NOAA's National Weather Service Reservoir Simulations for the Delaware River Basin Flood of June, 2006

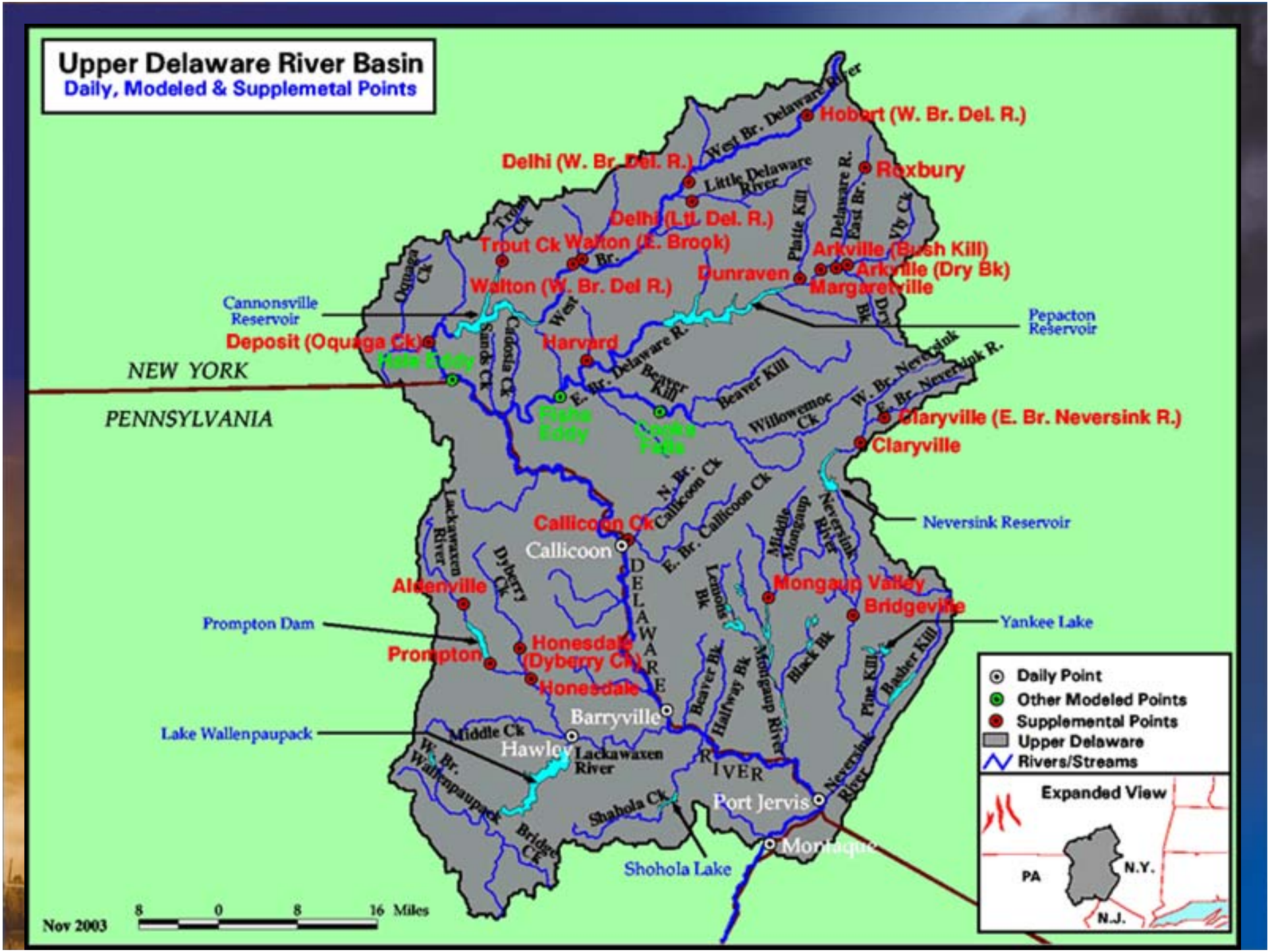
Ted Rodgers

Hydrologist

Middle Atlantic River Forecast Center, State College, PA

Outline

- Overview of Upper Delaware Basin
- 5 Case Scenarios and the Actual Event
- Results (Differences in Stage and Flow)
- Conclusions (Effects of Dams on Flood Crests)
- Limit on Application of Results


Upper Delaware River Basin
Daily, Modeled & Supplemetal Points
Hobert (W. Br. Del. R.)
Delhi (W. Br. Del. R.)
Roxbury
Delhi (Ltl. Del. R.)
Trout Ck
Walton (E. Brook)
Walton (W. Br. Del R.)
Arkville (Bush Kill)
Arkville (Dry Bk)
Dunraven
Margaretville
Cannonsville Reservoir
Pepacton Reservoir
Deposit (Oquaga Ck)
Fish Eddy
Harvard
NEW YORK
PENNSYLVANIA
Cooks Falls
Claryville (E. Br. Neversink R.)
Claryville
Callicoon Ck
Callicoon
Neversink Reservoir
Aldenville
Mongaup Valley
Bridgeville
Prompton Dam
Yankee Lake
Prompton
Honesdale (Dyberry Ck)
Honesdale
Barryville
Lake Wallenpaupack
Hawley
Port Jervis
Shohola Ck
Shohola Lake
Daily Point
Other Modeled Points
Supplemental Points
Upper Delaware
Rivers/Streams
Expanded View
PA
N.Y.
N.J.
8 0 8 16 Miles
Nov 2003

- **Case 1 – No Reservoir / Pass Outflow as Inflow**
- Cannonsville and Pepacton – Substituted inflow for outflow in the model.

