Using Forecasted Rainfall and Detailed Modeling to Estimate Flood Levels in Laurel, MD

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MAFSM 2015

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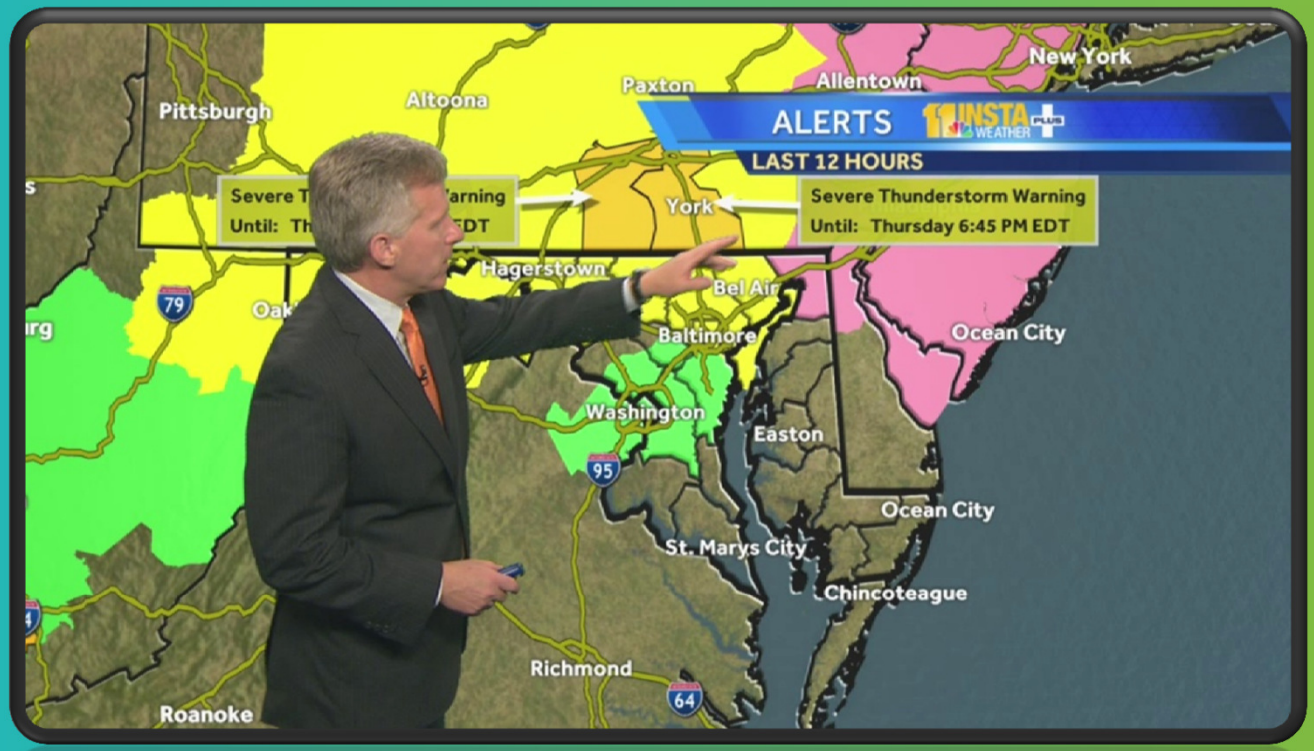
A Common Scenario



Outline

- Objective
- Study Area
- Modeling System Structure
- Modeling Components and Data Sources
- System Operation
- Conclusion

Objective

– To proactively estimate flood elevations at population centers and critical locations ahead of storm events.

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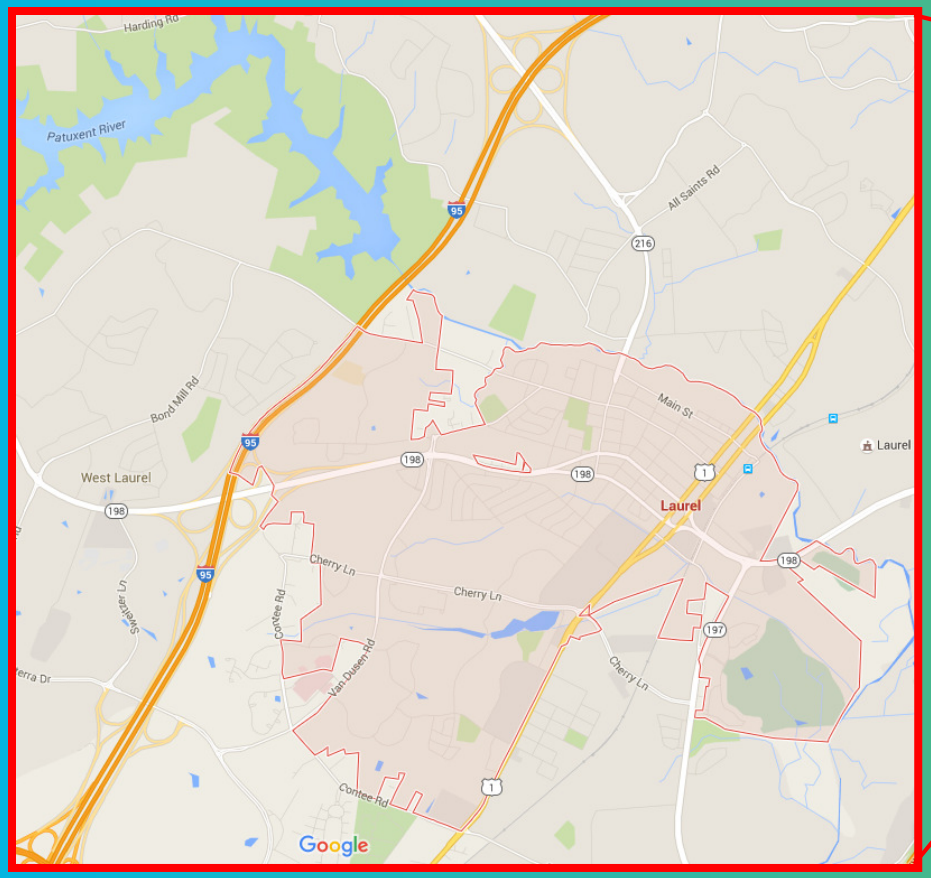
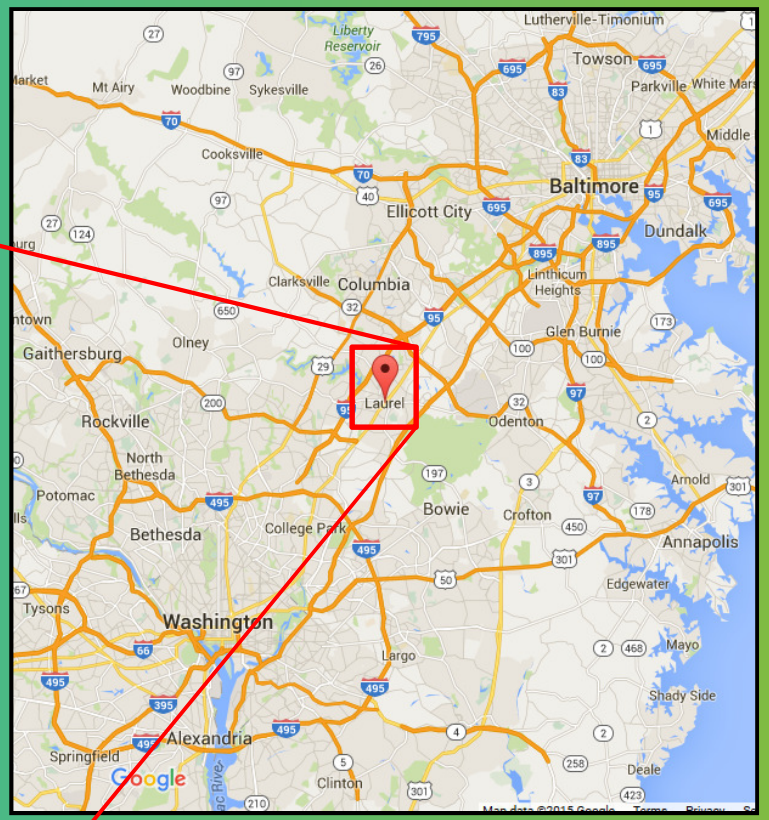
Study Area





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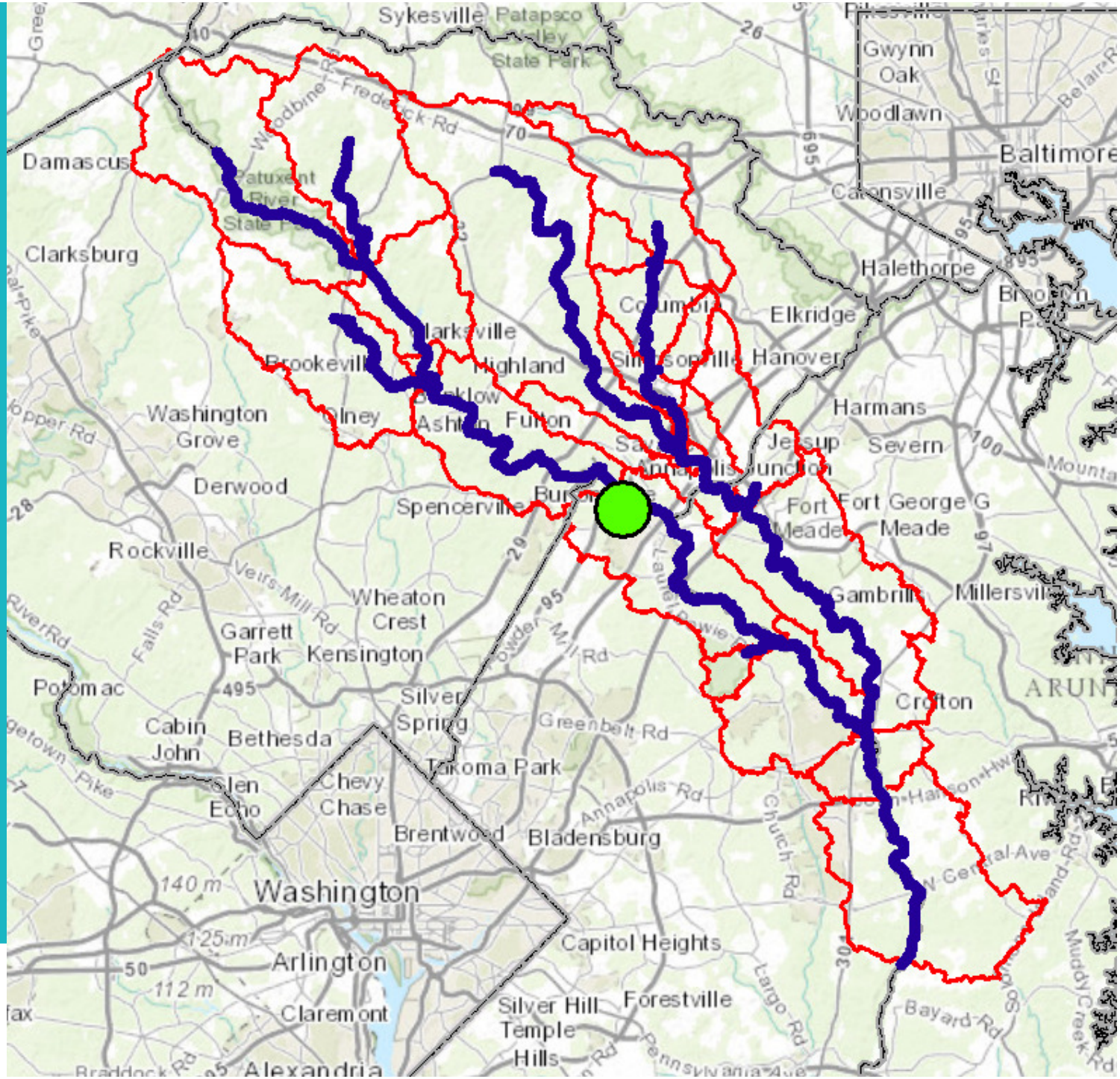
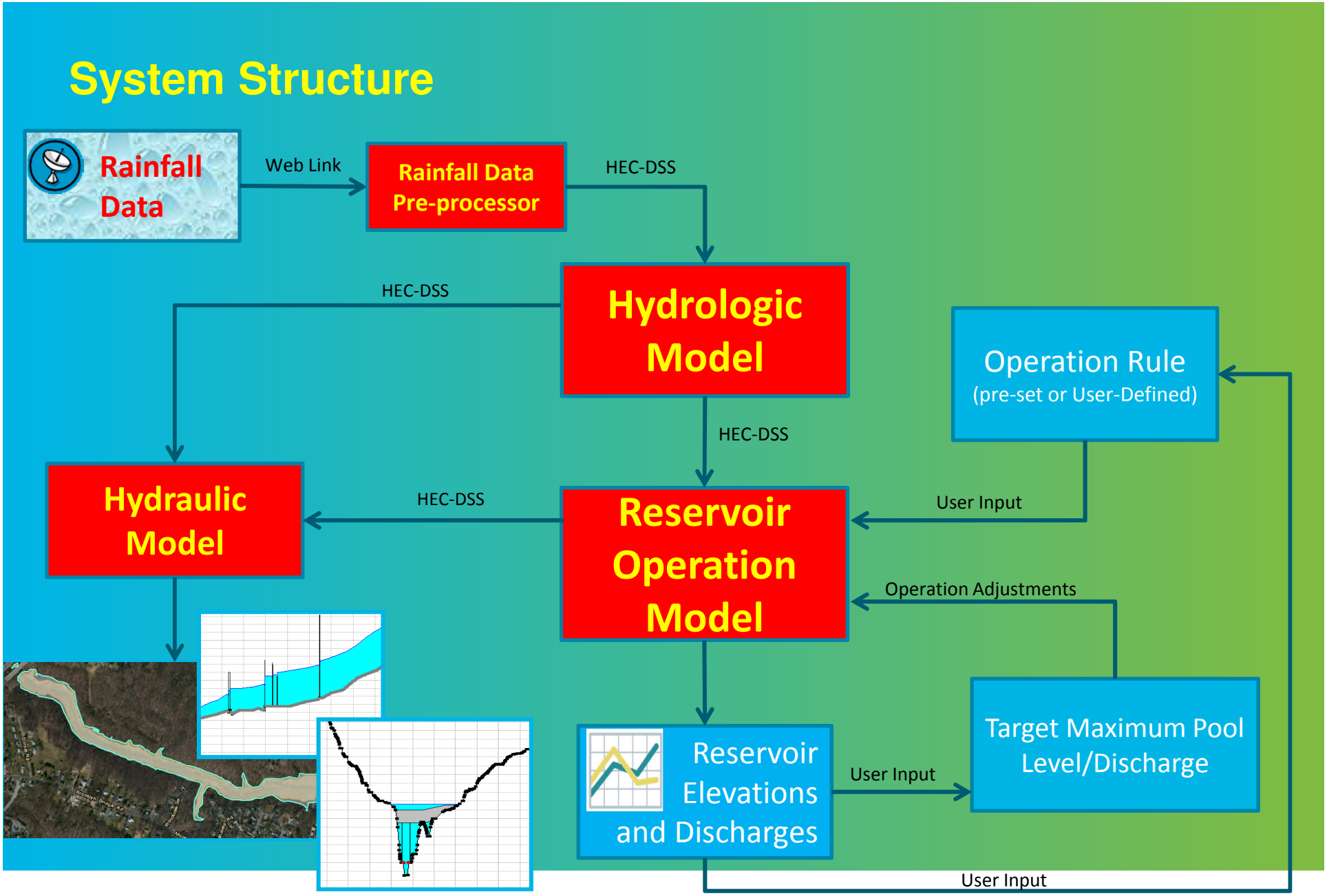
Study Area

