Flood Risk Project

Wyoming County, New York

Hydrology Review Meeting

September 20, 2021

FEMA

Agenda

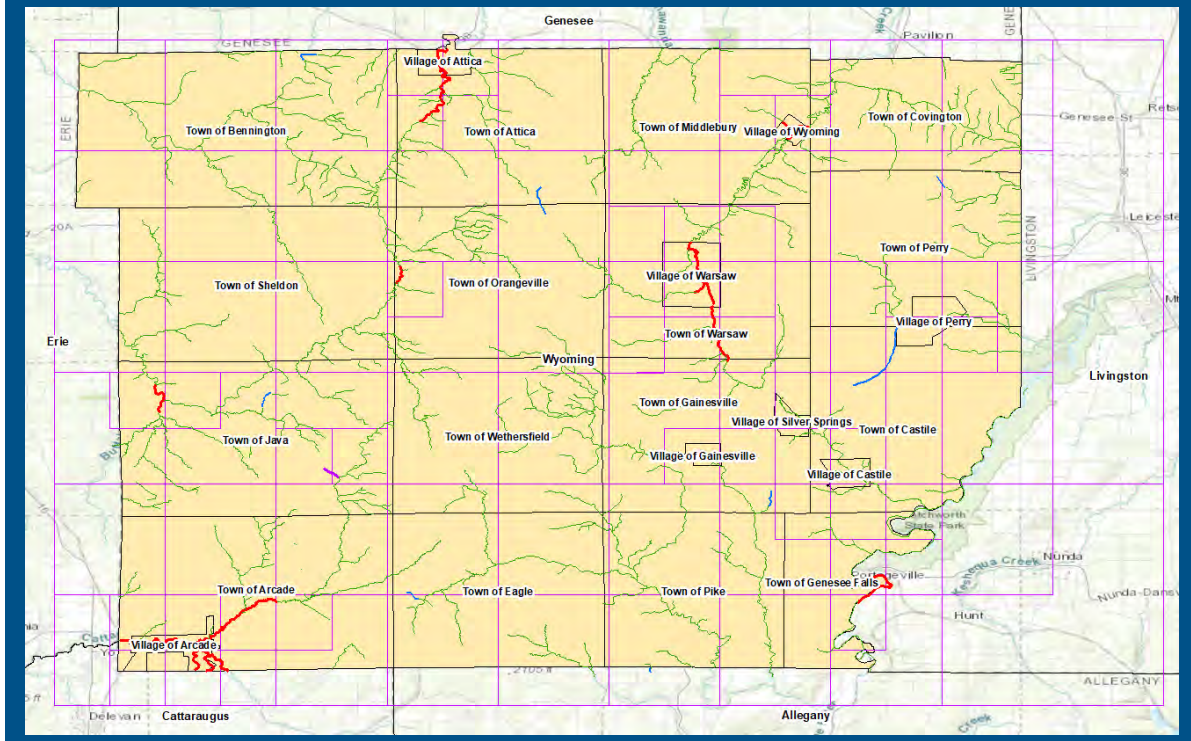
Recap/Refresh

Hydrology Analysis Review

Path Forward

Project Recap

- **Discovery Projects in Wyoming County**
  - Meetings held in November 2013
  - Discovery project completed in July 2016
  - Community input guided FEMA priorities
- **Current Wyoming Study Progress**
  - Kickoff meeting: Held virtually January 19, 2021
  - Engineering models notification: February 17, 2021
  - Field survey: November 2020 – August 2021
  - Hydrologic analysis: January 2021 – Present