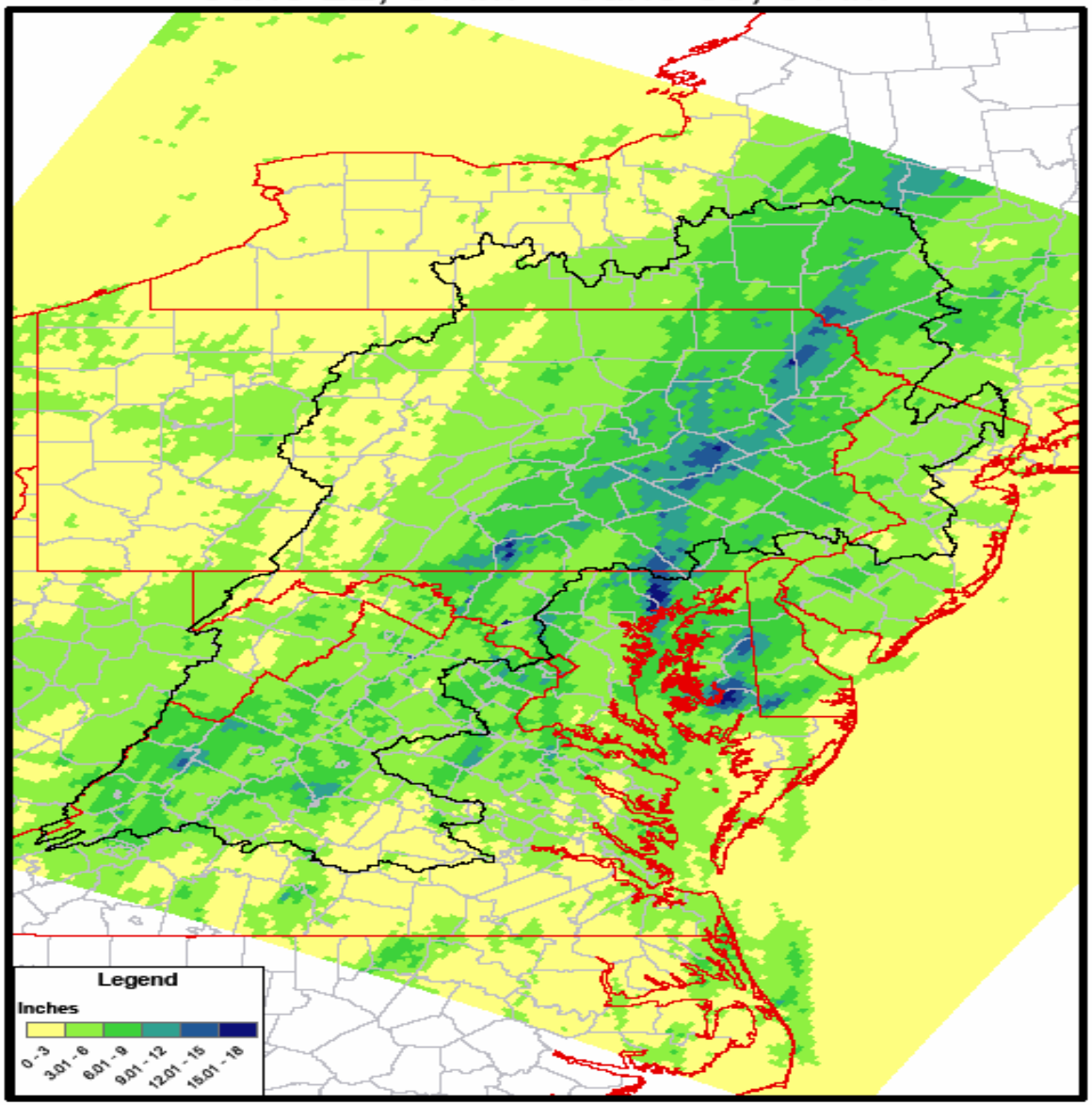
- **Case 2 – Void about 2.5 billion gallons**
- Pool Elevations 8 am June 22nd Cannonsville 1148.5 ft Pepacton 1278.5 ft

- **Case 3 – Void about 5 billion gallons**
- Pool Elevations 8 am June 22nd Cannonsville 1147.0 ft Pepacton 1277.0 ft

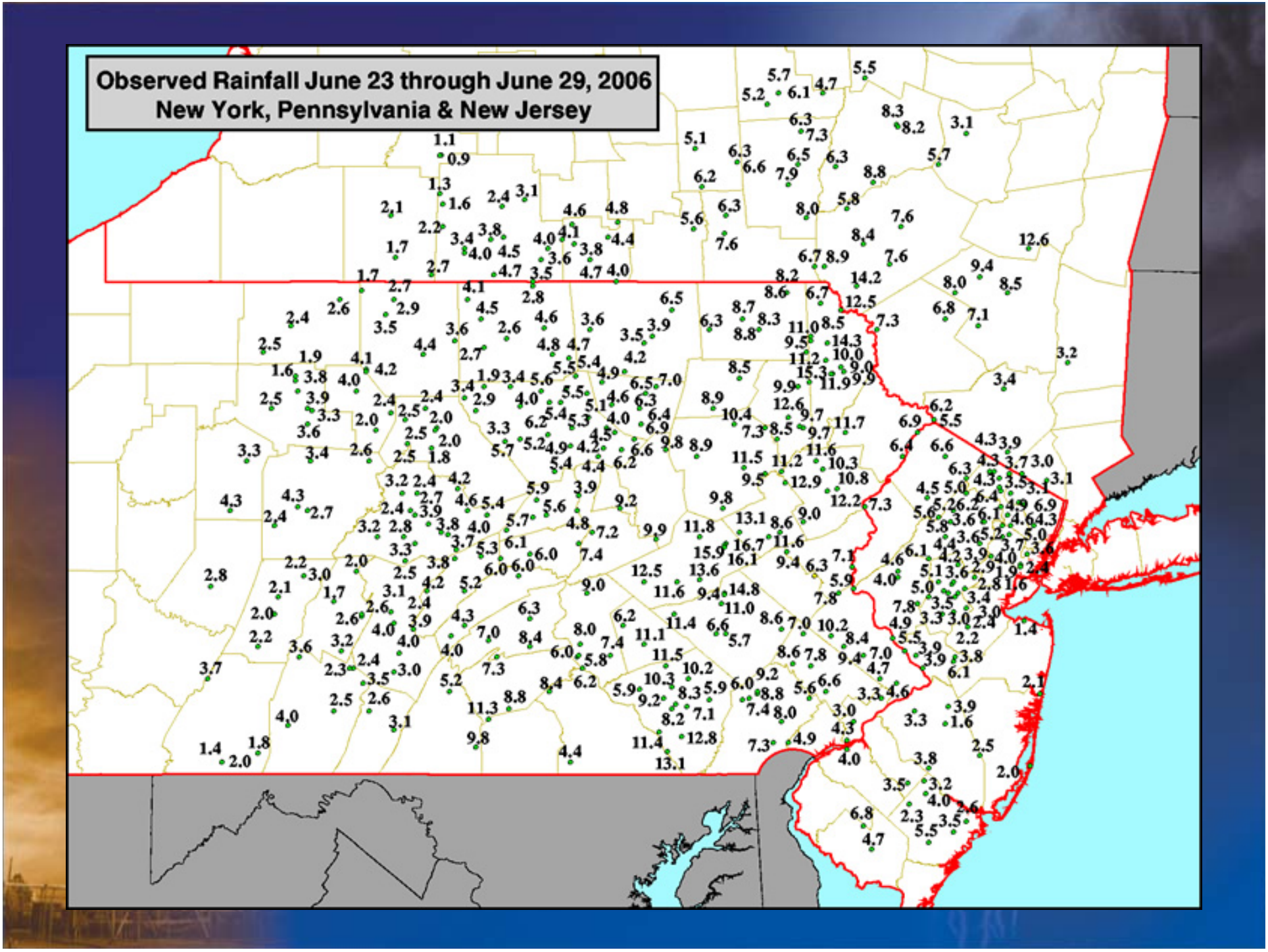
- **Case 4 – Void 10 billion gallons**
- Pool Elevations 8 am June 22nd Cannonsville 1143.3 ft Pepacton 1274.5 ft

