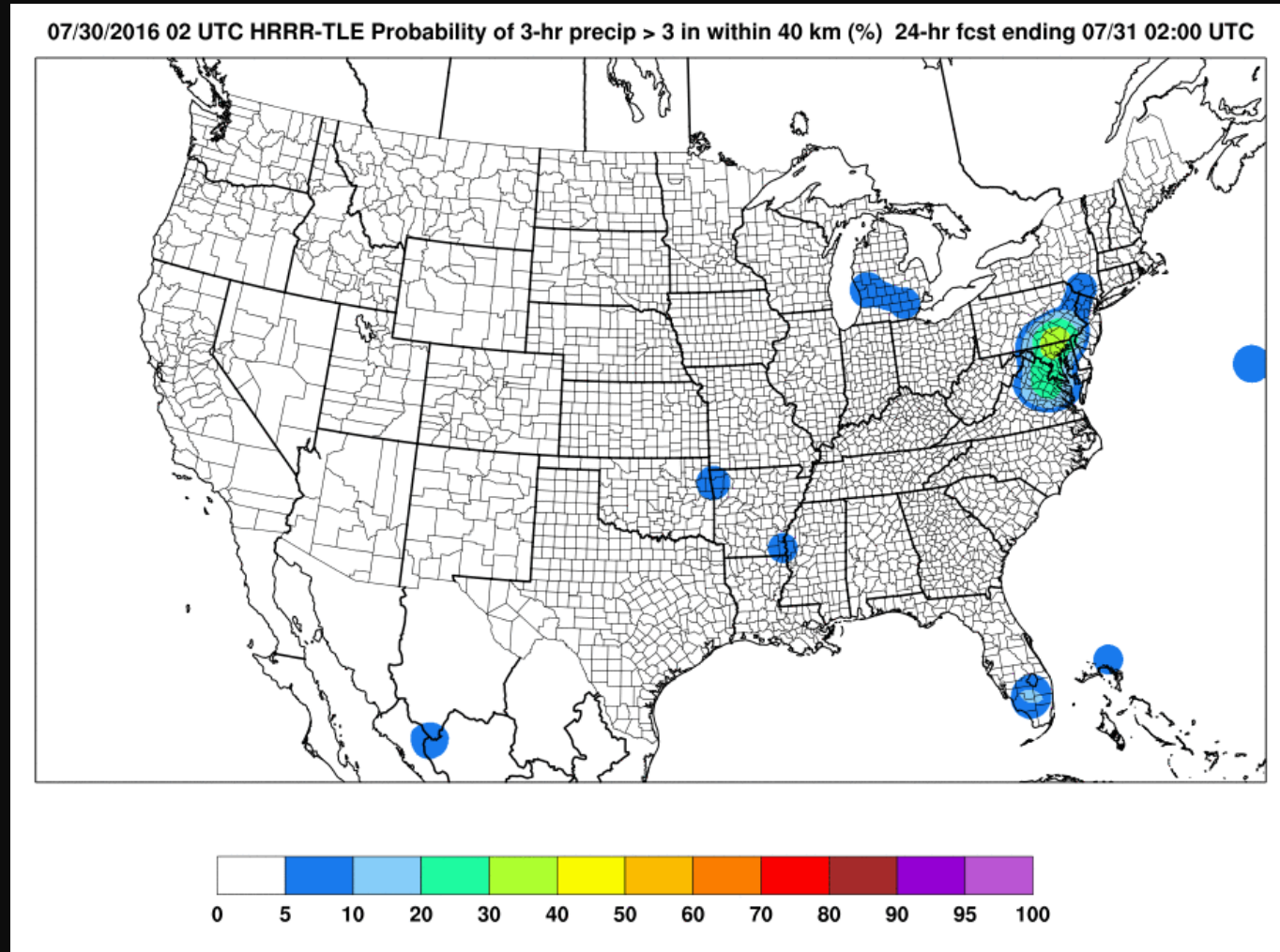
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