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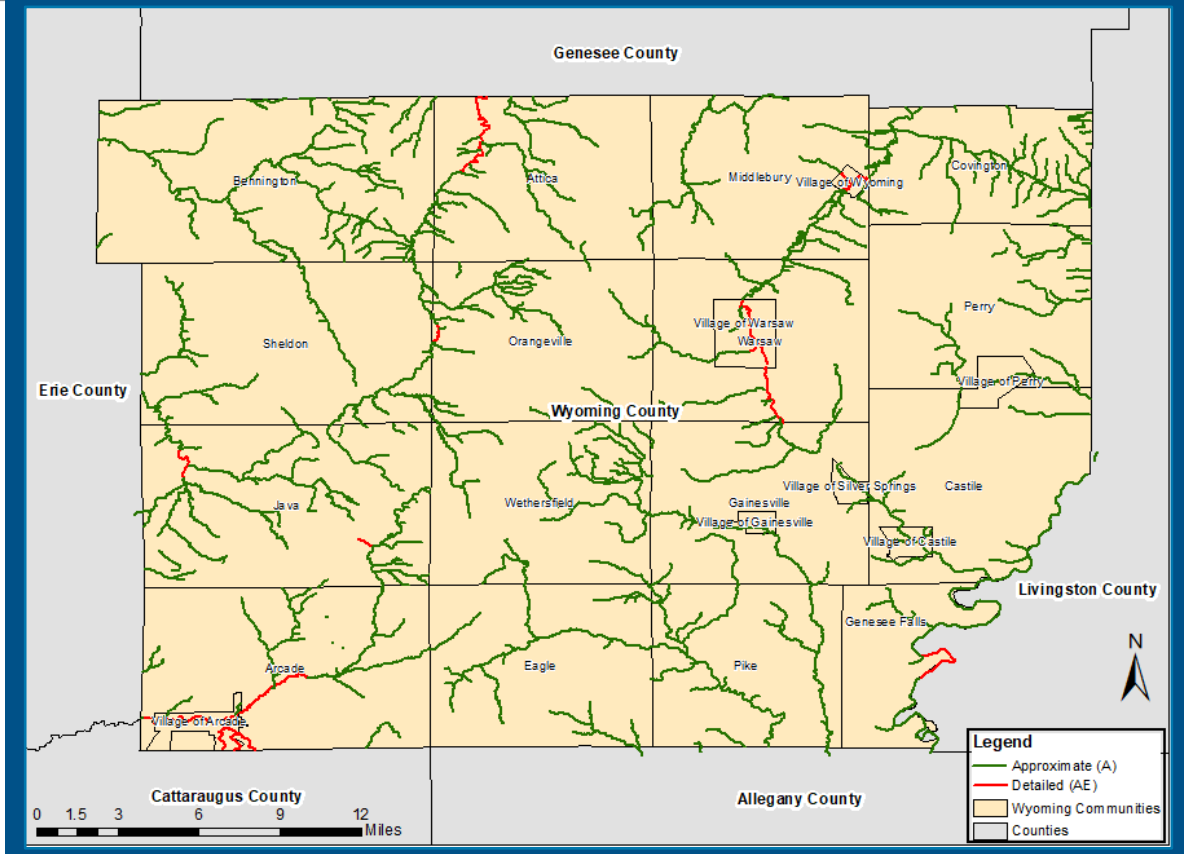
Project Scope

- First time digital maps
- Flooding sources analyzed
  - Detailed riverine studies (AE) – 11 streams, 28 miles
  - Detailed lake studies (AE) – 1 Lake, 0.5 miles
  - Approximate studies (A) – multiple streams, 548 miles
- 25 Updated Communities – 97 Map Panels
- Review Meetings
  - Hydrology Meeting
  - Hydraulics Meeting
  - Flood Risk Review Meeting