- **Case 5 – No Spill**
- Outflow set to zero in the model. No spill contributions on crests from Cannonsville and Pepacton.
- Pool Elevations 8 am June 22nd Cannonsville 1108.4 ft Pepacton 1260.0

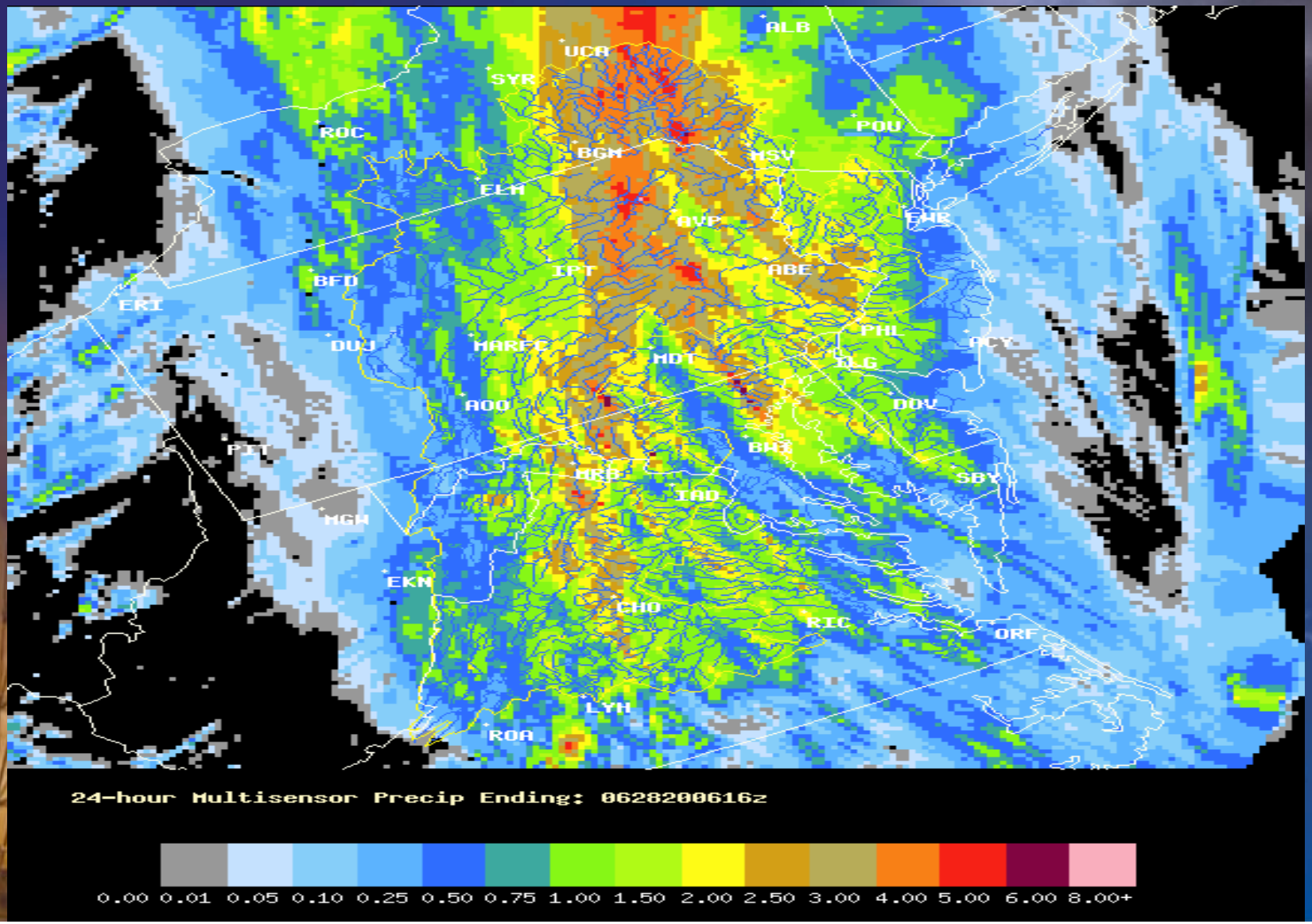
MPE Rainfall Totals (preliminary)
June 22, 8 AM - June 30, 8 AM