- 4 Counties:
  - Montgomery
  - Howard
  - Prince George's
  - Anne Arundel



System Structure



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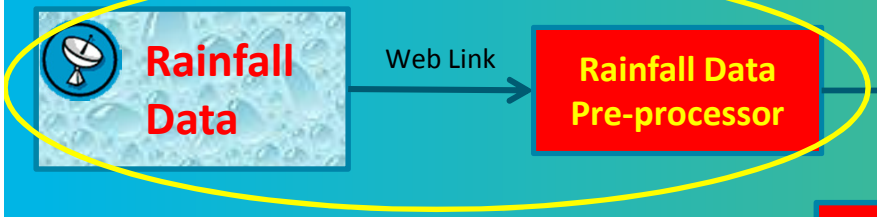
Rainfall Data



Web Link

Rainfall Data Pre-processor

HEC-DSS

Hydrologic Model

HEC-DSS

Operation Rule
(pre-set or User-Defined)

HEC-DSS

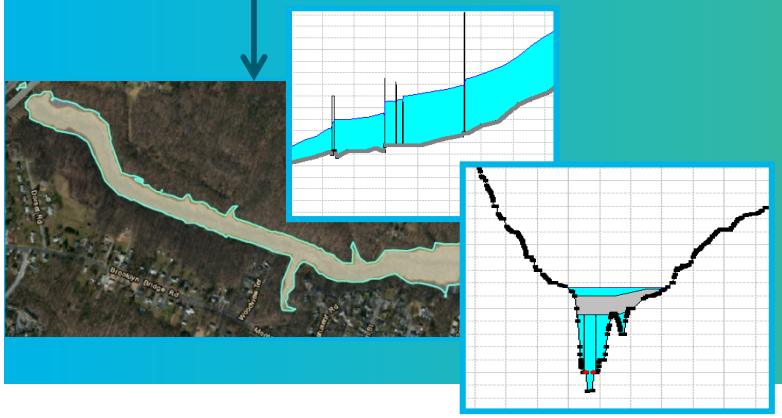
Hydraulic Model

HEC-DSS

Reservoir Operation Model

User Input

Operation Adjustments



Reservoir Elevations and Discharges

User Input

Target Maximum Pool Level/Discharge

User Input

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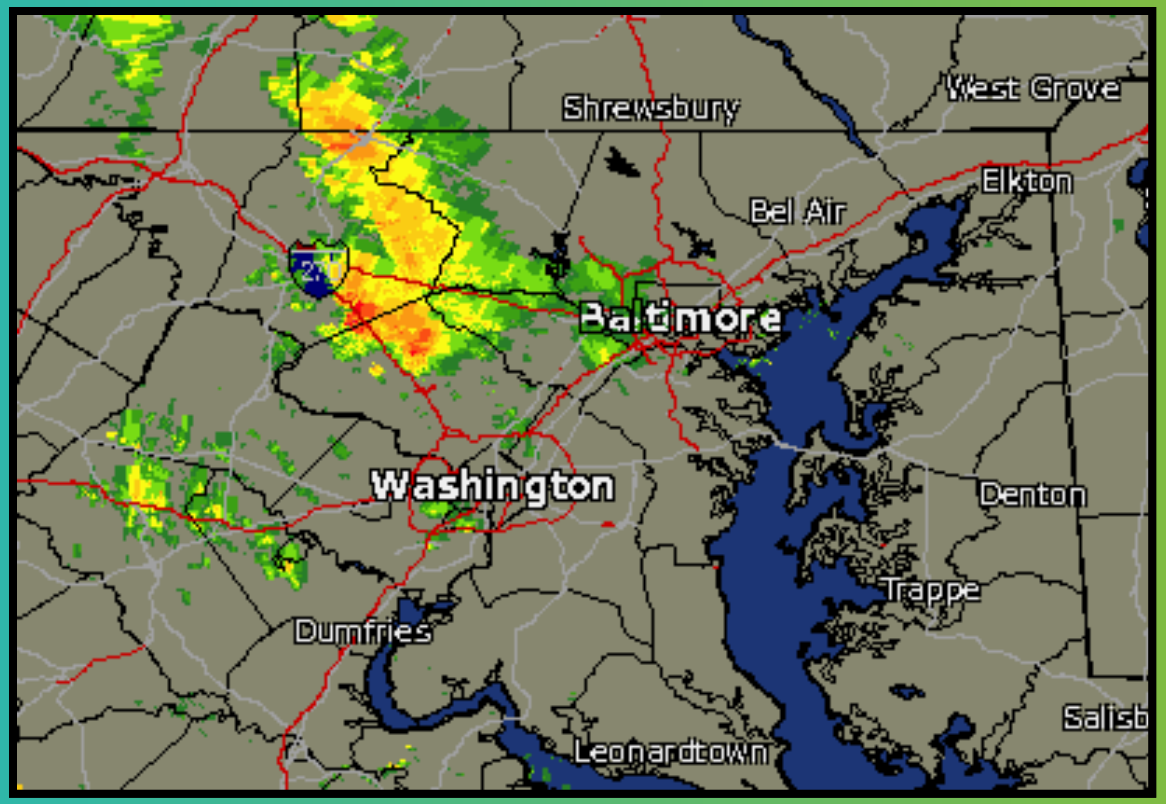
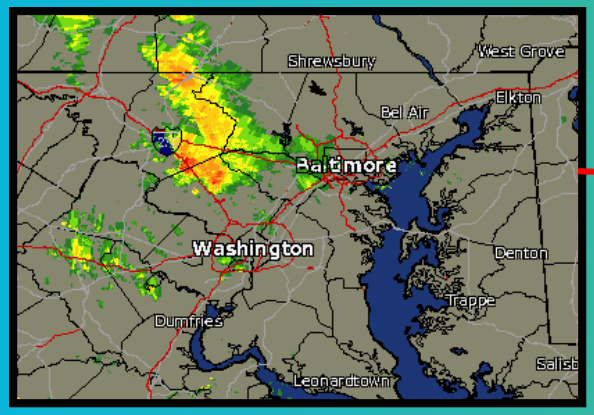
Rainfall Data

- Standardized
  - 2-500 year
- Past/Historical
  - NOAA/Private
- “Near” Real-Time
  - Private gages/NWS
- Forecast
  - Private/NWS

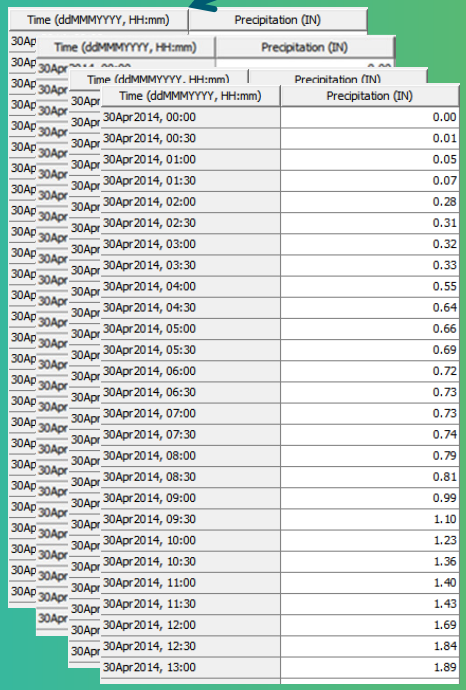


Rainfall Data

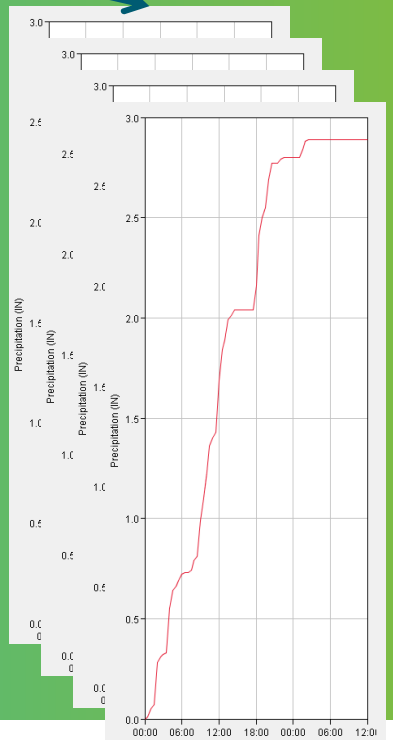


Providers

AccuWeather
OneRain
etc.



Time (ddMMMYYYY, HH:mm)	Precipitation (IN)
30Apr2014, 00:00	0.00
30Apr2014, 00:30	0.01
30Apr2014, 01:00	0.05
30Apr2014, 01:30	0.07
30Apr2014, 02:00	0.28
30Apr2014, 02:30	0.31
30Apr2014, 03:00	0.32
30Apr2014, 03:30	0.33
30Apr2014, 04:00	0.55
30Apr2014, 04:30	0.64
30Apr2014, 05:00	0.66
30Apr2014, 05:30	0.69
30Apr2014, 06:00	0.72
30Apr2014, 06:30	0.73
30Apr2014, 07:00	0.73
30Apr2014, 07:30	0.74
30Apr2014, 08:00	0.79
30Apr2014, 08:30	0.81
30Apr2014, 09:00	0.99
30Apr2014, 09:30	1.10
30Apr2014, 10:00	1.23
30Apr2014, 10:30	1.36
30Apr2014, 11:00	1.40
30Apr2014, 11:30	1.43
30Apr2014, 12:00	1.69
30Apr2014, 12:30	1.84
30Apr2014, 13:00	1.89



Rainfall time series average at each sub-basin:

- Actual records from start of storm event
- Radar records adjusted by ground gages
- Forecast for next 6 hours

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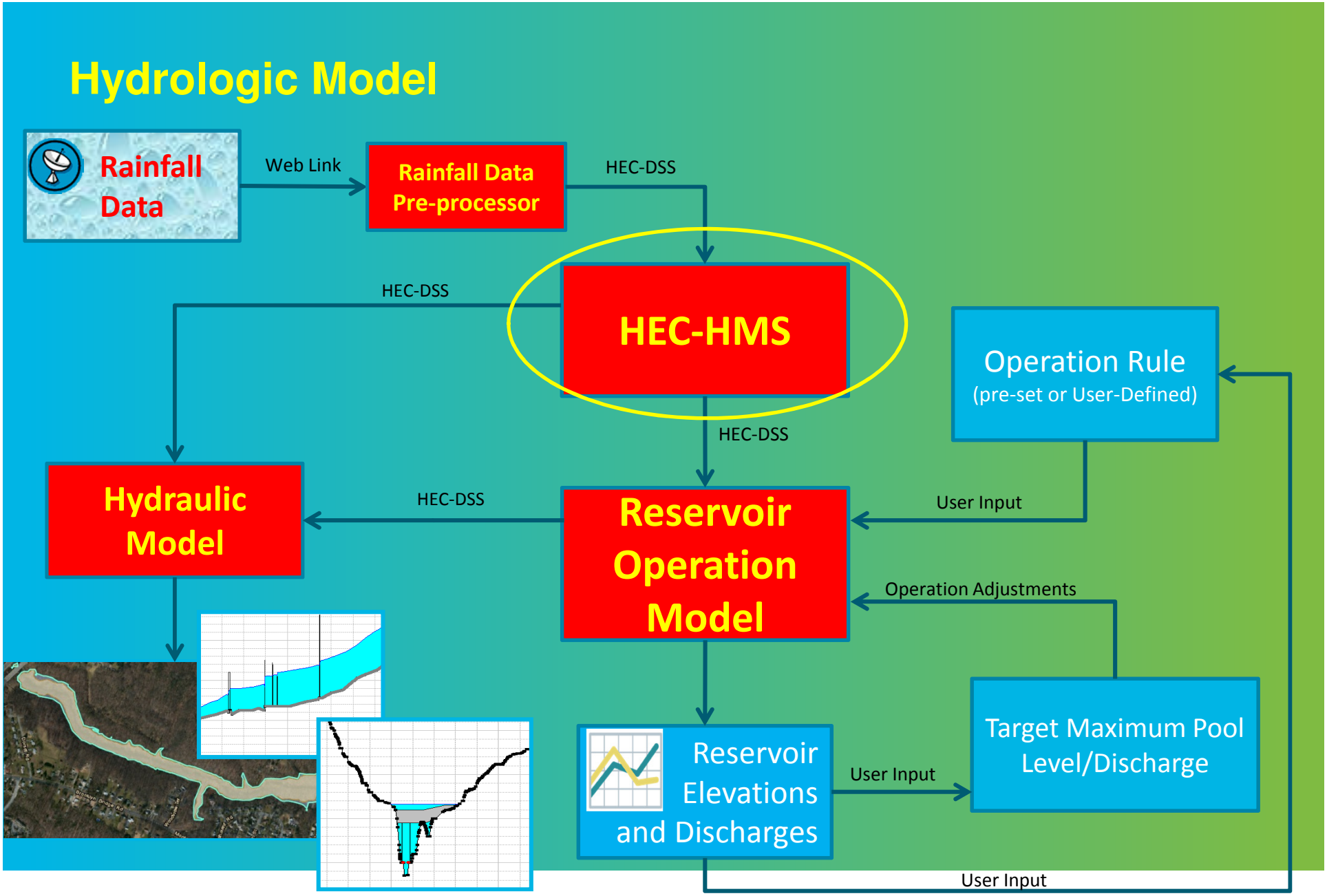
Hydrologic Model