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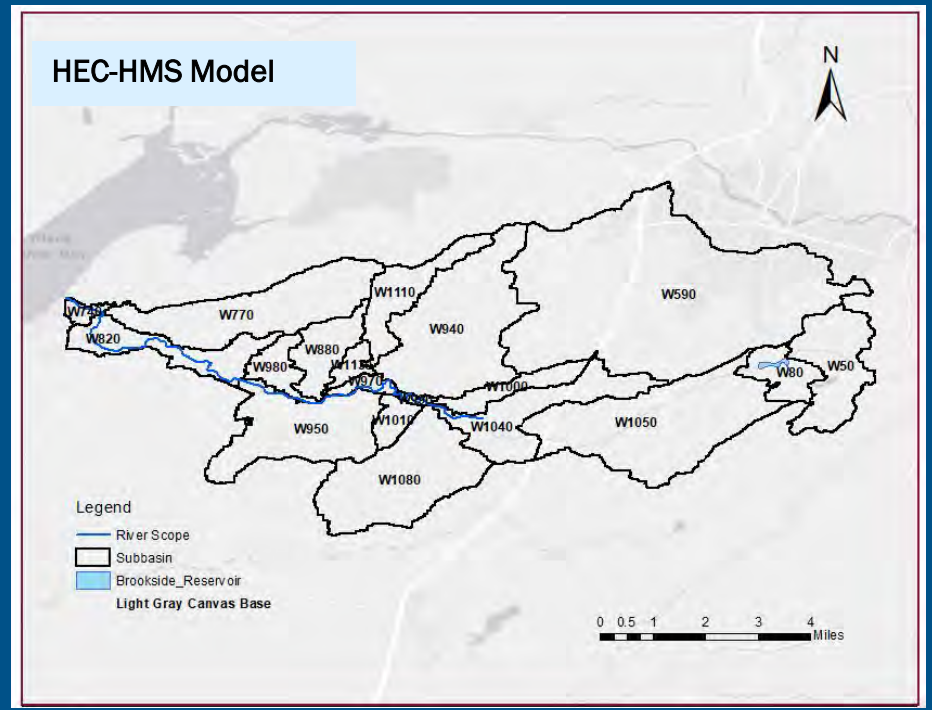
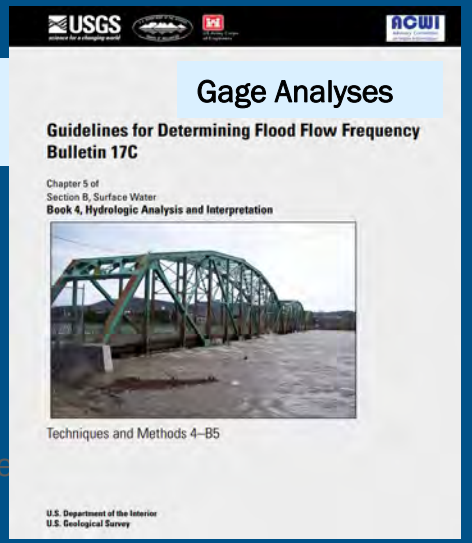
Hydrologic Analysis Methods

- Typical Methods FEMA utilizes
  - Statistical Gage Analyses
  - Regression Analyses
  - Rainfall Runoff Modeling
- Gage/Regression are based on availability of stream gage data
- Rainfall-Runoff physical modeling
- Discharges developed for
  - 10%, 4%, 2%, 1%, 1%+, 1%-, 0.2%
  - Inputs for hydraulic analyses