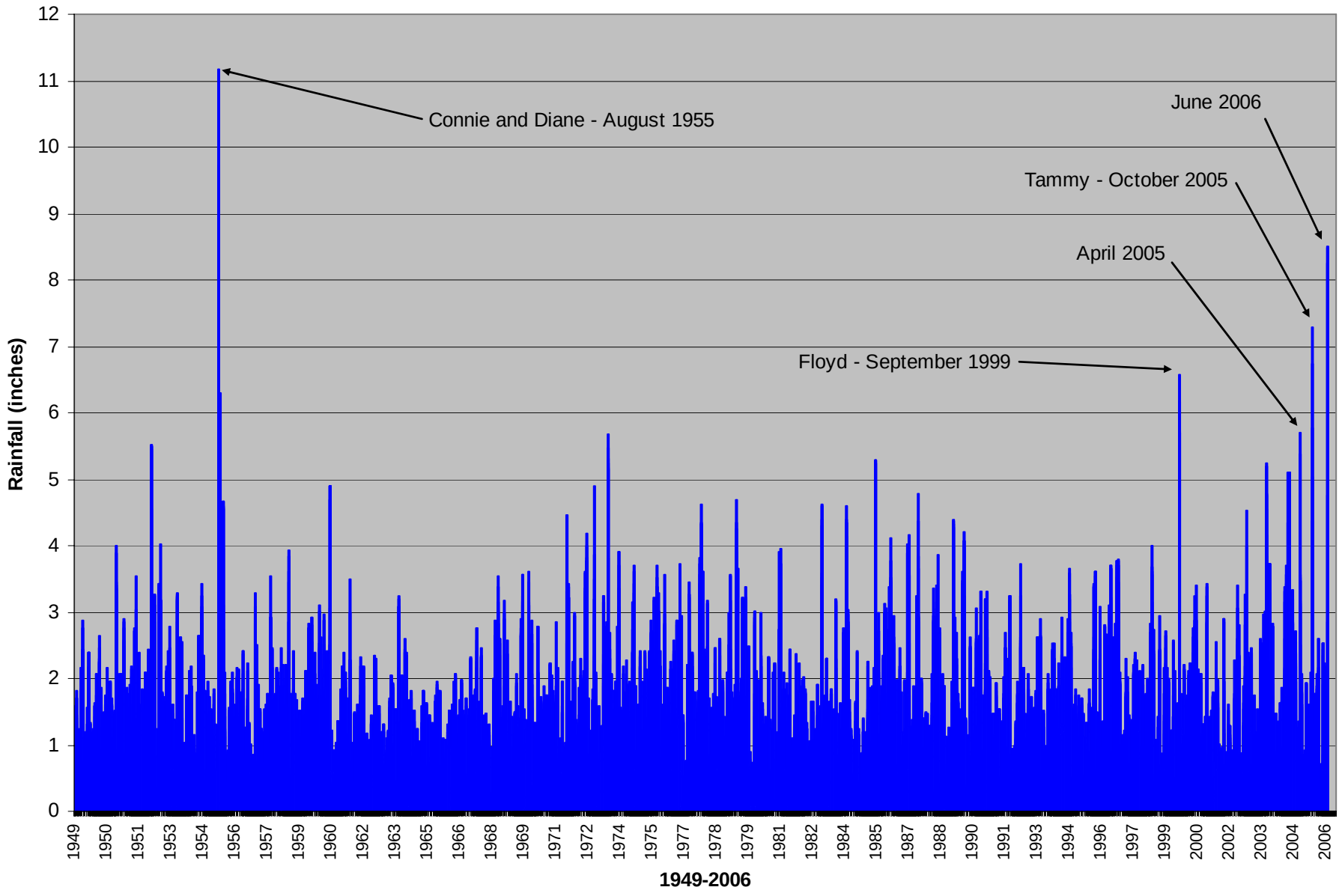
MARFC 6/30/2006

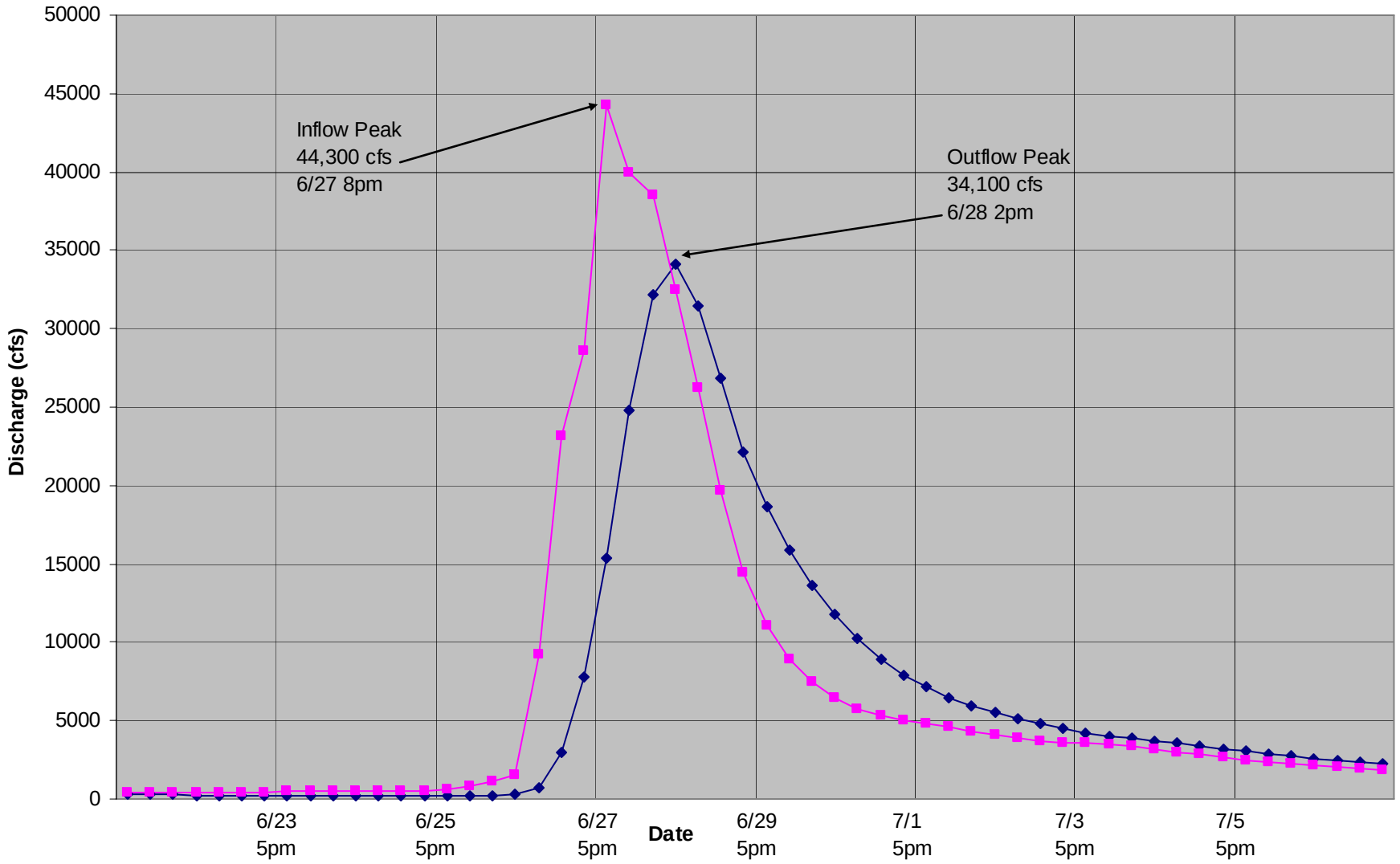

Observed Rainfall June 23 through June 29, 2006
New York, Pennsylvania & New Jersey