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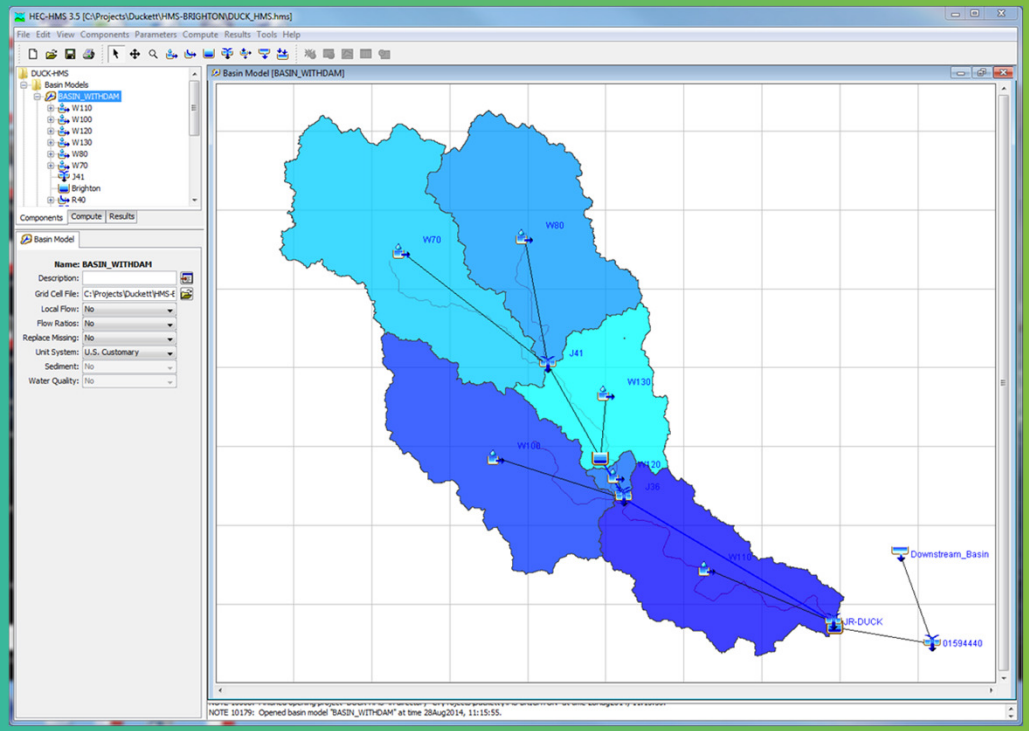
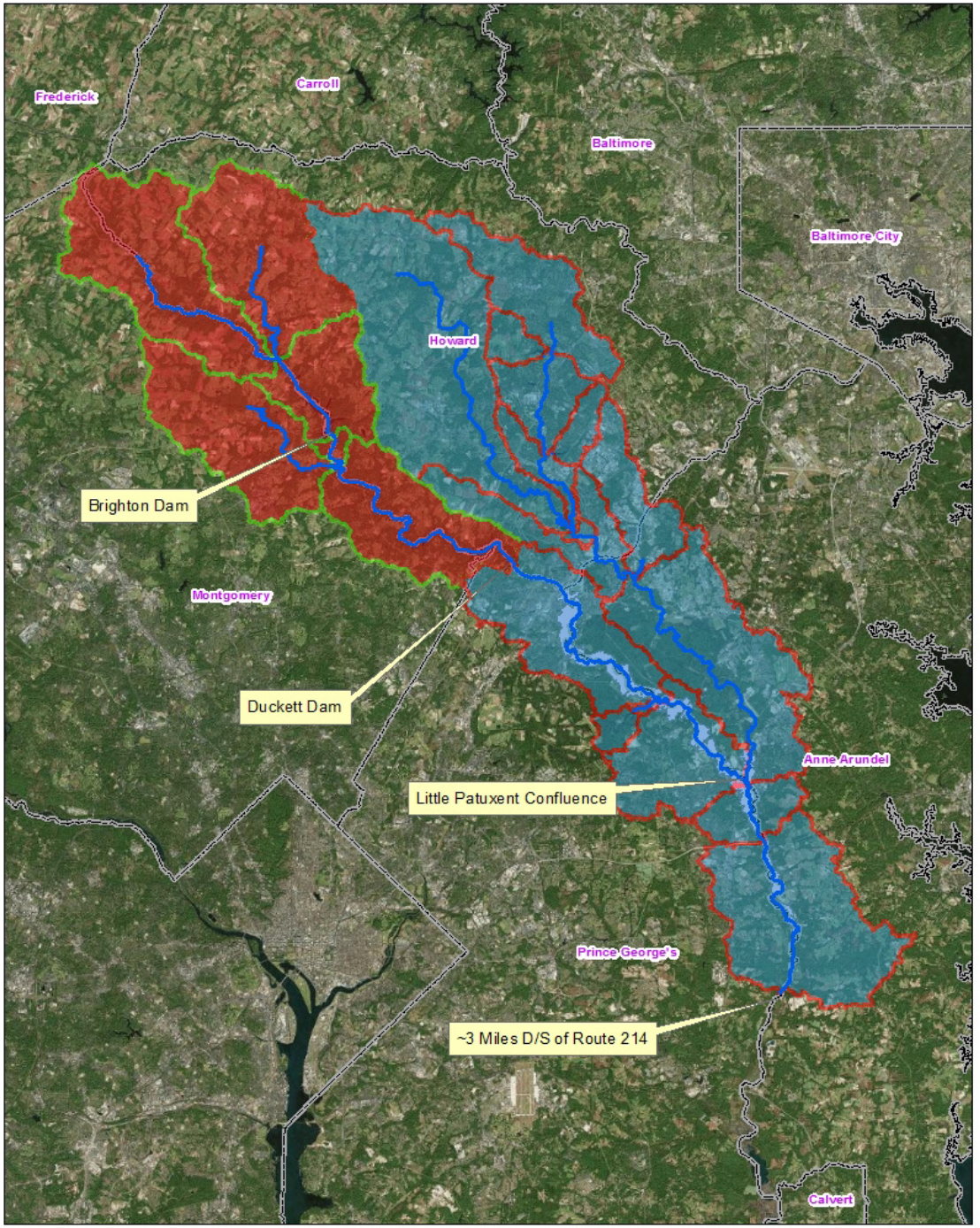
Hydrologic Model

- USACE HEC-HMS
  - No cost
  - Widely accepted
  - Multiple methods

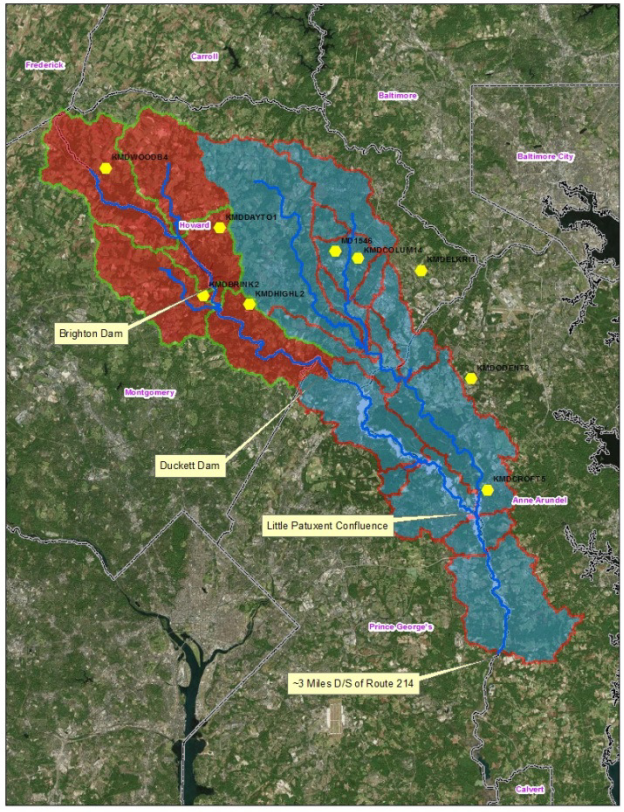


Hydrologic Model

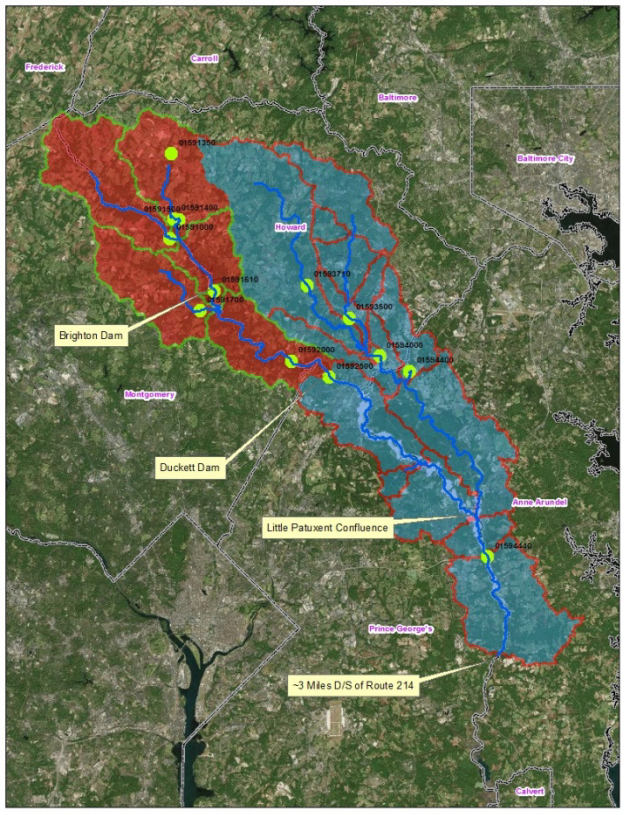
- 22 Sub-basins
- ~31.5 miles D/S of Duckett Dam
- ~3 miles D/S of Route 214
- 132 Mi^2 U/S Duckett Dam
- 386 Mi^2 Total watershed
- 5 Dams
- 5 USGS gages
- 6 Rain gages