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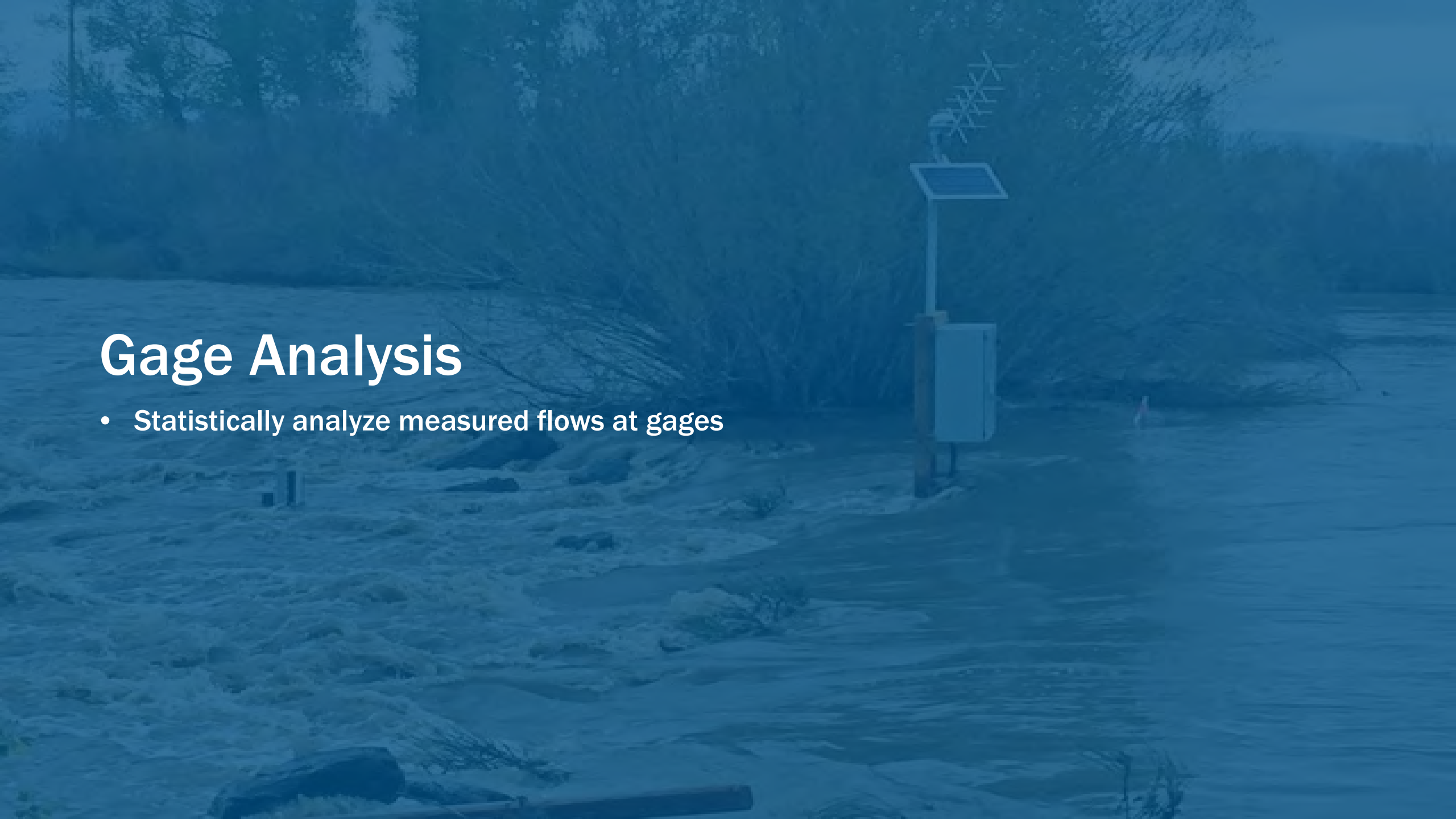