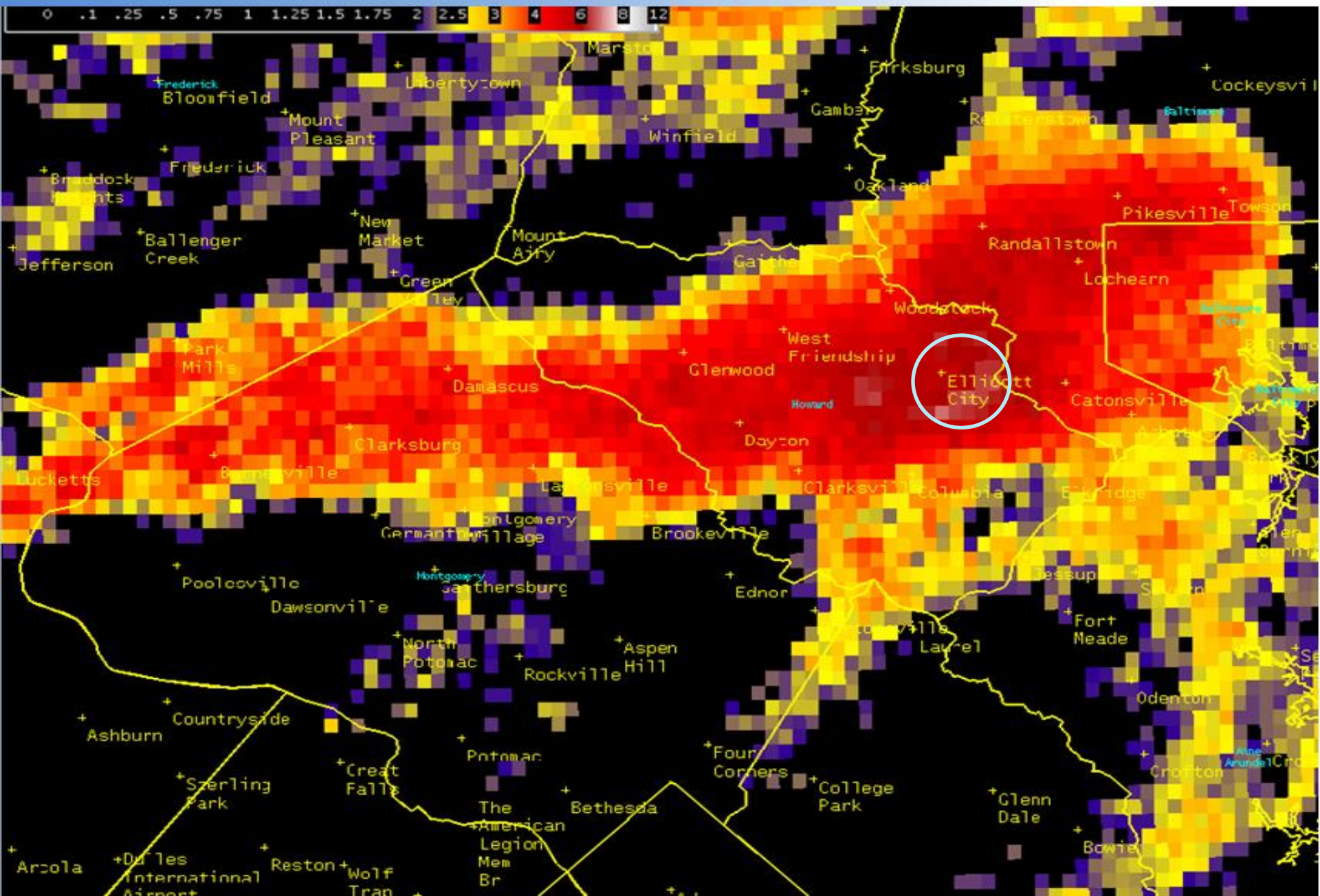
HRRR-TLE