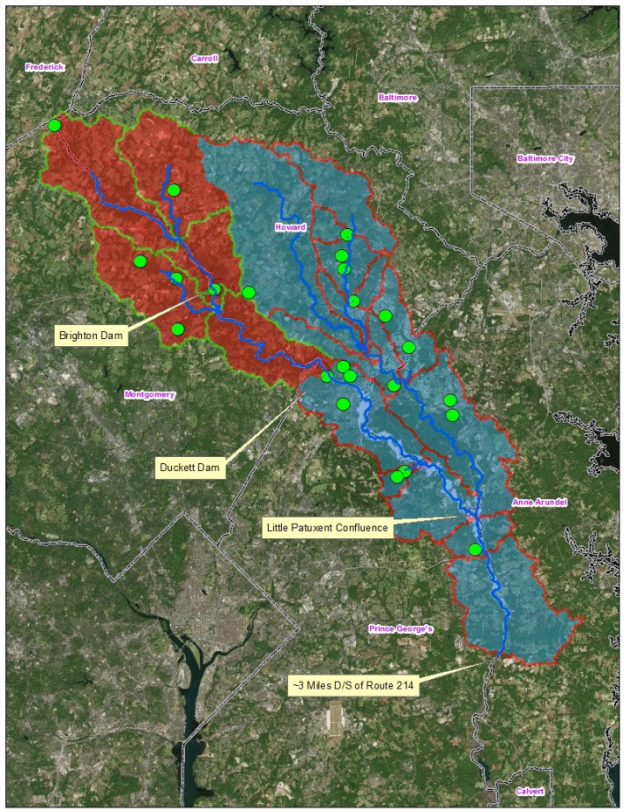
Hydrologic Model



Rain Gages



Flow Gages



Dams

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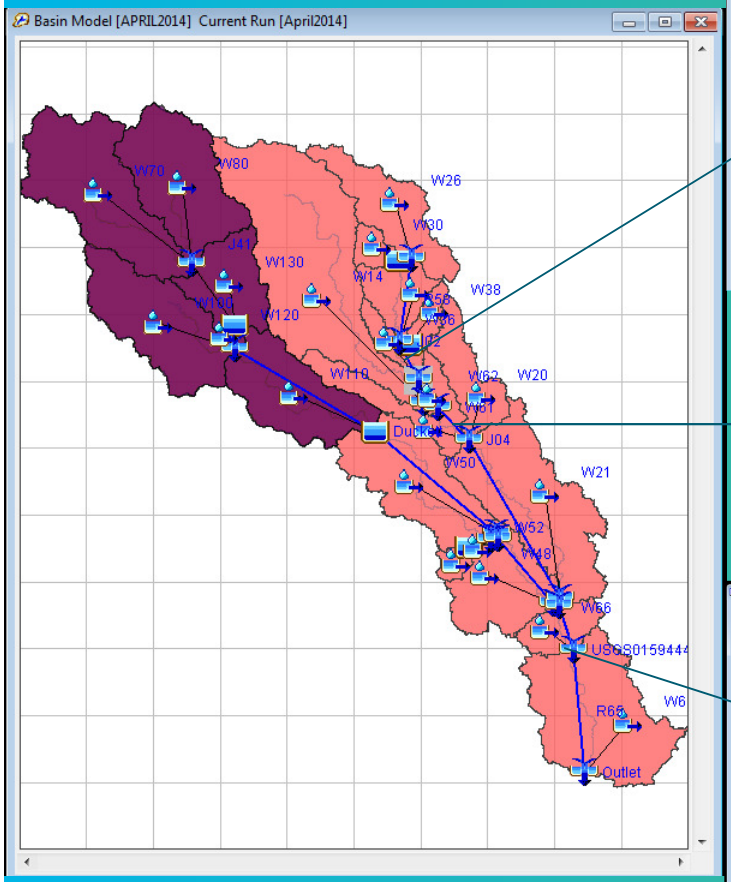
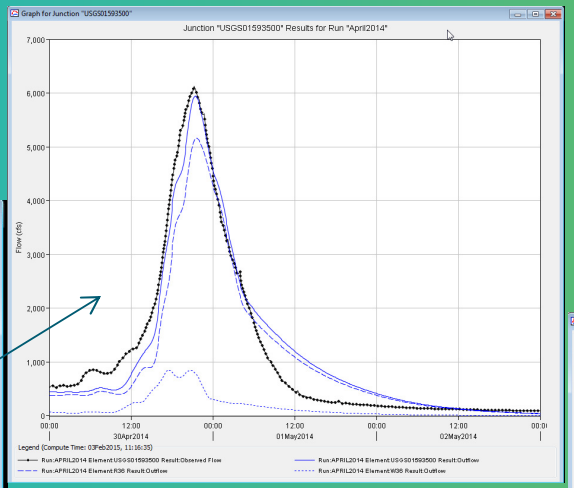
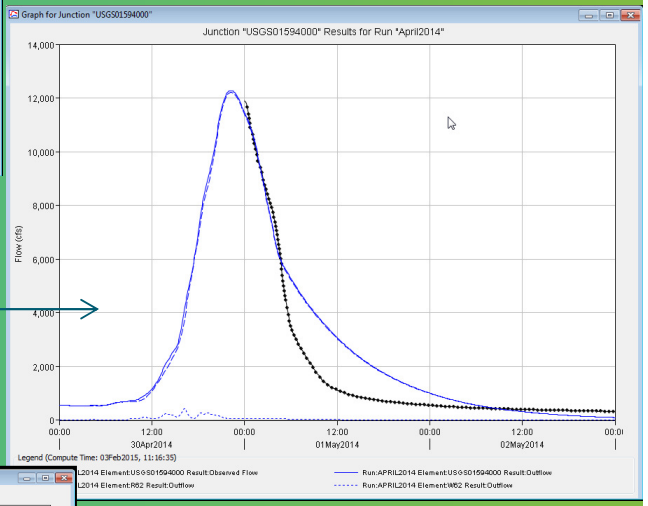
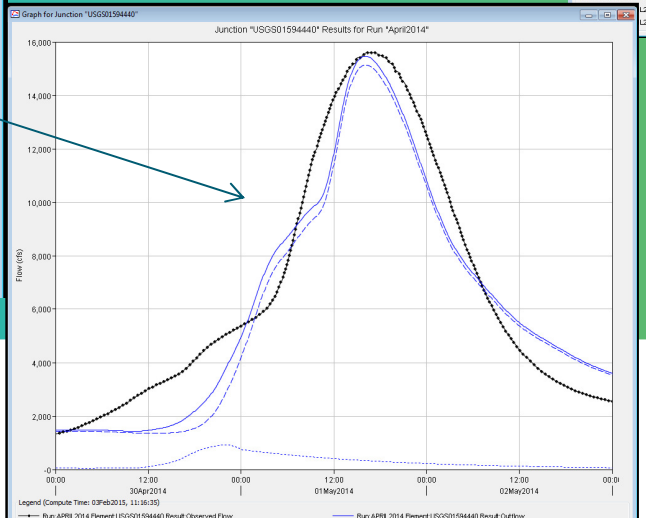
Hydrologic Model

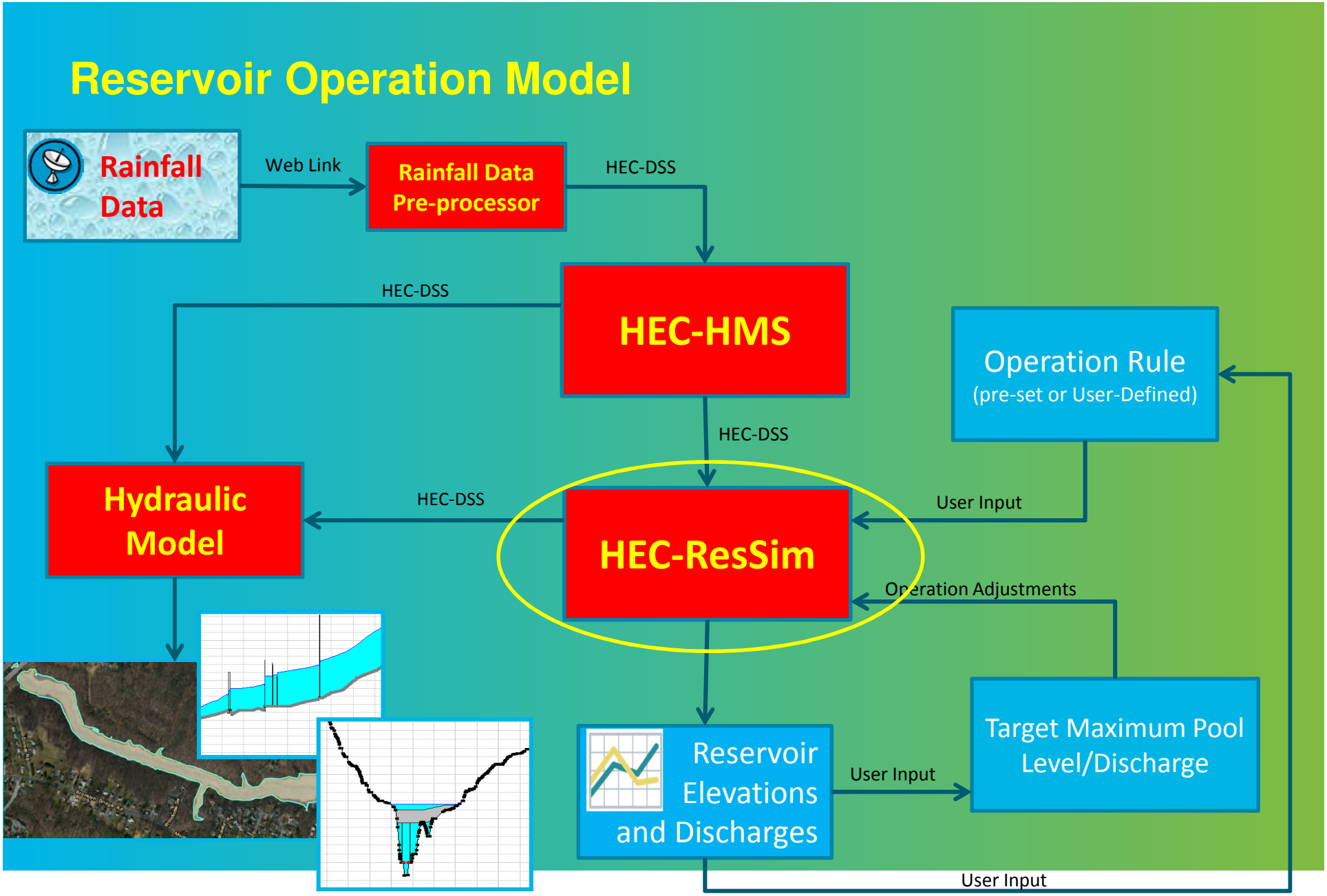








Reservoir Operation Model



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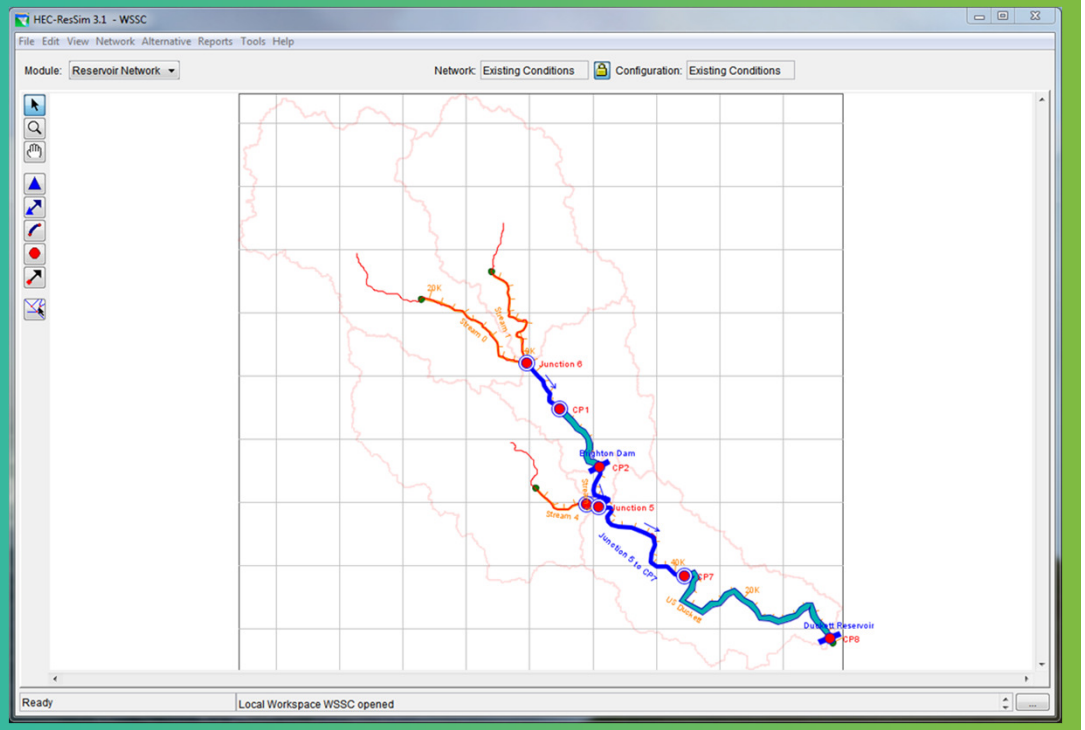
Reservoir Operation Model

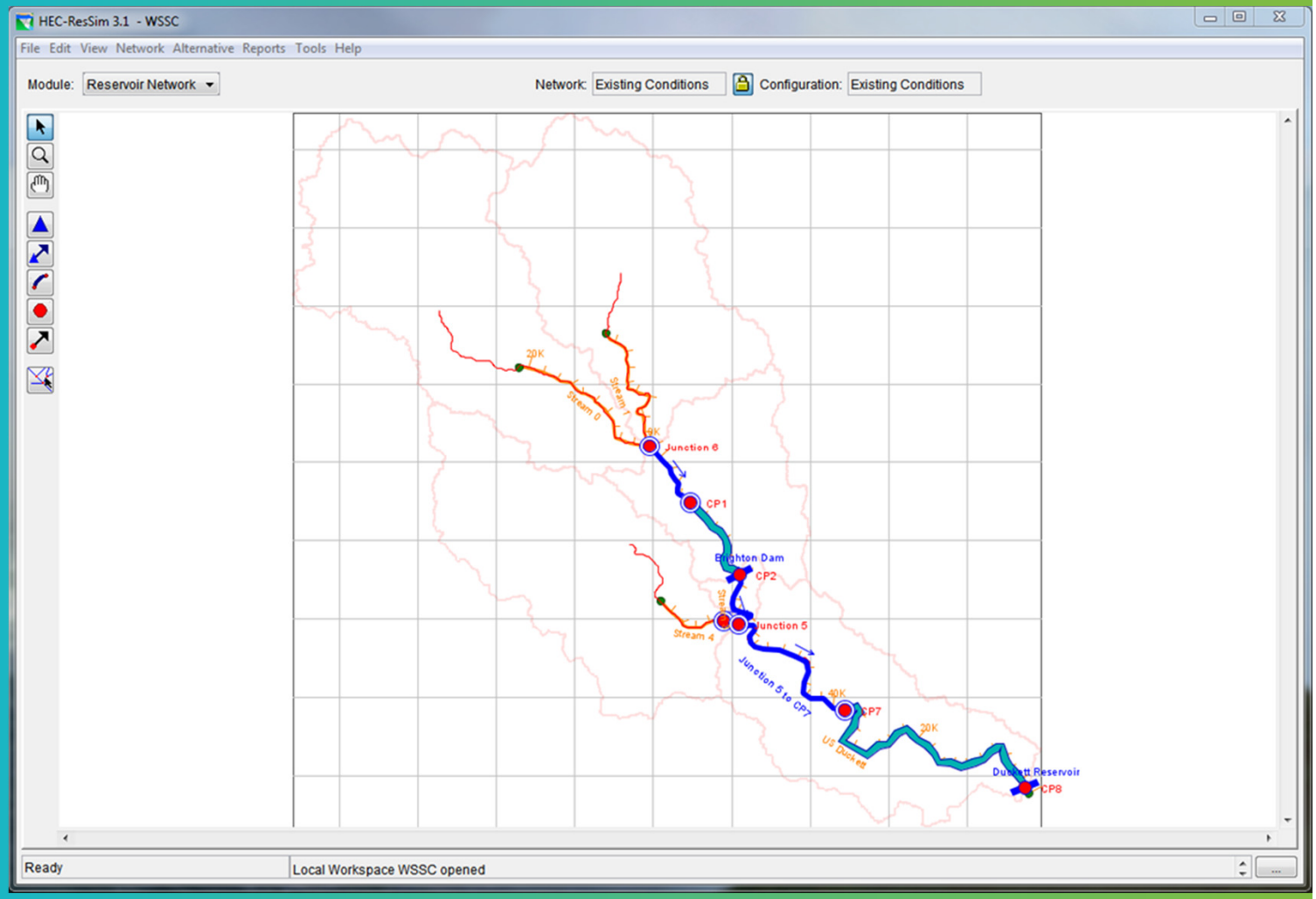
- USACE HEC-ResSim
  - No Cost
  - Compatible with other HEC models
  - Flexible dam operation options