Gage Analysis

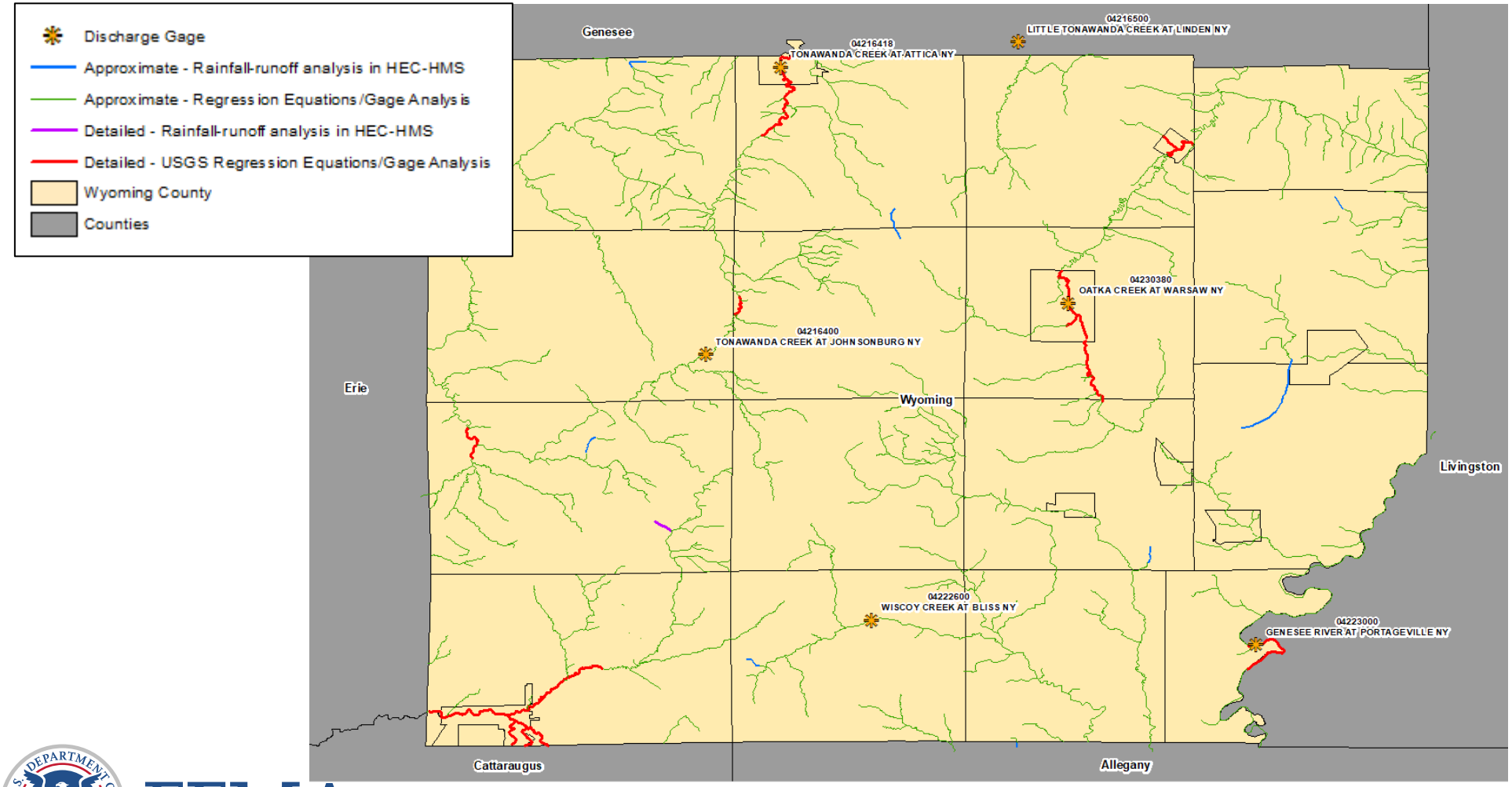
- Statistically analyze measured flows at gages

Hydrology – Gage Analysis

USGS Gage No.	Description	Drainage Area (square miles)
04223000	Genesee River at Portageville, NY	984
04216500	Little Tonawanda Creek at Linden, NY	22.1
04230380	Oatka Creek at Warsaw, NY	39.5
04216418	Tonawanda Creek at Attica, NY	76.9
04216400	Tonawanda Creek near Johnsonburg, NY	23.7
04222600	Wiscoy Creek at Bliss, NY	22

- Flow gage analysis performed in support of regression analysis
- Viable gage = minimum 15 years current record
- Bulletin 17C methodology