What is becoming a “classic case” – a strong signal exists but it occurs in a *slightly* different location than CAMs

Also, “classic case” – notice the HRRR had it, lost it, and then got it back...



Precipitation Estimates – July 30, 2016



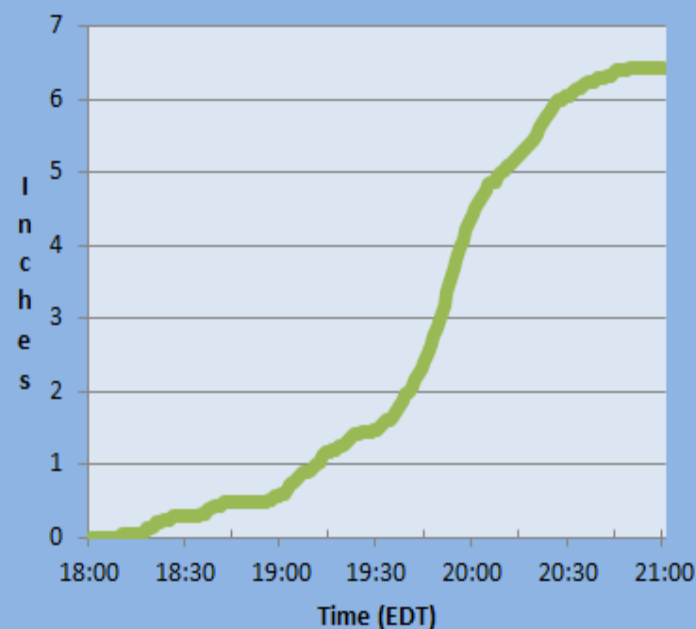
Extreme Precipitation

Historic Rainfall in Ellicott City, Maryland – July 30, 2016



Duration	Max Rainfall in Duration	Time of Occurrence
1 minute	0.20"	7:52pm-7:53pm
5 minutes	0.80"	7:50pm-7:55pm
10 minutes	1.44"	7:50pm-8:00pm
15 minutes	2.04"	7:46pm-8:01pm
20 minutes	2.44"	7:44pm-8:04pm
30 minutes	3.20"	7:36pm-8:06pm
60 minutes	4.56"	7:30pm-8:30pm
90 minutes	5.48"	7:00pm-8:30pm
2 hours	5.96"	6:50pm-8:50pm

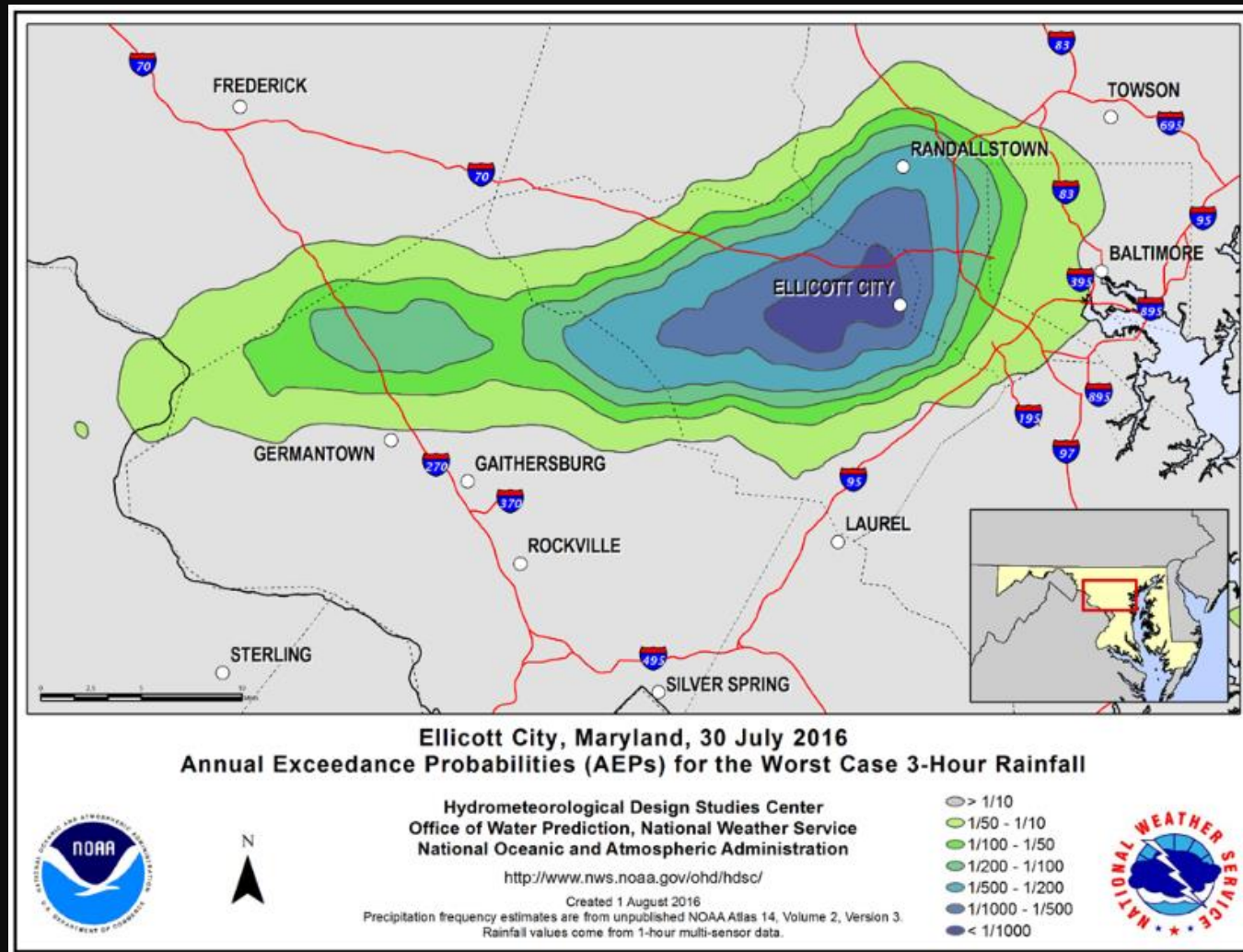
Total Rain in Ellicott City (ELYM2)