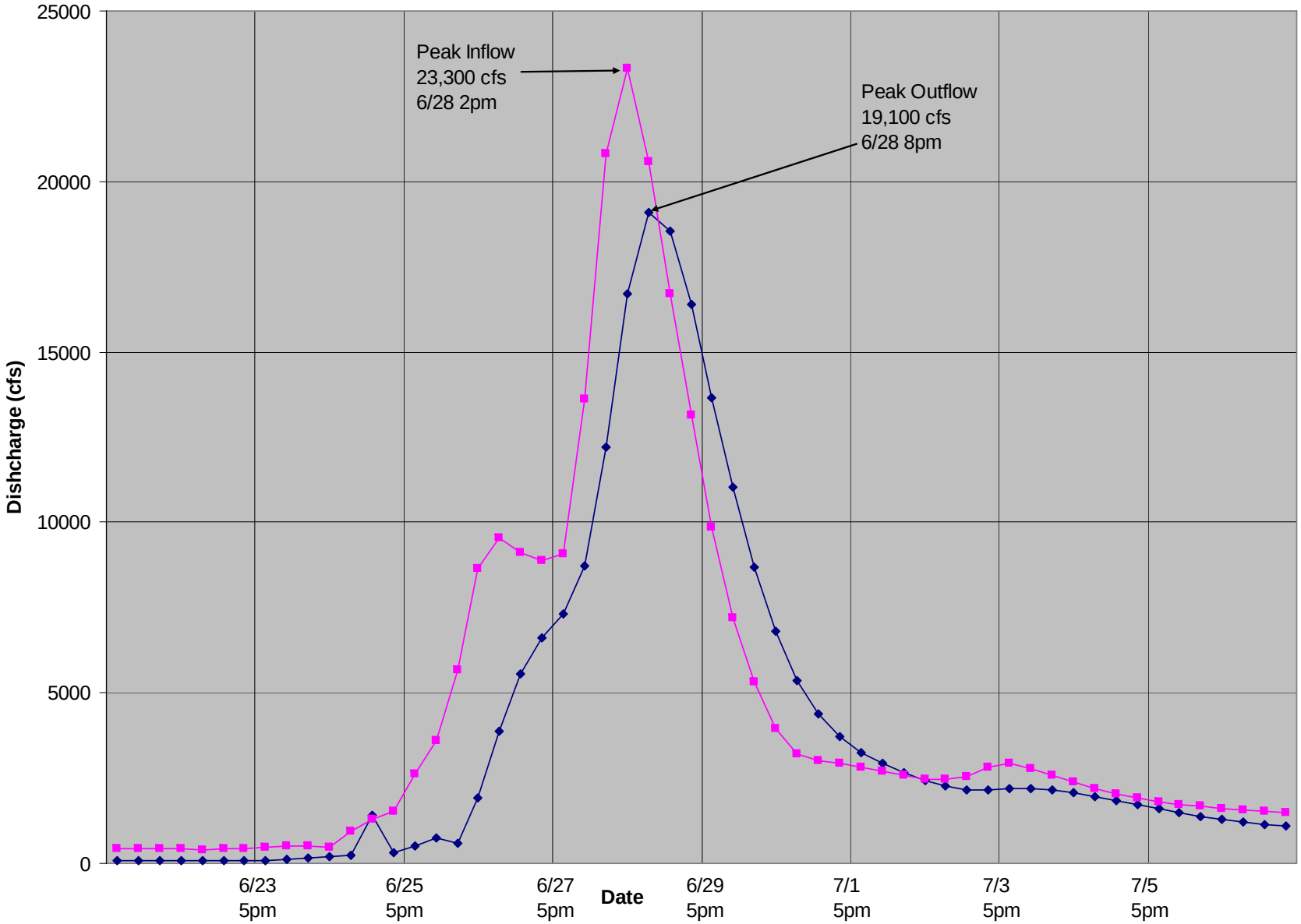
24 Hour Rainfall ending noon 6/28



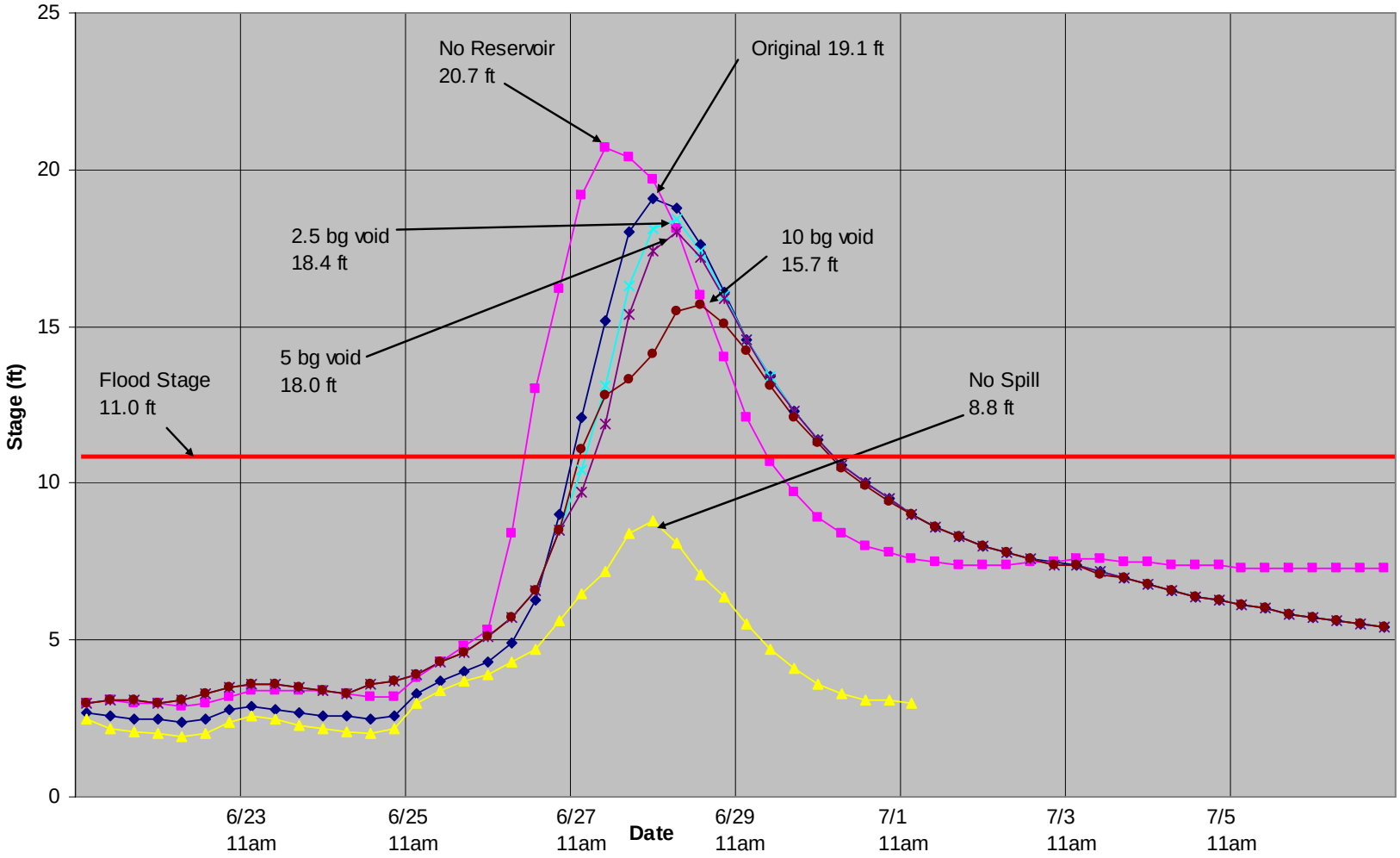
Upper Delaware Basin 7-Day MAP (running total)