Reservoir Operation Model

- Dams
- Streams
- Junctions
- Sources

- Alternatives
- Simulations



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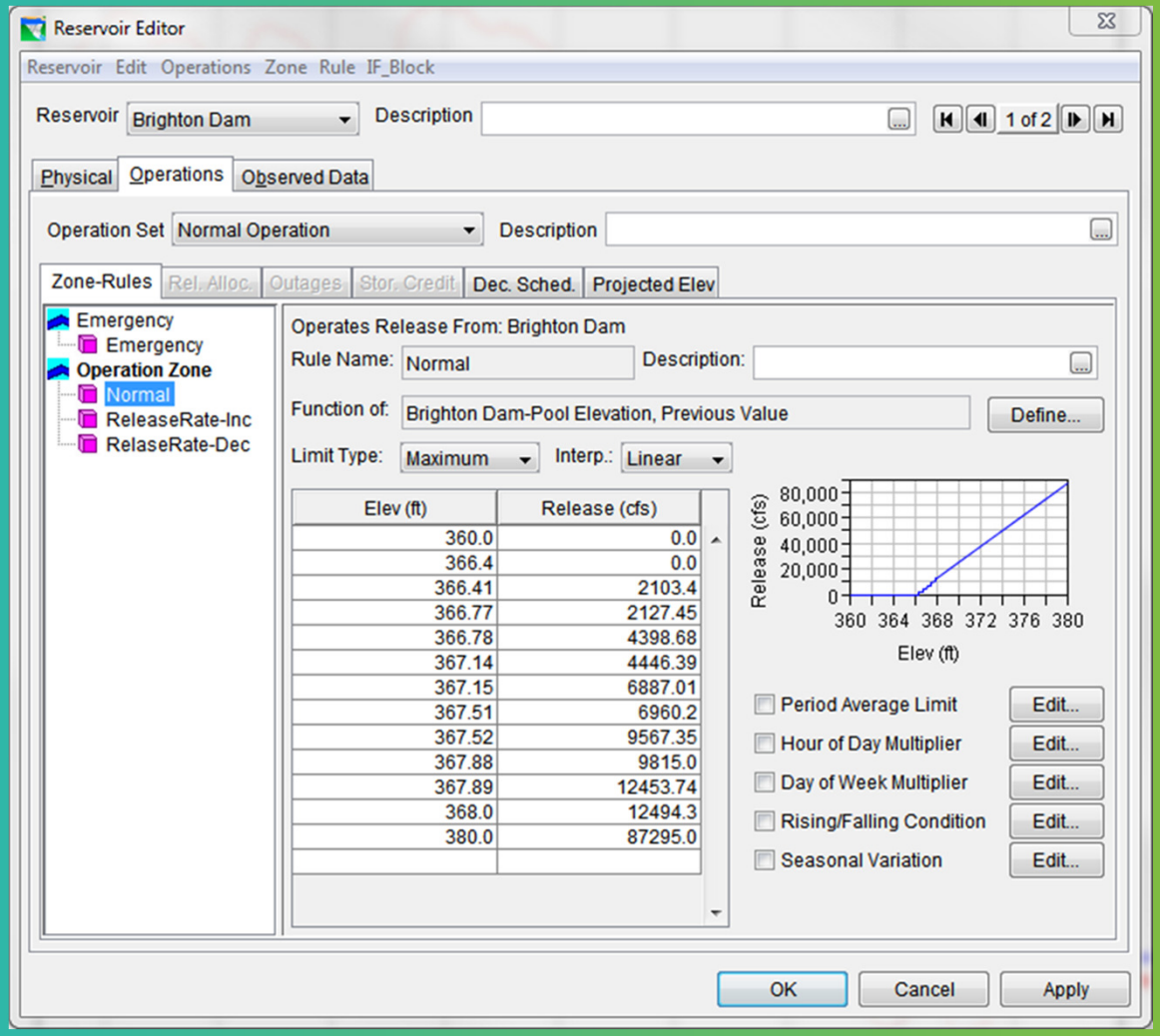
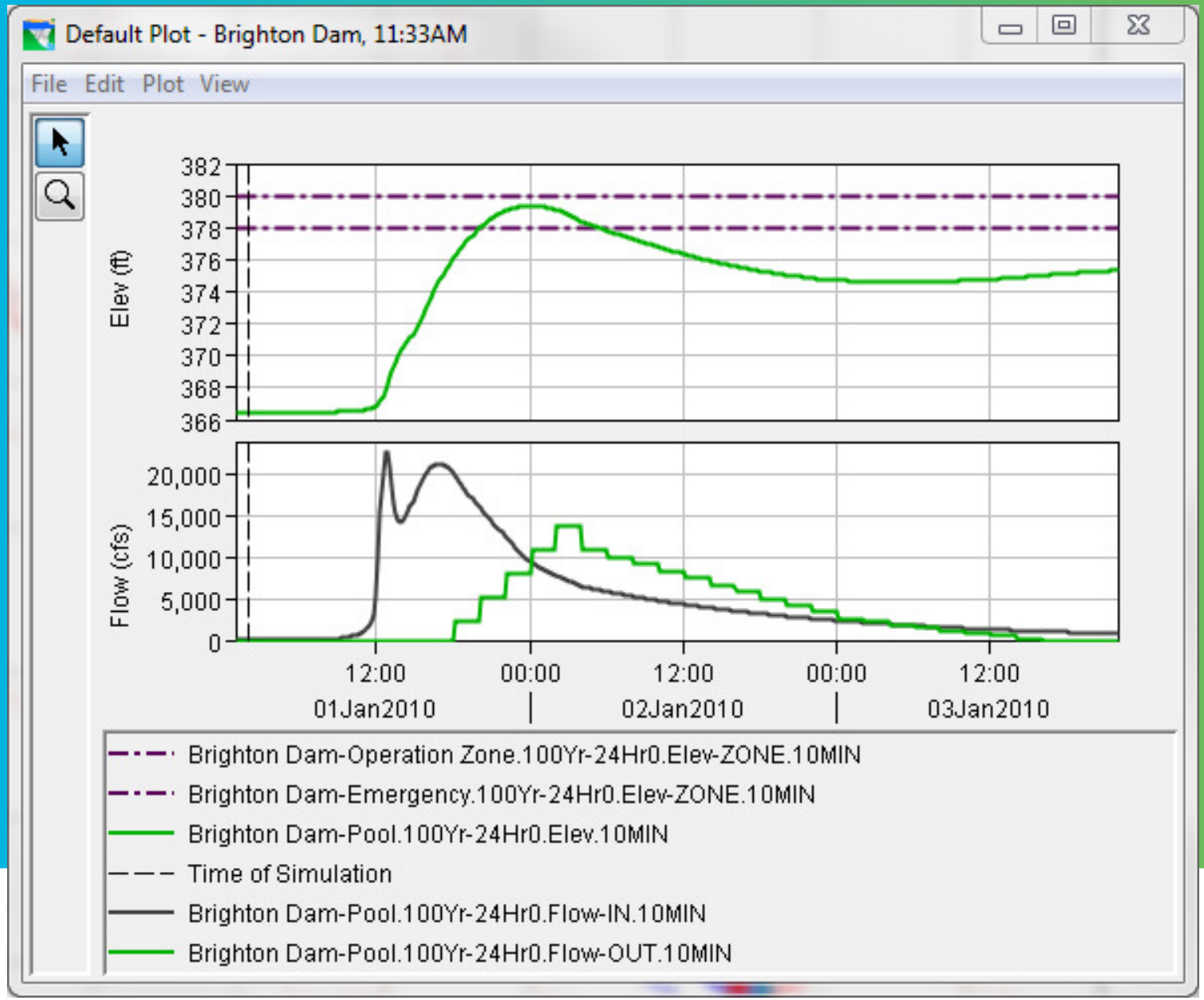
Reservoir Operation Model

– Operation Rules



Reservoir Operation Model



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Reservoir Operation Model

Release Decision Report: Brighton Dam

File

Alternative: 100Yr-24Hr:100Yr-24Hr
Run: 100Yr-24Hr0

Lookback: 01 Jan 2010, 0100
Start Time: 01 Jan 2010, 0200
End Time: 03 Jan 2010, 2200
Rule Key: GC=Guide Curve, RO=Release Override, EO=Elevation Override, ZB=Zone Boundary

Date-Time	Brighton Dam								
	Active Zone Elev (ft)	Net Inflow (cfs)	Brighton Dam Active Rule Flow (cfs)	-Dam at Stream 2 Active Rule Flow (cfs)	-Dam at Stream 2 ... Uncontrolled Flow (cfs)	-Controlled Outlet Active Rule Flow (cfs)	-Controlled Outlet 1 Active Rule Flow (cfs)	-Controlled Outlet 2 Active Rule Flow (cfs)	-Controlled Outlet 3 Active Rule Flow (cfs)
					Unctrl				
01Jan2010, 02:00	366.40	144.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Operation Zone		GC	GC	Unctrl	GC	GC	GC	GC
01Jan2010, 02:15	366.40	142.28	132.82	132.82	0.00	33.21	33.21	33.21	33.21
	Emergency Zone				Unctrl				
01Jan2010, 02:30	366.40	140.51	132.82	132.82	0.00	33.21	33.21	33.21	33.21
	Emergency Zone				Unctrl				
01Jan2010, 02:45	366.40	138.76	132.82	132.82	0.00	33.21	33.21	33.21	33.21
	Emergency Zone				Unctrl				
01Jan2010, 03:00	366.40	137.03	132.82	132.82	0.00	33.21	33.21	33.21	33.21
	Emergency Zone				Unctrl				
01Jan2010, 03:15	366.40	135.32	132.82	132.82	0.00	33.21	33.21	33.21	33.21
	Emergency Zone				Unctrl				
01Jan2010, 03:30	366.40	133.63	132.82	132.82	0.00	33.21	33.21	33.21	33.21
	Emergency Zone				Unctrl				
01Jan2010, 03:45	366.40	131.97	132.82	132.82	0.00	33.21	33.21	33.21	33.21
	Emergency Zone				Unctrl				
01Jan2010, 04:00	366.40	130.32	132.82	132.82	0.00	33.21	33.21	33.21	33.21
	Emergency Zone				Unctrl				
01Jan2010, 04:15	366.40	128.70	132.82	132.82	0.00	33.21	33.21	33.21	33.21
	Emergency Zone				Unctrl				
01Jan2010, 04:30	366.40	127.09	132.82	132.82	0.00	33.21	33.21	33.21	33.21
	Emergency Zone				Unctrl				
01Jan2010, 04:45	366.40	125.51	132.82	132.82	0.00	33.21	33.21	33.21	33.21
	Emergency Zone				Unctrl				

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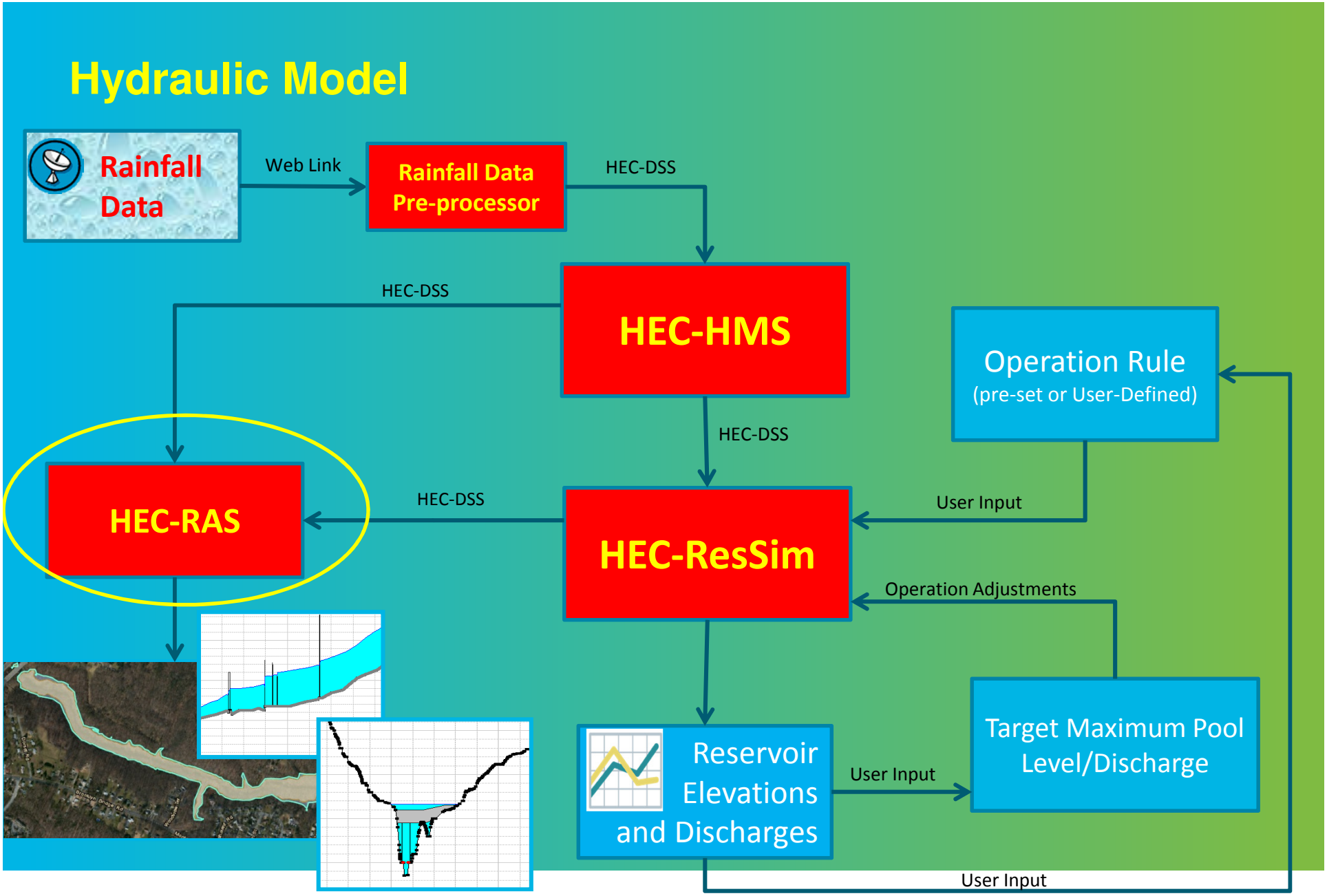
Hydraulic Model