Hydrology – Gage Analysis



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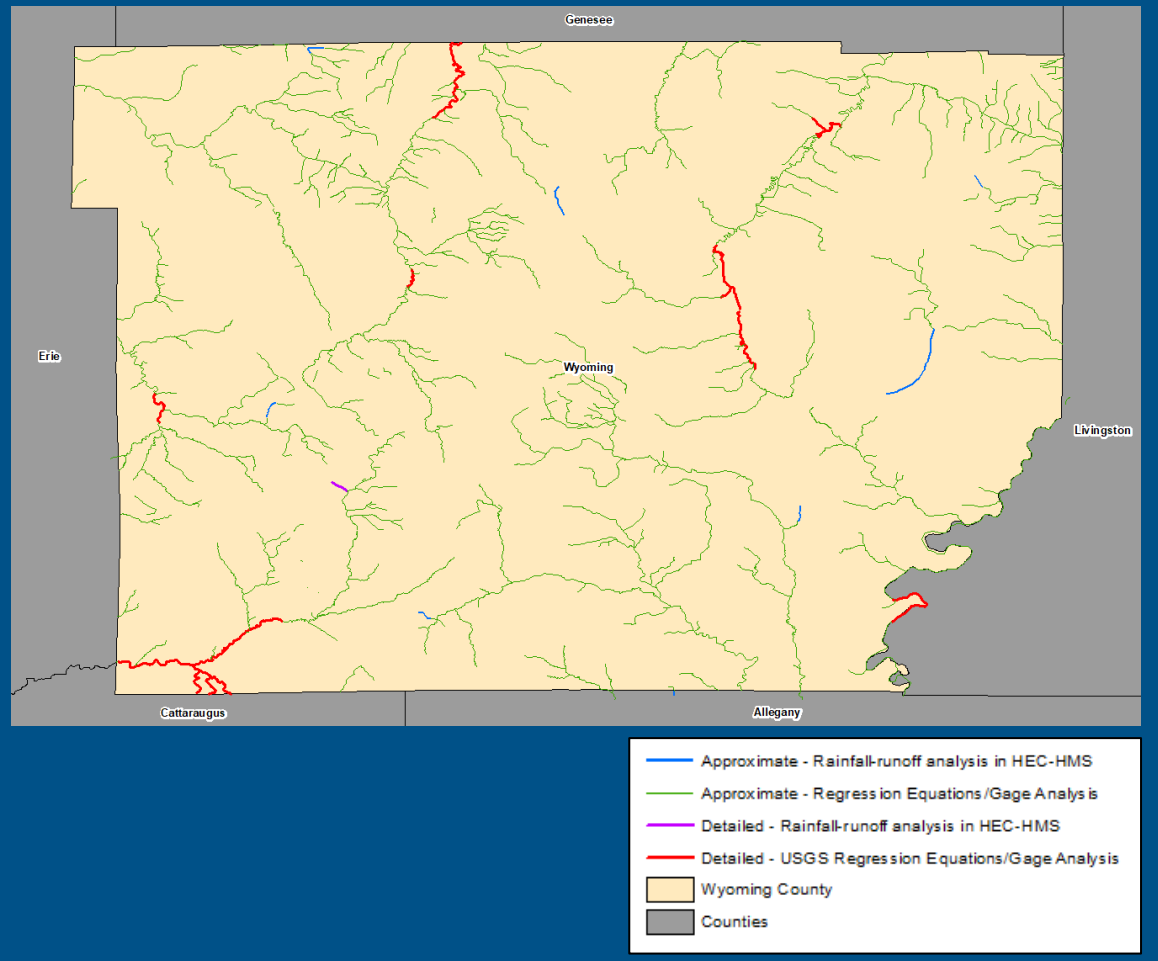
Regression Analysis

- USGS Stream Stats Discharges
- Relationships between peak flows and watershed characteristics
- Regional Regression Equations
- Gage Weighting

Hydrology – Regression Analysis

- Regression Analysis = Wyoming County (576 miles)
  - 28 miles of Detailed streams (AE Zone)
  - 548 miles of Approximate streams (A Zone)



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Hydrology – Regression Analysis

- USGS New York regression equations
  - SIR 2006-5112
- Study area falls within USGS NY regression Regions 5 and 6
- USGS StreamStats v5.02 p7
- Primary method for Zone A streams and for some Zone AE streams