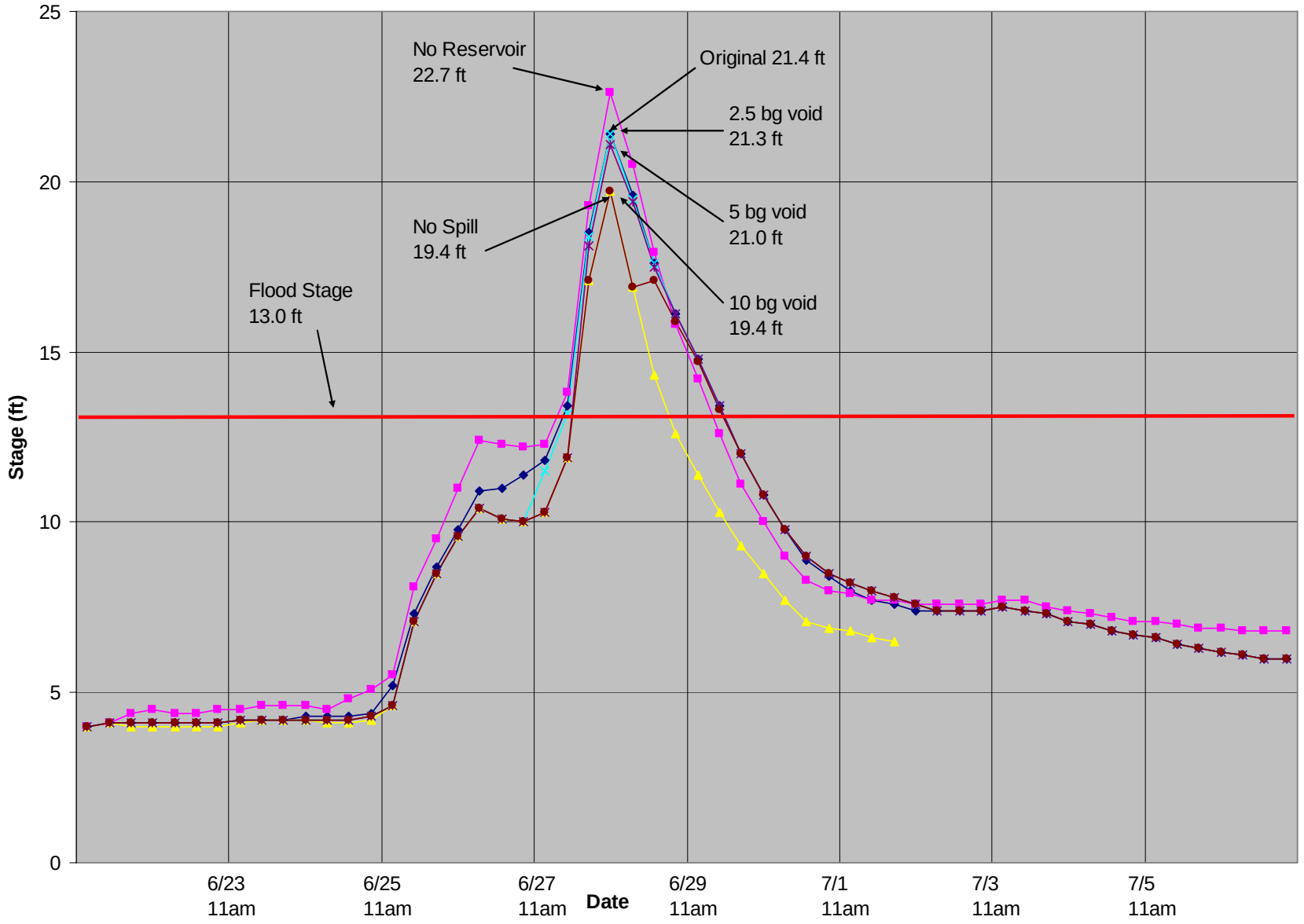


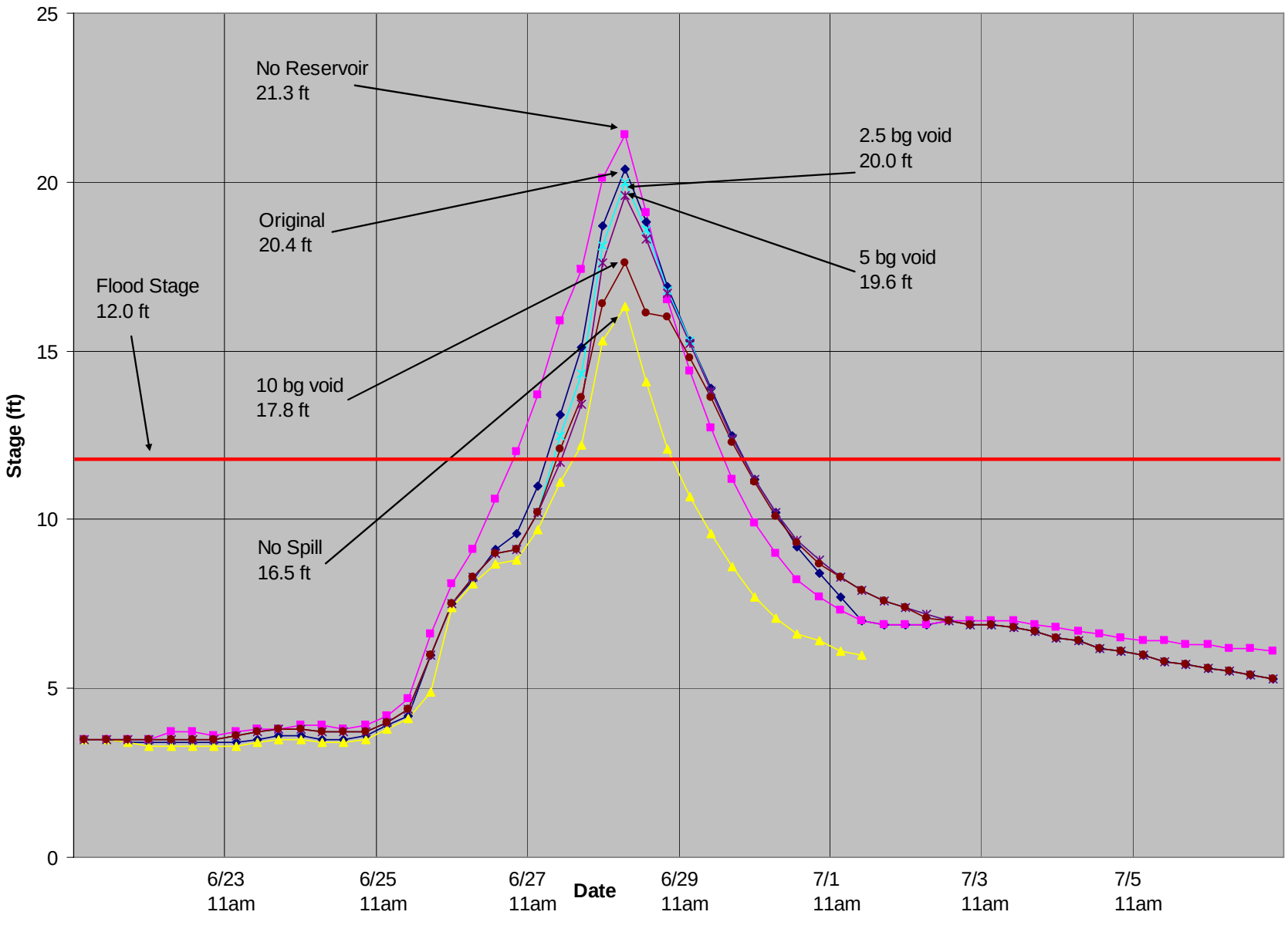

Cannonsville June 2006 (inflow vs outflow)
Discharge (cfs)
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
Inflow Peak
44,300 cfs
6/27 8pm
Outflow Peak
34,100 cfs
6/28 2pm
6/23
5pm
6/25
5pm
6/27
5pm
Date
6/29
5pm
7/1
5pm
7/3
5pm
7/5
5pm