Storm Total Rainfall: 6.60 inches

*Information obtained from the Ellicott City (ELYM2) rain gauge.
This gauge reports in 0.04" increments.*

Precipitation Annual Exceedance



http://www.nws.noaa.gov/ohd/hdsc/aep_storm_analysis/

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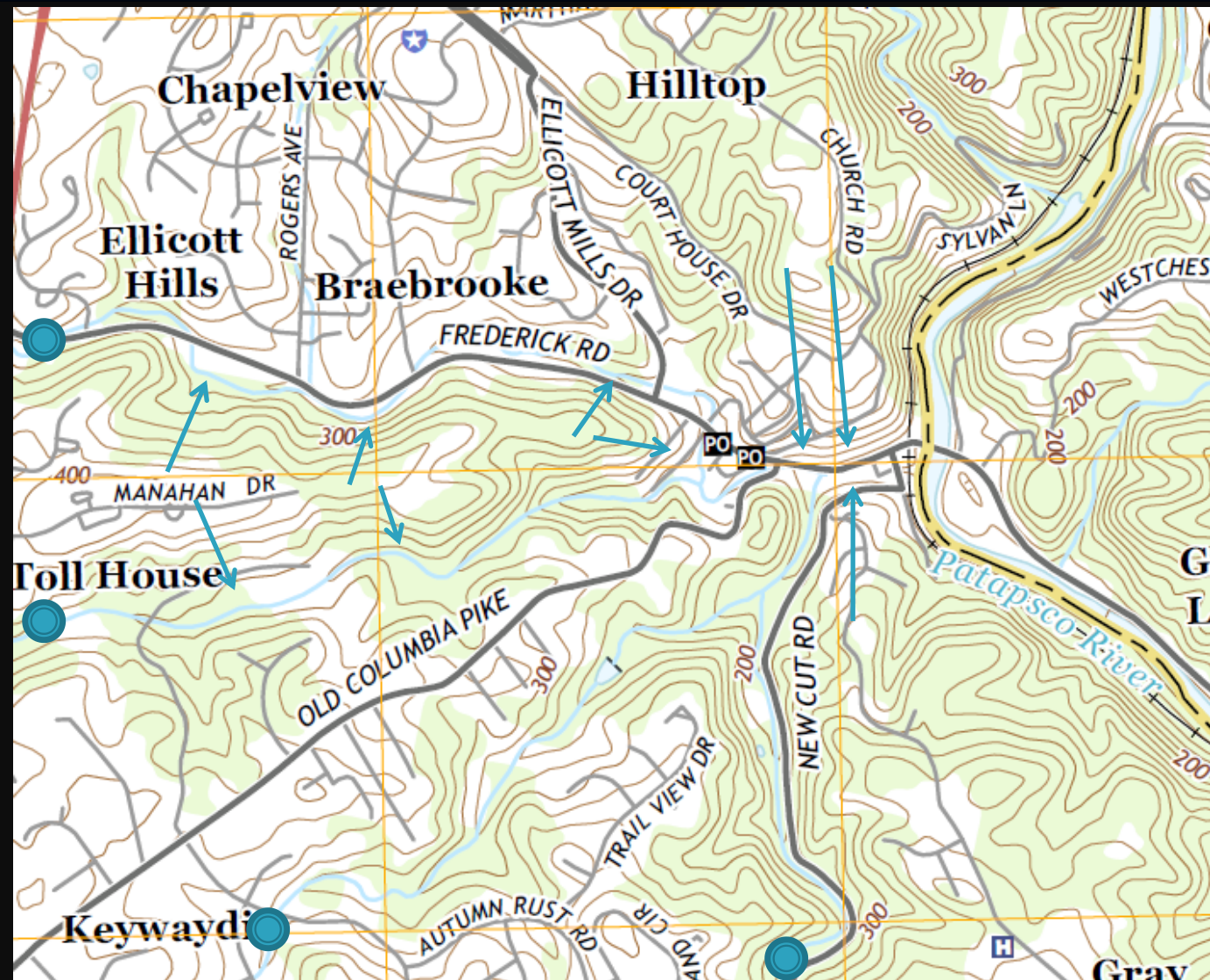