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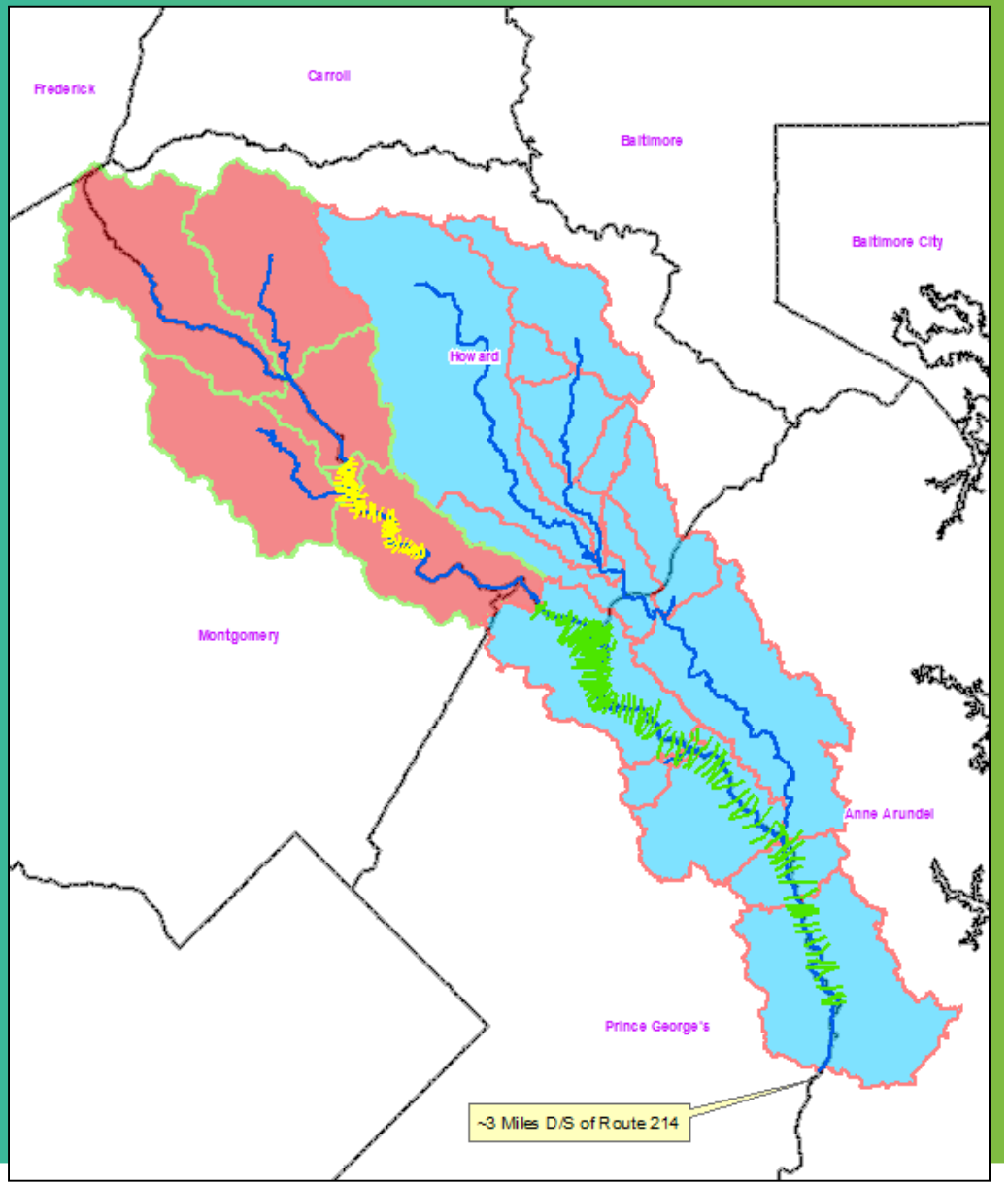
Hydraulic Model

– HEC-RAS 4.1
  - No cost
  - 1-D unsteady flow
  - Linked to HMS and ResSim using DSS



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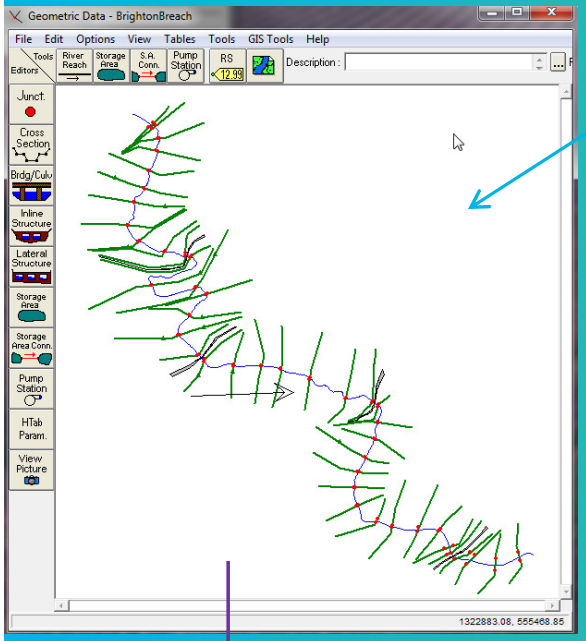
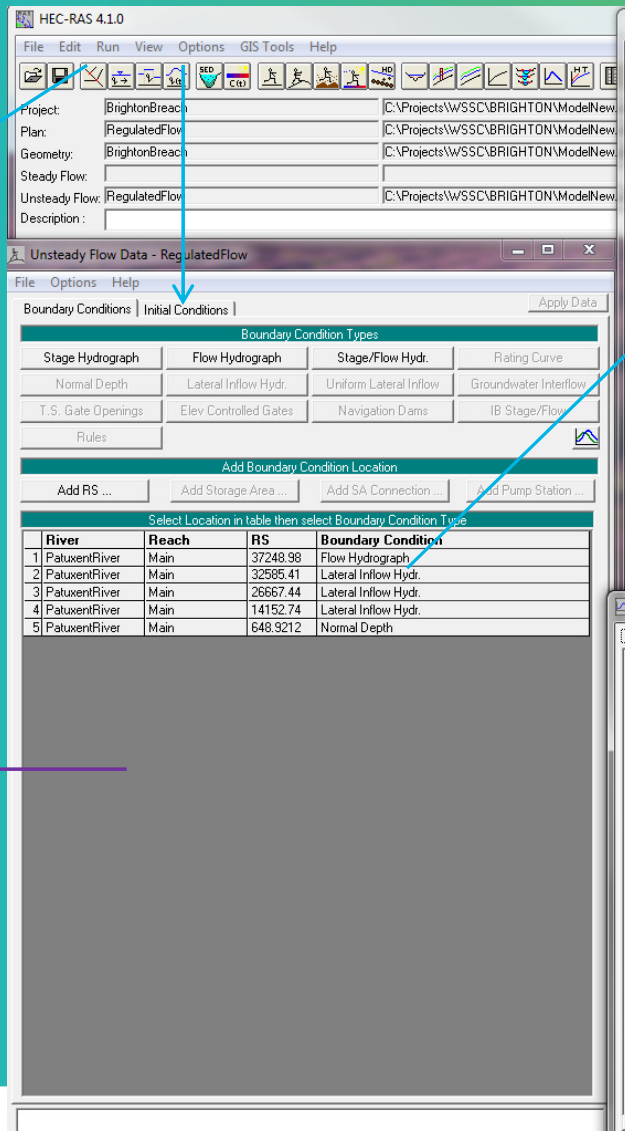
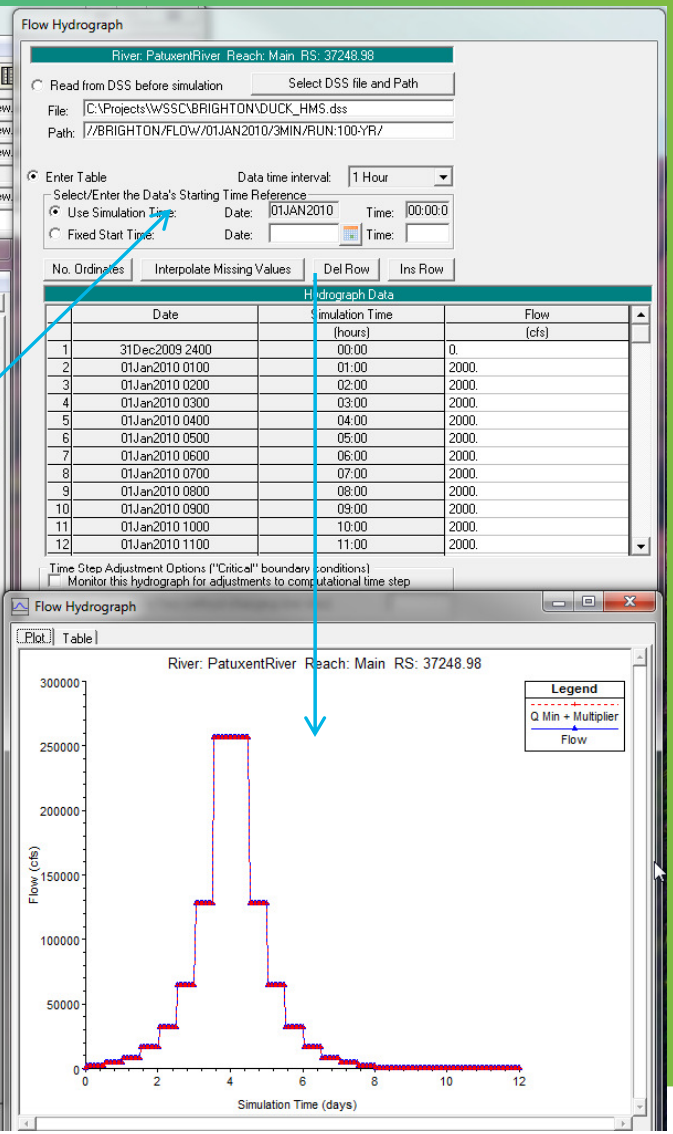
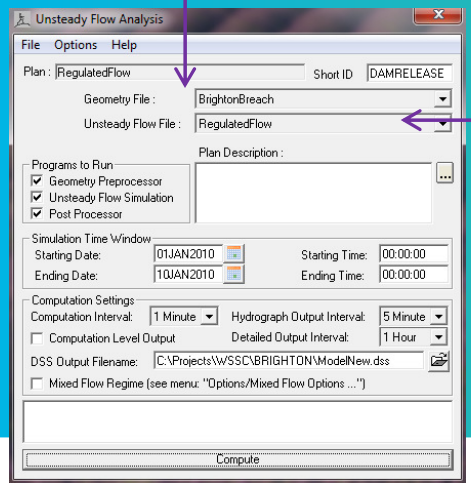
Hydraulic Model









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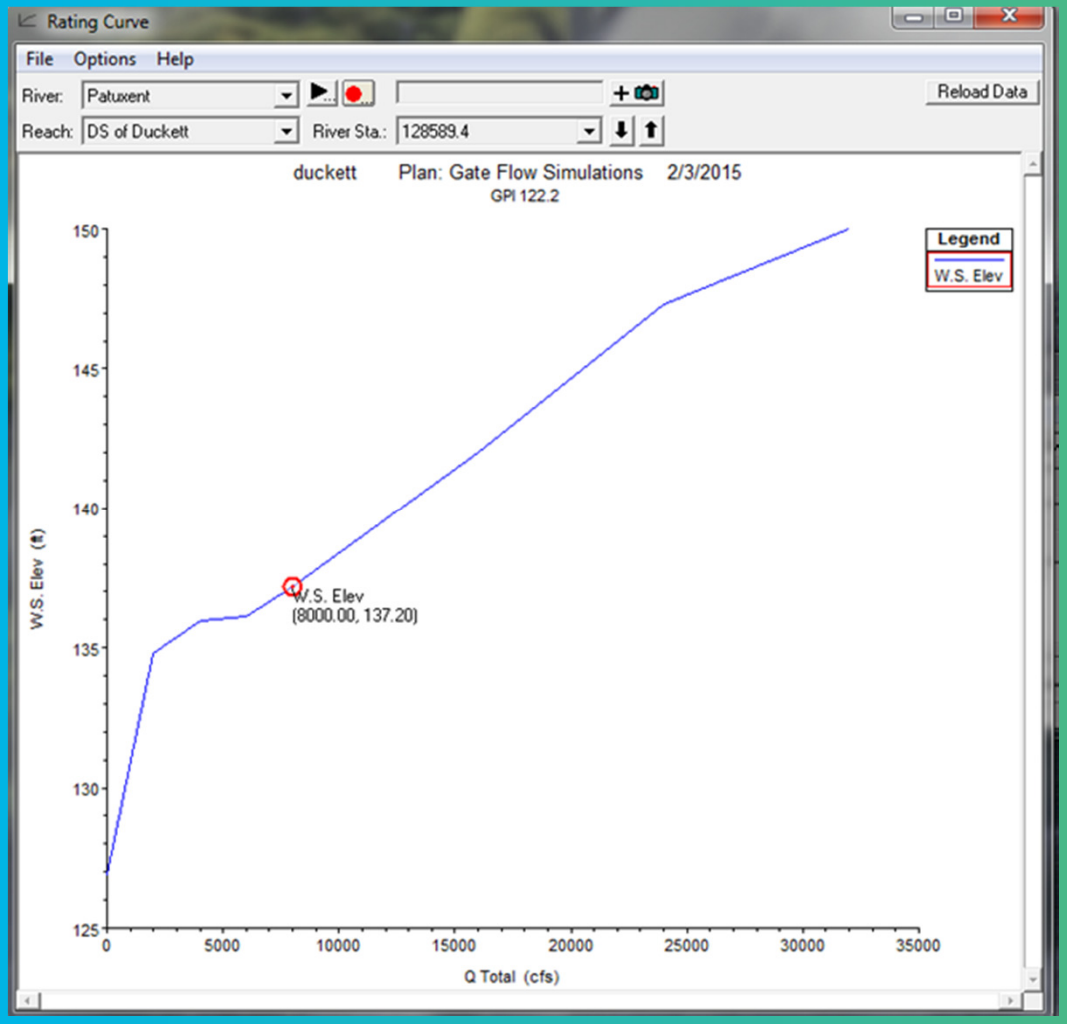
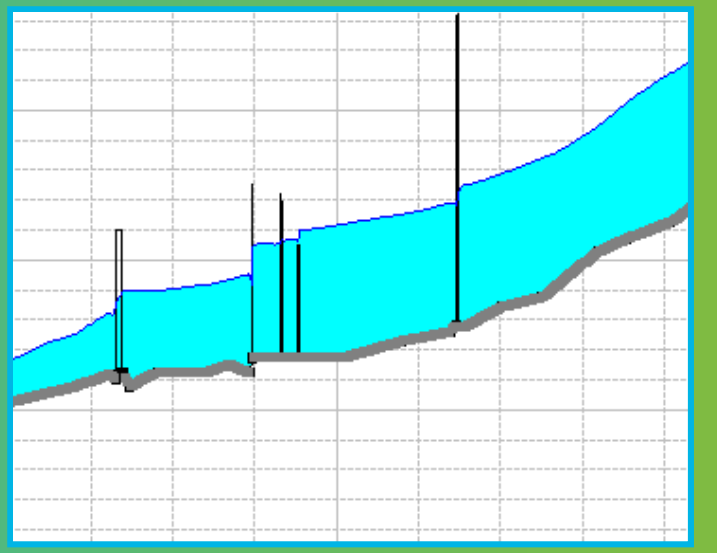
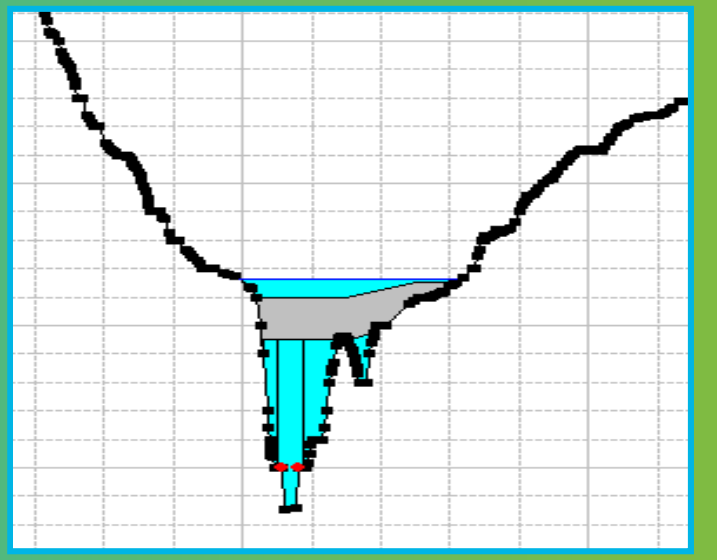
Hydraulic Model