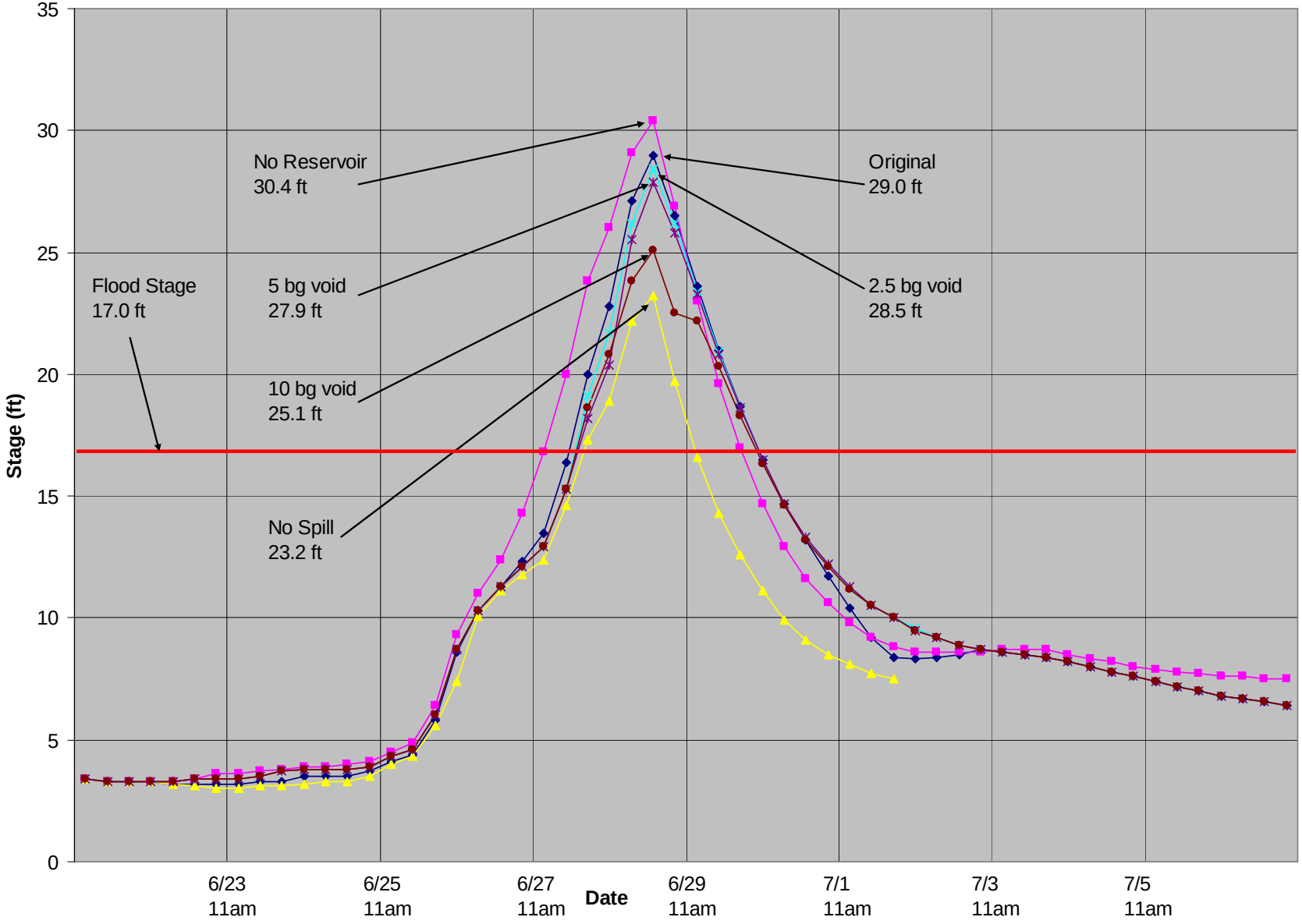

Pepacton June 2006 (inflow vs outflow)
Peak Inflow
23,300 cfs
6/28 2pm
Peak Outflow
19,100 cfs
6/28 8pm
Dischcharge (cfs)
25000
20000
15000
10000
5000
0
6/23
5pm
6/25
5pm
6/27
5pm
Date
6/29
5pm
7/1
5pm
7/3
5pm
7/5
5pm

Hale Eddy (all scenarios)




Fishs Eddy (all scenarios)
No Reservoir
22.7 ft
Original 21.4 ft
2.5 bg void
21.3 ft
5 bg void
21.0 ft
No Spill
19.4 ft
10 bg void
19.4 ft
Flood Stage
13.0 ft
Stage (ft)
25
20
15
10
5
0
6/23
11am
6/25
11am
6/27
11am
Date
6/29
11am
7/1
11am
7/3
11am
7/5
11am


Callicoon (all scenarios)
Stage (ft)
25
20
15
10
5
0
No Reservoir
21.3 ft
2.5 bg void
20.0 ft
Original
20.4 ft
5 bg void
19.6 ft
Flood Stage
12.0 ft
10 bg void
17.8 ft
No Spill
16.5 ft
6/23
11am
6/25
11am
6/27
11am
Date
6/29
11am
7/1
11am
7/3
11am
7/5
11am


Barryville (all scenarios)
Stage (ft)
35
30
25
20
15
10
5
0
No Reservoir
30.4 ft
Original
29.0 ft
Flood Stage
17.0 ft
5 bg void
27.9 ft
2.5 bg void
28.5 ft
10 bg void
25.1 ft
No Spill
23.2 ft
6/23
11am
6/25
11am
6/27
11am
Date
6/29
11am
7/1
11am
7/3
11am
7/5
11am

Results – June 2006

Table 2. Maximum pool elevations and flood peaks (ft) from the USGS or NYCDEP for the June 2006 event and simulation results. A "plus" sign indicates the flood peak would have been higher than the observed value and a "minus" sign indicates a lower flood peak would have occurred.

	Actual	Case 1 No Res	Case 2 Void ~2.5bg	Case 3 Void ~5bg	Case 4 Void ~10bg	Case 5 No Spill
Cannonsville	1160.08		1159.7	1159.4	1158.4	1150.0
Pepacton	1283.66		1283.6	1283.6	1283.4	1280.0
Hale Eddy	19.10	+1.6	-0.7	-1.1	-3.4	-10.3
Fishs Eddy	21.43	+1.3	-0.1	-0.4	-2.0	-2.0
Callicoon	20.38	+0.9	-0.4	-0.8	-2.6	-3.9
Barryville	28.97	+1.4	-0.5	-1.1	-3.9	-5.8
Port Jervis	21.47	+0.8	-0.3	-0.6	-1.6	-2.5
Montague	32.15	+1.3	-0.5	-1.0	-2.0	-3.1
Tocks Island	33.87	+1.1	-0.4	-0.8	-1.7	-2.6
Belvidere	27.16	+0.9	-0.3	-0.7	-1.7	-2.6
Riegelsville	33.62	+1.1	-0.4	-0.8	-1.6	-2.4
Trenton	25.09	+0.6	-0.3	-0.6	-1.0	-1.6

Conclusions

- 1) For both events, the Upper Delaware basin crest reductions due to the presence of the Cannonsville and Pepacton reservoirs ranged from 0.9 to 2.2 feet while lower basin crest reductions ranged from 0.5 to 1.5 feet. These reservoirs attenuated flood peaks downstream even though they spilled, so their mere presence was beneficial despite having any additional storage capacity.