Geography – Tiber River Basin



Geography – Terrain & Streams

In addition to the four streams, local runoff can also occur off relatively steep terrain throughout the watershed.



Hudson Branch Hydrograph

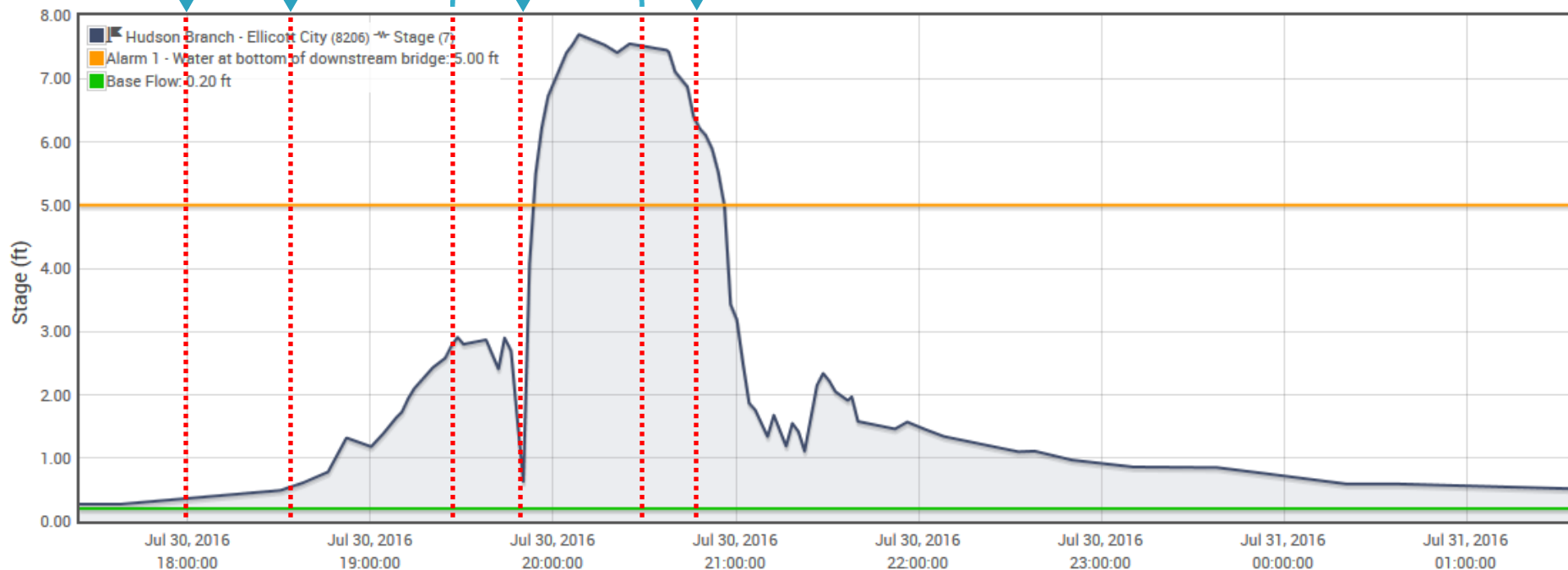
6:00pm:
Light rain
begins

6:34pm:
First heavy
shower

7:52pm:
Heaviest
1-min. RA

8:45pm:
Rain Ends

Period of
heaviest rain



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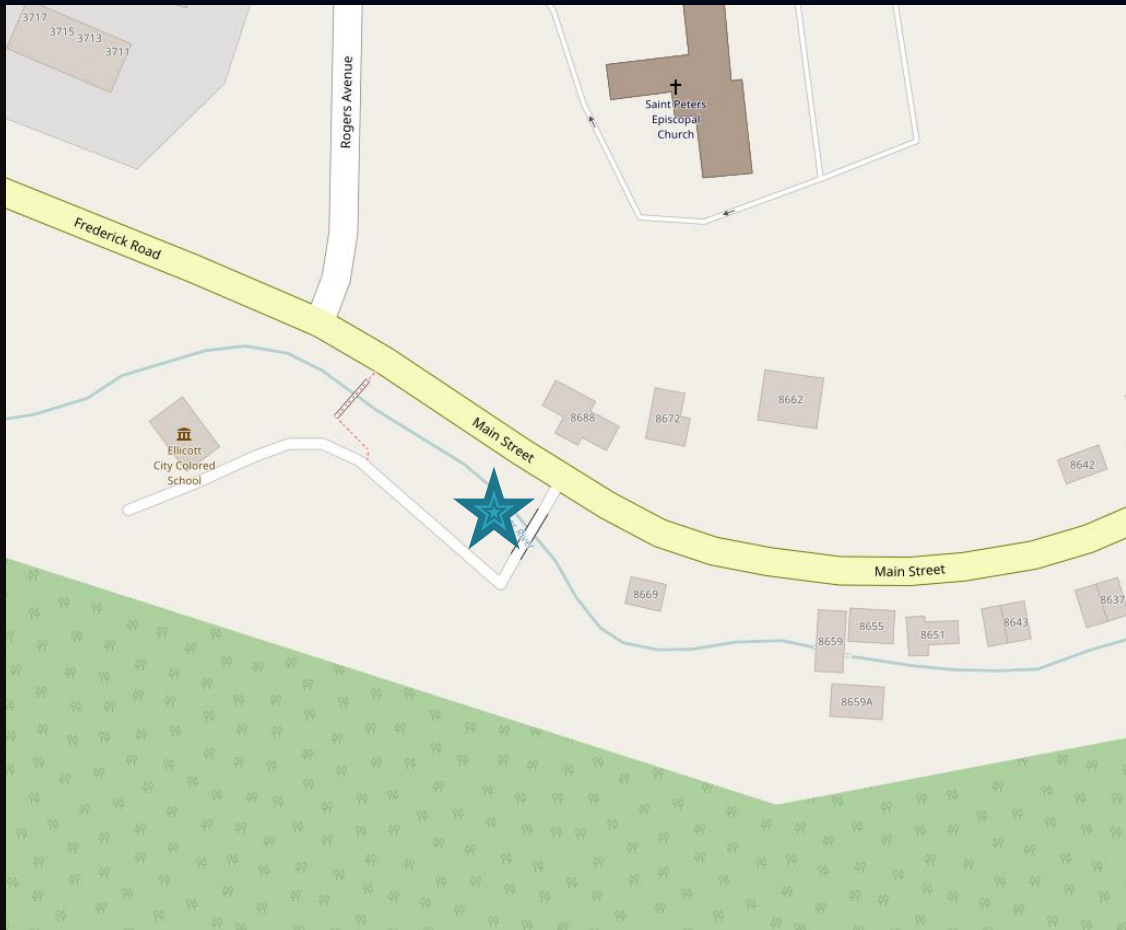


Hudson Branch Hydrograph

USGS computations:

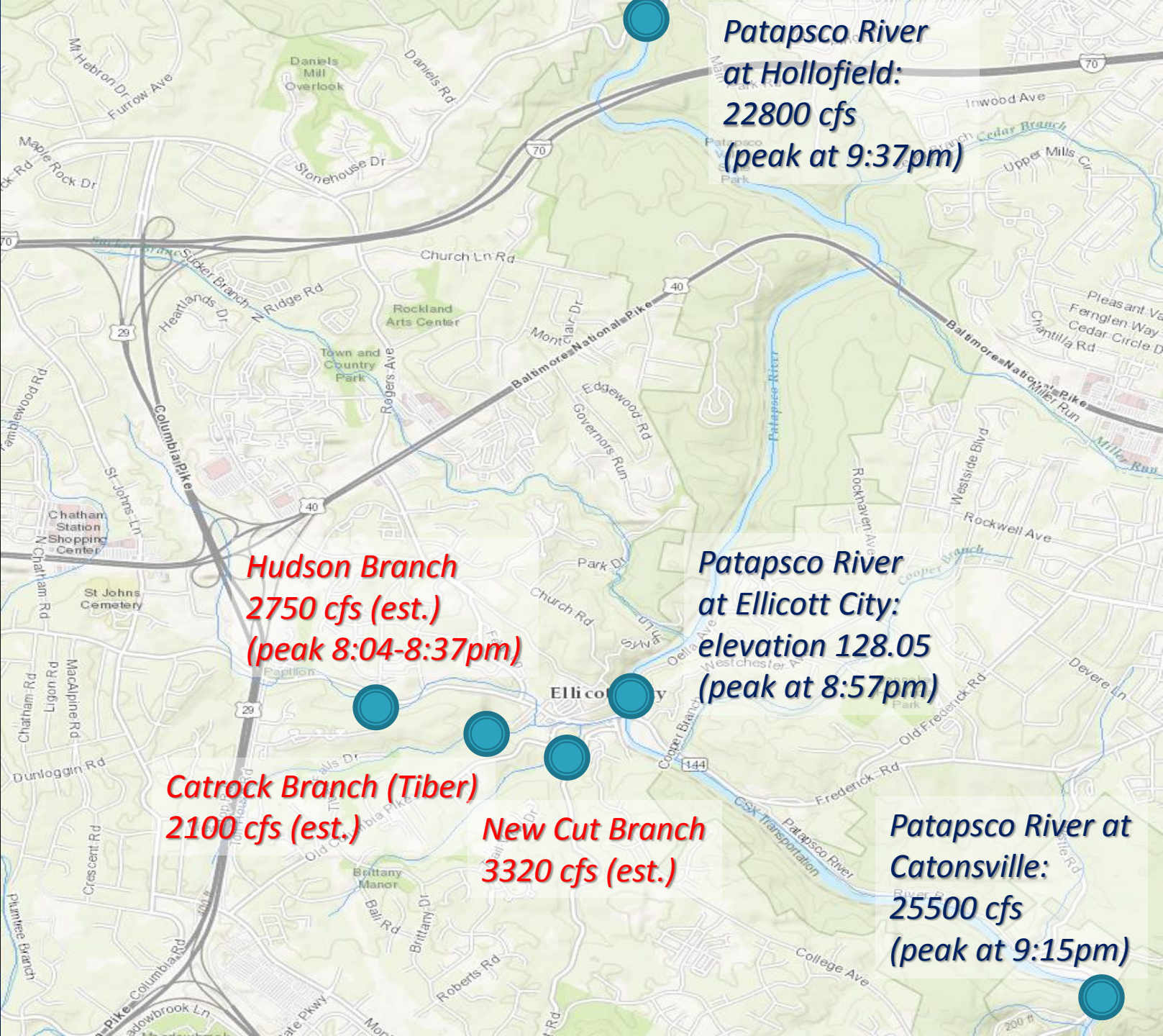
Bridge opening at gauge location can pass 525 cfs

Estimated flow on 30 July 2016 = 2750 cfs \pm 20%



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**Patapsco River
at Hollofield:**
22800 cfs
(peak at 9:37pm)

Hudson Branch
2750 cfs (est.)
(peak 8:04-8:37pm)