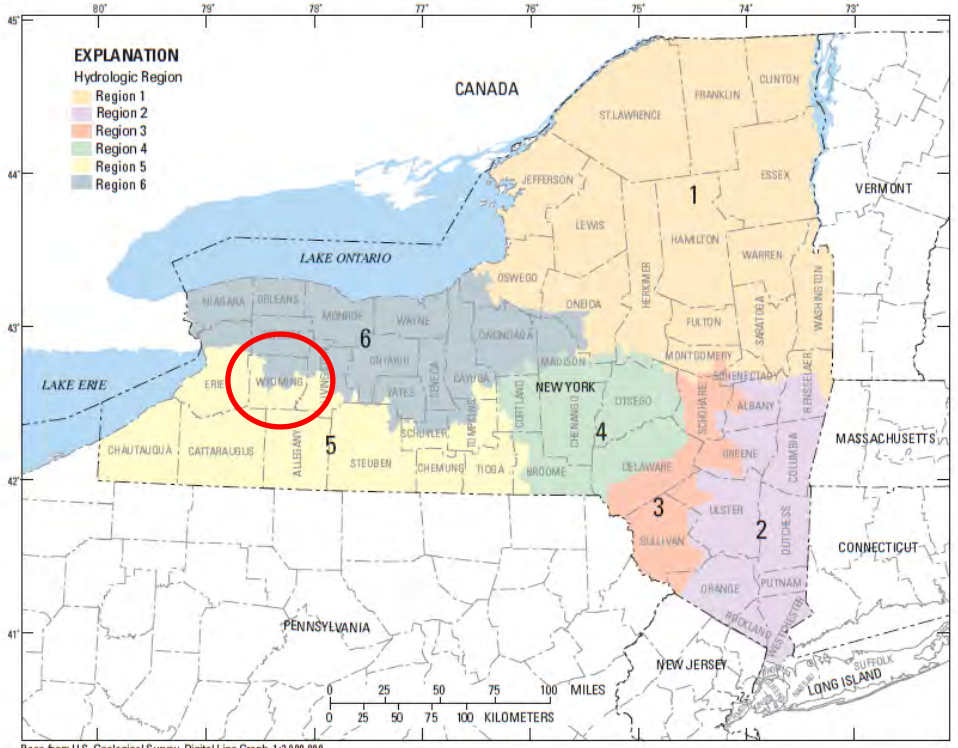


Figure 2. Six hydrologic regions of New York and locations of 388 streamflow-gaging stations represented in this study. (Map numbers refer to streamflow-gaging stations shown in tables 7 and 8.)

Summary of Regression Equations

Factors considered in Region 5:

- Drainage area (square miles)
- Main-channel slope (feet per mile)
- Mean annual precipitation (inches per year)

Factors considered in Region 6:

- Drainage Area
- Basin storage (percentage of total drainage area)
- Mean annual runoff (inches)
- Ratio of main-channel slope to basin slope within the basin
- Percentage of drainage basin at or greater than 1,200 feet above sea level

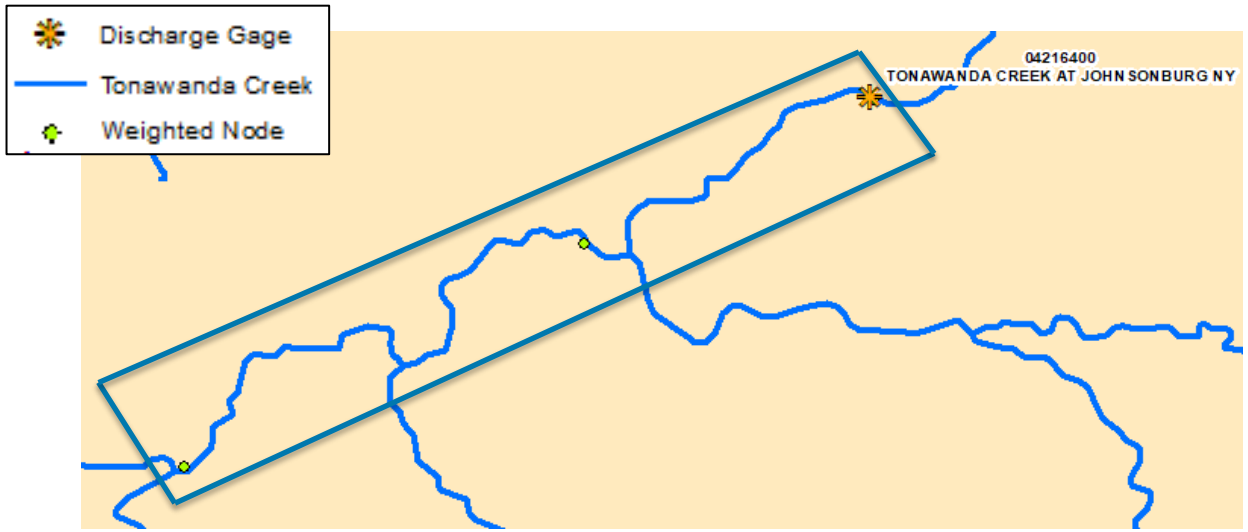
Summary of Gage Weighting Streams with Regression Discharges