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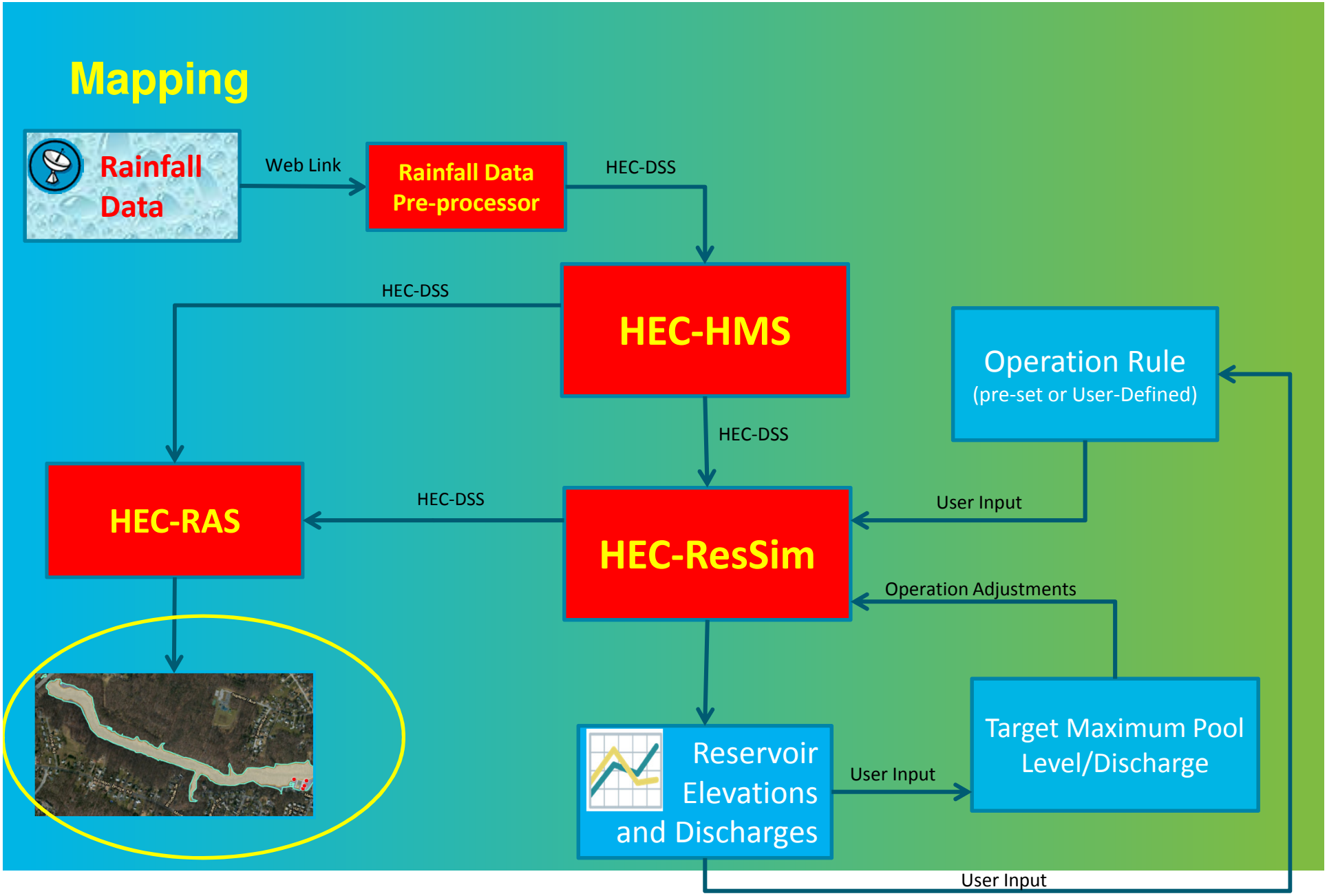
Mapping



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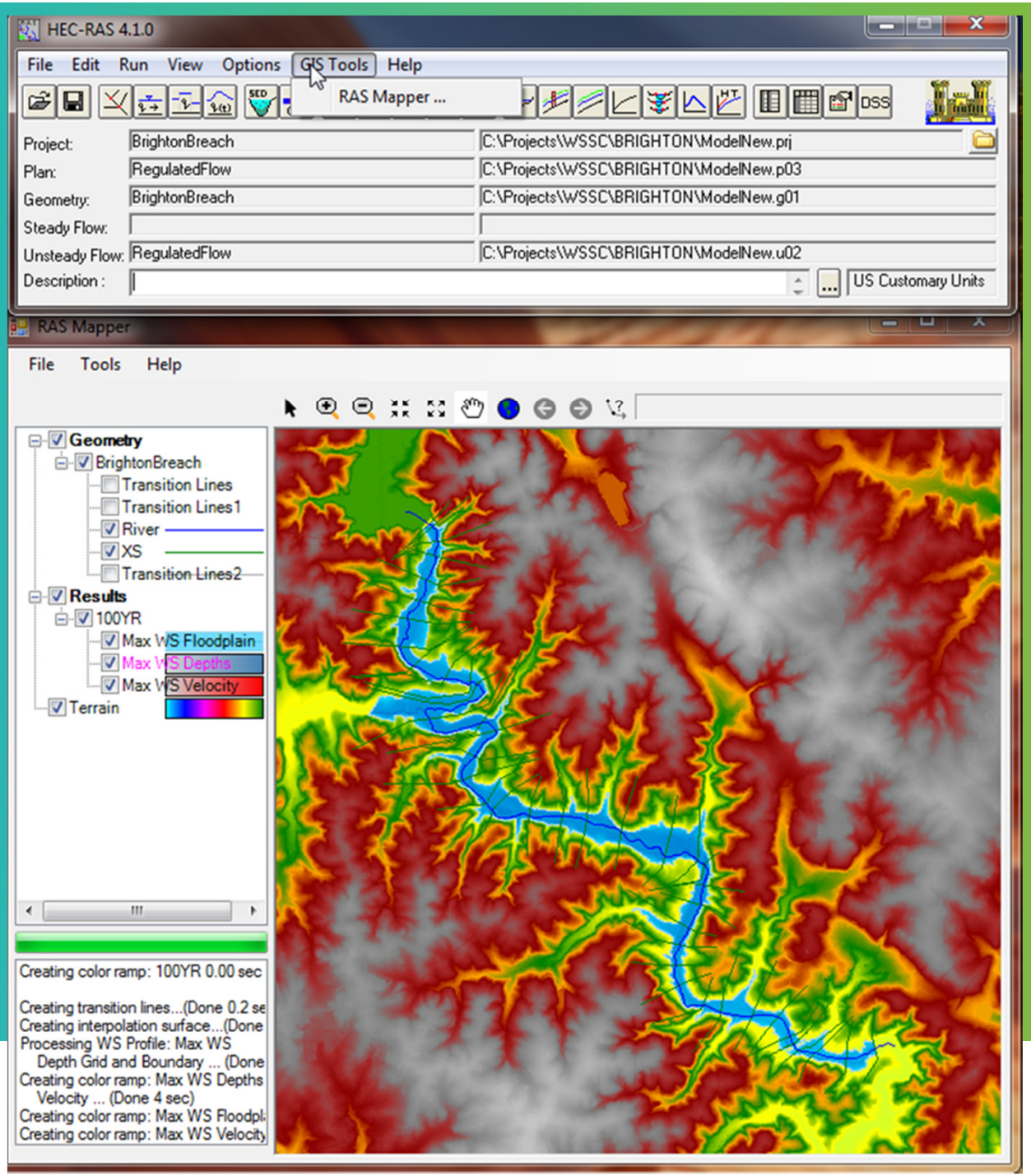
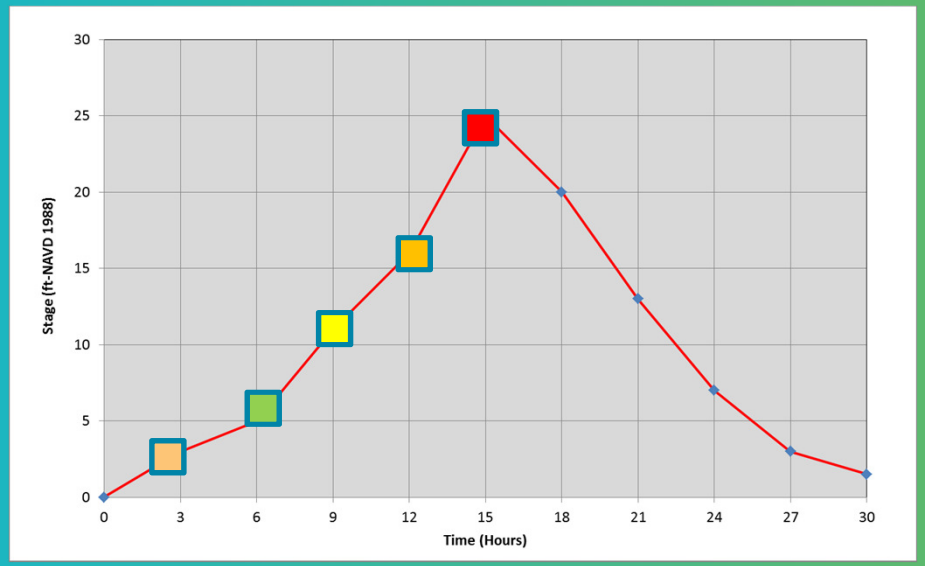
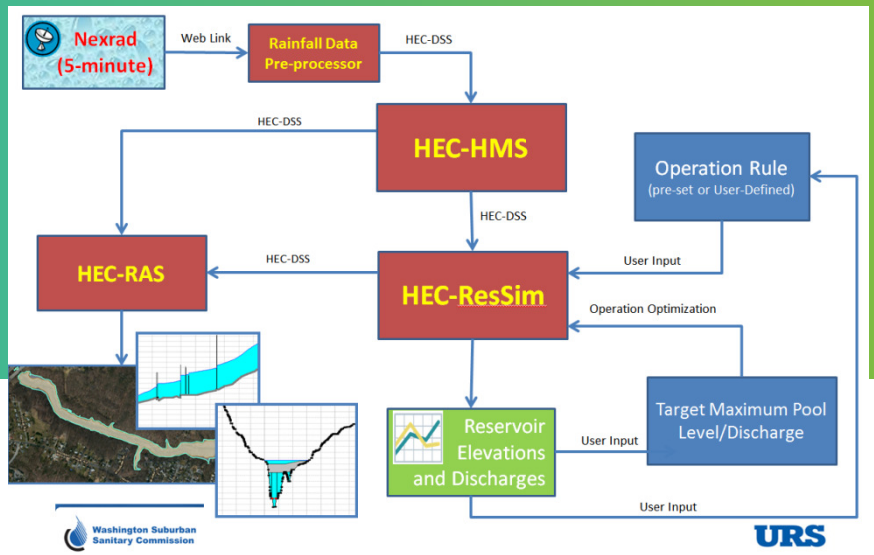
Mapping

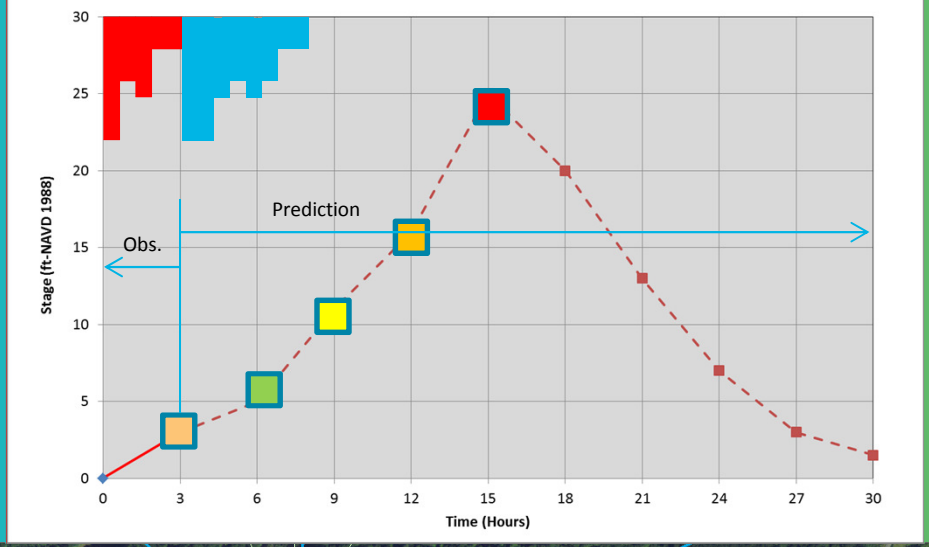
- RAS Mapper
  - Easy to use
  - No GIS license required