**Patapsco River
at Ellicott City:**
elevation 128.05
(peak at 8:57pm)

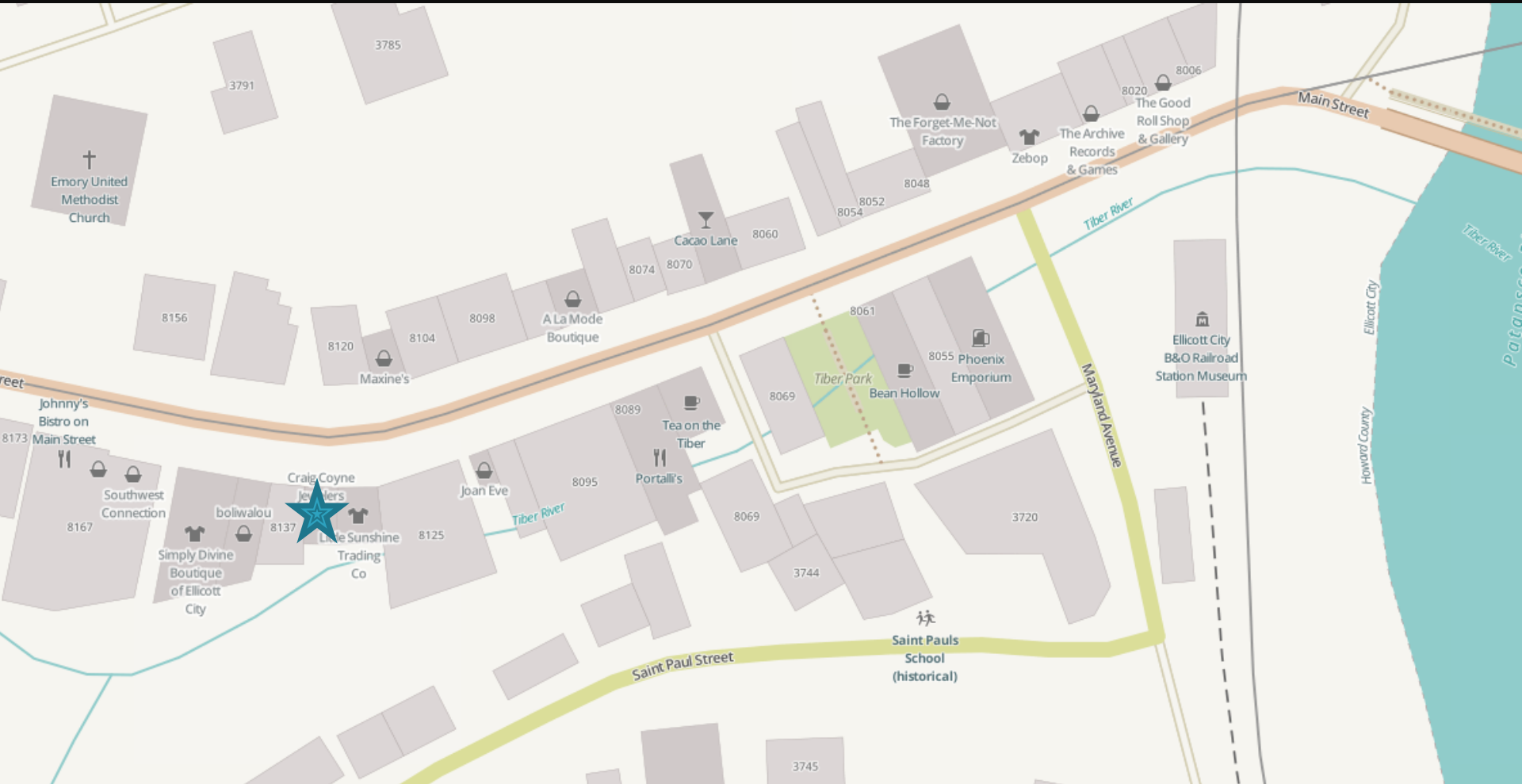
Catrock Branch (Tiber)
2100 cfs (est.)

New Cut Branch
3320 cfs (est.)

**Patapsco River at
Catonsville:**
25500 cfs
(peak at 9:15pm)



The Tiber is Trouble



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Ellicott City Flood – July 30, 2016

- ▶ **Security camera footage** (used with permission)
Craig Coyne Jewelers, Ellicott City



National Weather Service Baltimore/Washington



Timeline

- ▶ NWS issued flash flood warning: 7:18pm
- ▶ First flooding in Ellicott City's West End: 7:54pm
- ▶ Water enters buildings from Tiber River: 8:04pm
- ▶ Main Street Ellicott City starts to flood: 8:05pm
- ▶ Flash Flooding reaches its worst: 8:15pm
- ▶ Patapsco River reaches flood stage: 8:25pm
- ▶ Deepest flooding on lower Main Street: 8:45pm
- ▶ Patapsco River crests: 8:57pm
- ▶ Patapsco River falls below flood stage: 11:00pm

<http://www.weather.gov/baltimore/EllicottCityFlood2016>



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Questions?

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<http://www.weather.gov/baltimore/EllicottCityFlood2016>



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