- 2) A "No Spill" scenario for the June 2006 event would have required a massive pre-storm drawdown of pool levels of 41.93 ft (53.9 billion gallons) at Cannonsville reservoir and 19.95 ft (34.5 billion gallons) at Pepacton reservoir. Such an unrealistic drawdown would hypothetically yield a crest reduction of 2.0 to 10.3 ft on the Upper Delaware, and 1.6 to 3.1 ft on the Lower Delaware.
- 3) For both events, the magnitude of the flood mitigation provided by the dams (even when they spilled) was greater than or equal to the additional benefit that would have been provided by voids of 5 bg or less.
- 4) Voids, if possible, would have provided some additional attenuation of downstream flood peaks.

Conclusions (continued)

- 5) Comparing the June 2006 and April 2005 events shows that voids up to 5 billion gallons in each reservoir would have provided a similar reduction in downstream crests. Voids of 10 billion gallons or voids large enough to prevent the reservoirs from spilling at all would provide differing degrees of downstream peak reduction, based on the characteristics of the specific hydrometeorological event. Using specific reservoir void targets thus would not yield the same level of flood mitigation for every event.
- 6) The case study results presented here, while demonstrating the potential benefits of reservoir voids, are insufficient for optimizing flood mitigation plans for reservoirs in the Delaware basin. A detailed modeling analysis is needed that takes into account all large reservoirs; their release capabilities; limitations due to their hydropower, water supply, and other obligations; and the full range of historical and potential future hydrometerological conditions.

Limits on Application of Results

- The results are hypothetical cases based on hydrometeorological conditions prior to and during the June 2006 event.
- This modeling effort is strictly hypothetical in that, among other things, the void conditions analyzed do not take into consideration either New York City's water supply needs or the water supply needs of the lower basin parties who may prefer to have water stored in the reservoirs for releases at a later point in time.
- In addition, the scenarios modeled do not reflect the City's release obligations under the 1954 Supreme Court Decree governing operations of the reservoirs.

THE END