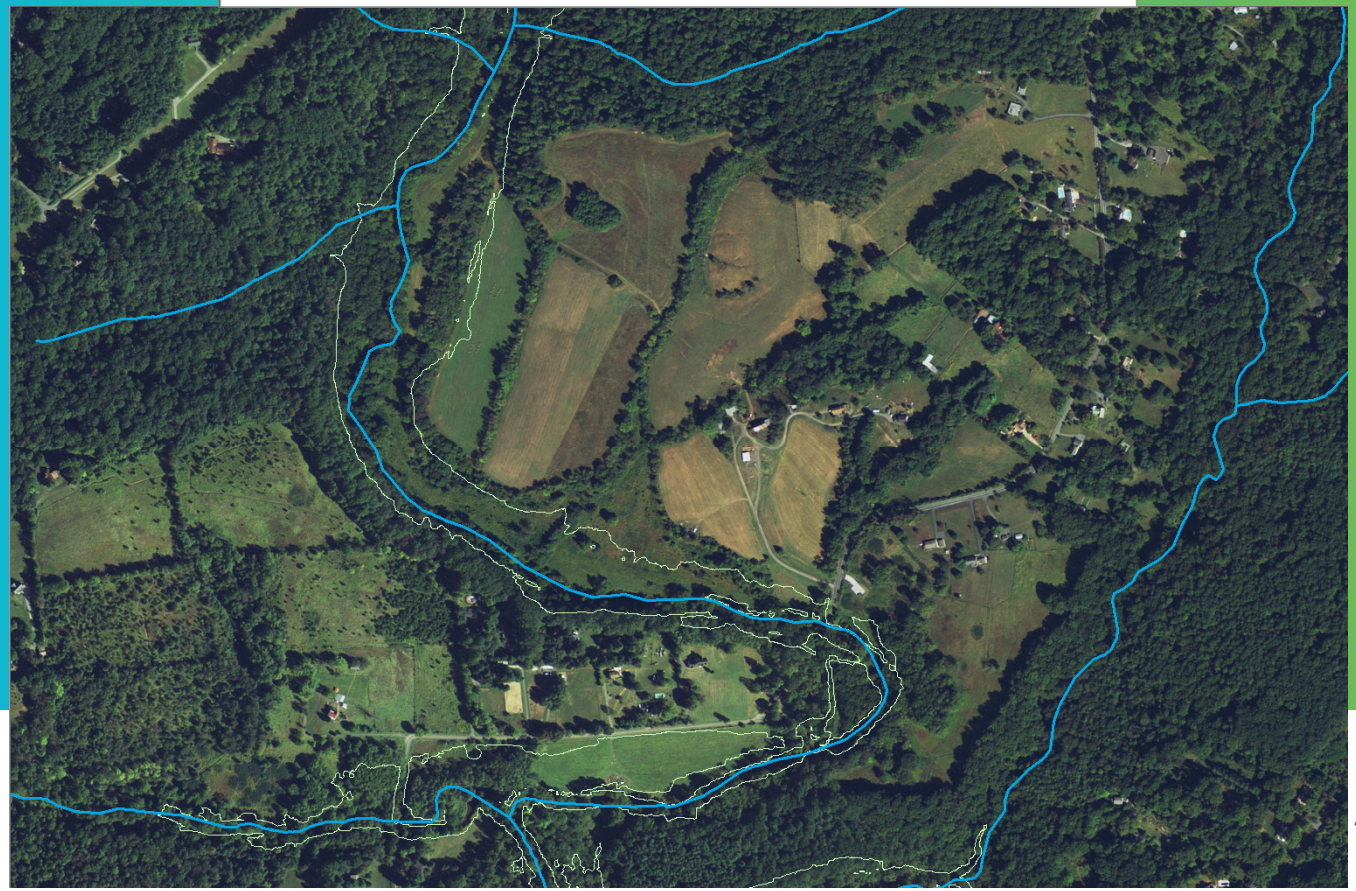


Predictive Flood Modeling






Prediction
Obs.
Stage (ft-NAVD 1988)
Time (Hours)
0
5
10
15
20
25
30
0
3
6
9
12
15
18
21
24
27
30



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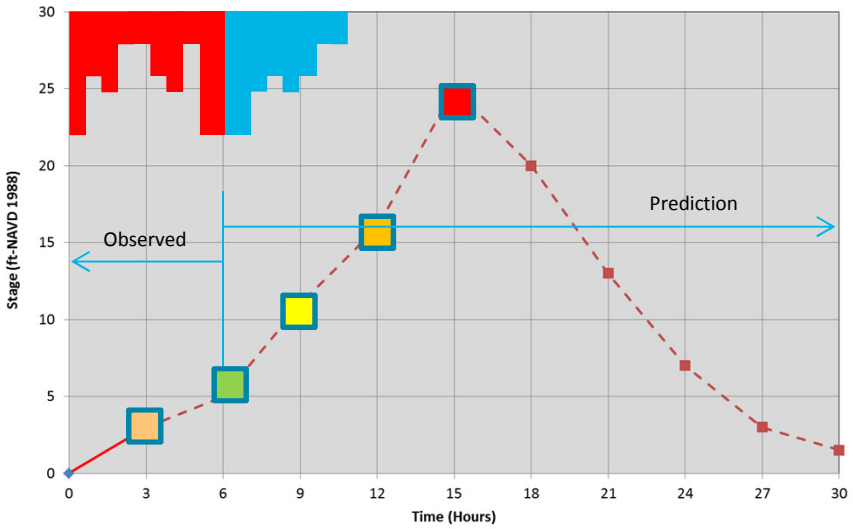
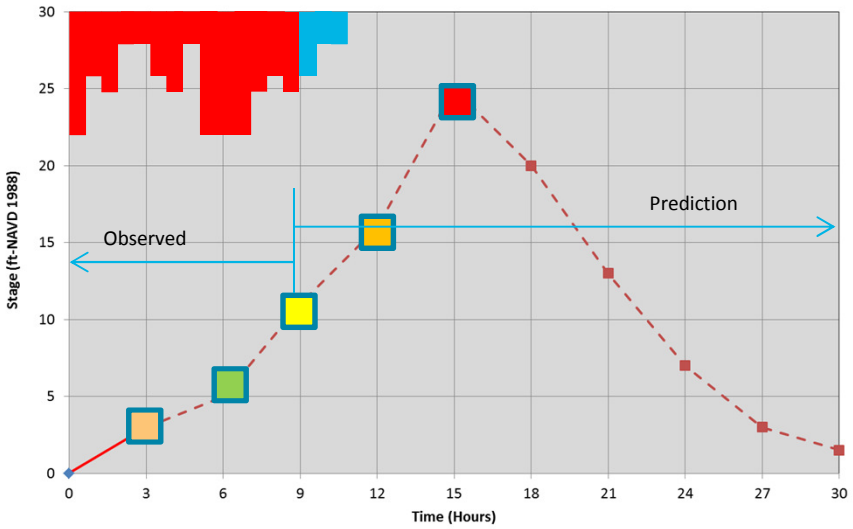
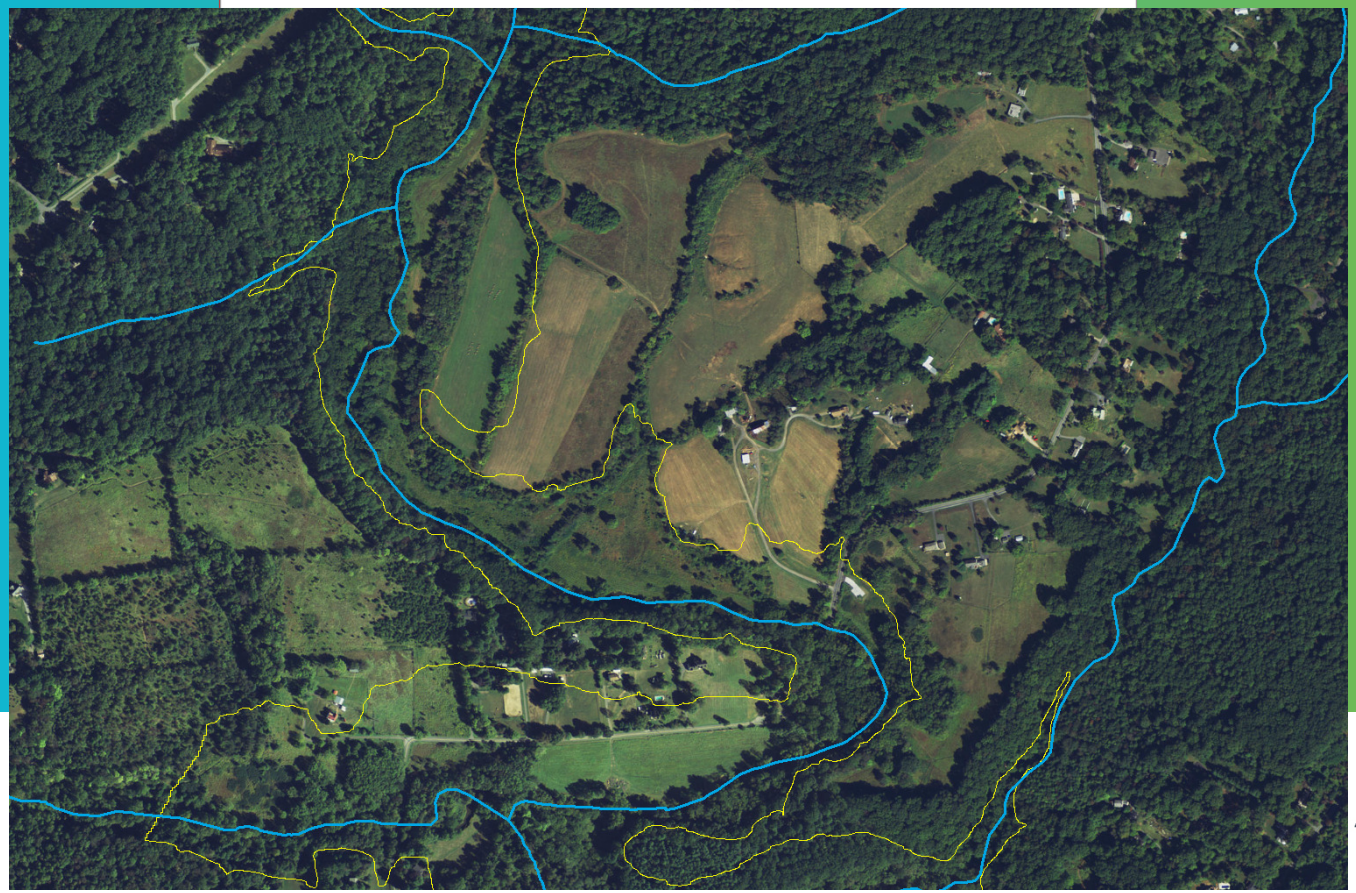
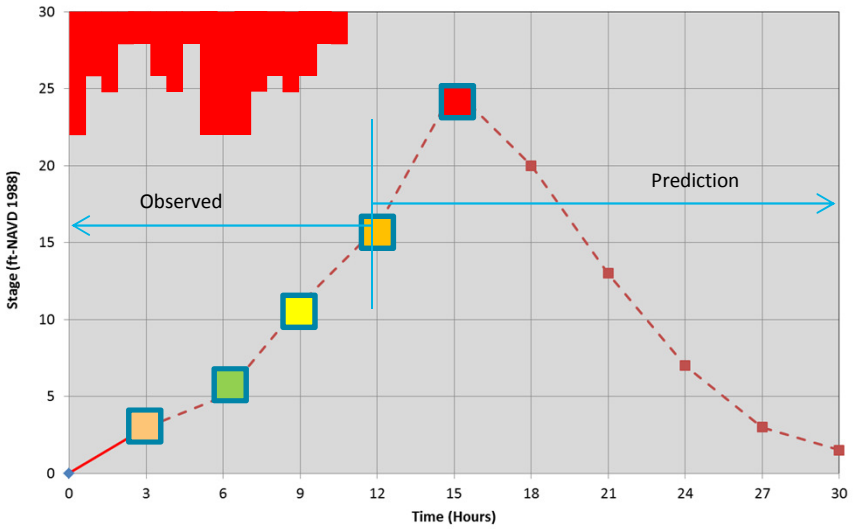

Observed
Prediction
Stage (ft-NAVD 1988)
Time (Hours)
0
5
10
15
20
25
30
0
3
6
9
12
15
18
21
24
27
30

AECOM

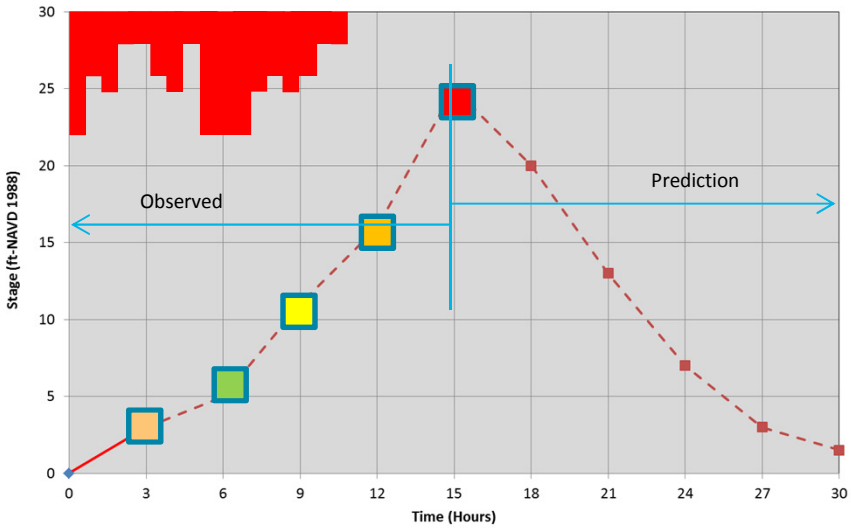

Stage (ft-NAVD 1988)
Time (Hours)
Observed
Prediction
0
5
10
15
20
25
30
0
3
6
9
12
15
18
21
24
27
30



AECOM


Observed
Prediction
Stage (ft-NAVD 1988)
Time (Hours)
0
5
10
15
20
25
30
0
3
6
9
12
15
18
21
24
27
30

AECOM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15
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30
0
3
6
9
12
15
18
21
24
27
30

AECOM

Conclusion

- It's a Concept!
- WSSC goal was to create a state-of-the-art operation and planning model to help understanding what's happening in lower watershed
- National Weather Service stream gage isn't in Advanced Hydrologic Prediction Service (AHPS)
- Demonstrates the use of highly sophisticated modeling in flood forecast
- Idea to be pilot tested

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Thank you!

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