- Gaged Sites
  - Log Pearson Type III, Bulletin 17C analysis to determine the discharges
  - Unregulated rivers – Discharges from the Bulletin 17C analysis are weighted with those from regression equations.

Example stream gage. Source: USGS/ Robert Swanson

Summary of Gage Weighting Streams with Regression Discharges

- Ungaged Sites on Gaged Streams
  - For unregulated streams, the gage discharge is weighted with the regression discharge.
    - Performed at all the flow change locations within 50% to 150% of the gage drainage area

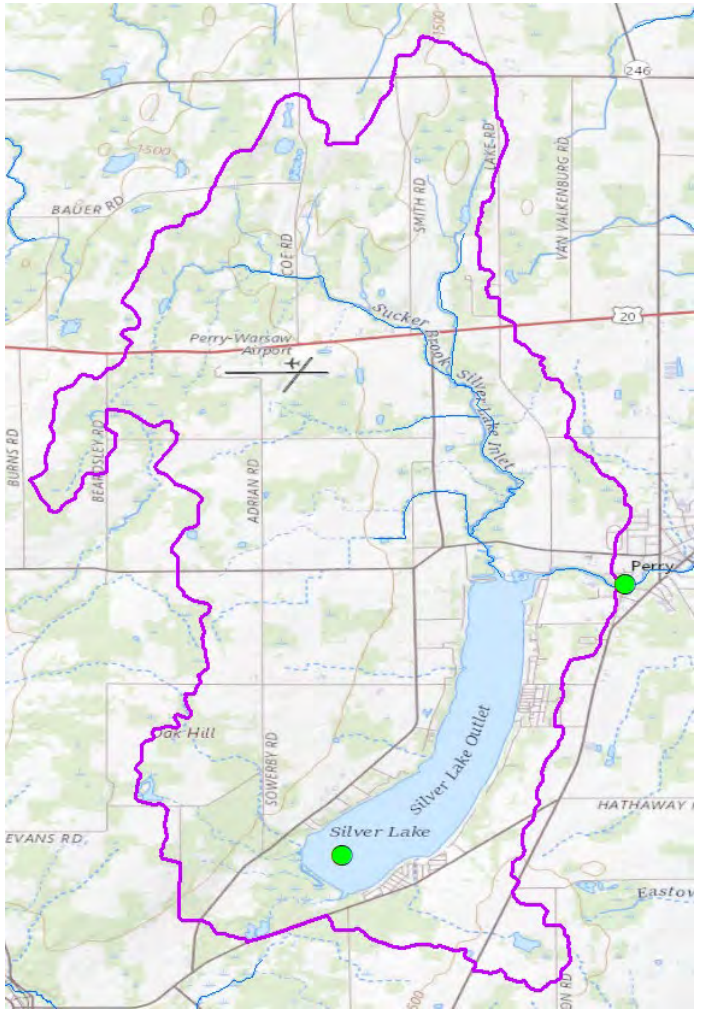


Rainfall-Runoff Analysis

- Creation of hydrologic models to calculate flows at outlet, node or subbasin
- Various inputs required
- Typically used for detailed studies

Hydrology – Rainfall-Runoff Modeling

- Attica Reservoir
- Akron Lake
- Beaverdam Lake
- Dream Lake
- East Koy Creek Tributary 3 Lake
- Elm Creek/Bush Brook Dam
- Java Lake
- Lake Leroy
- Silver Lake



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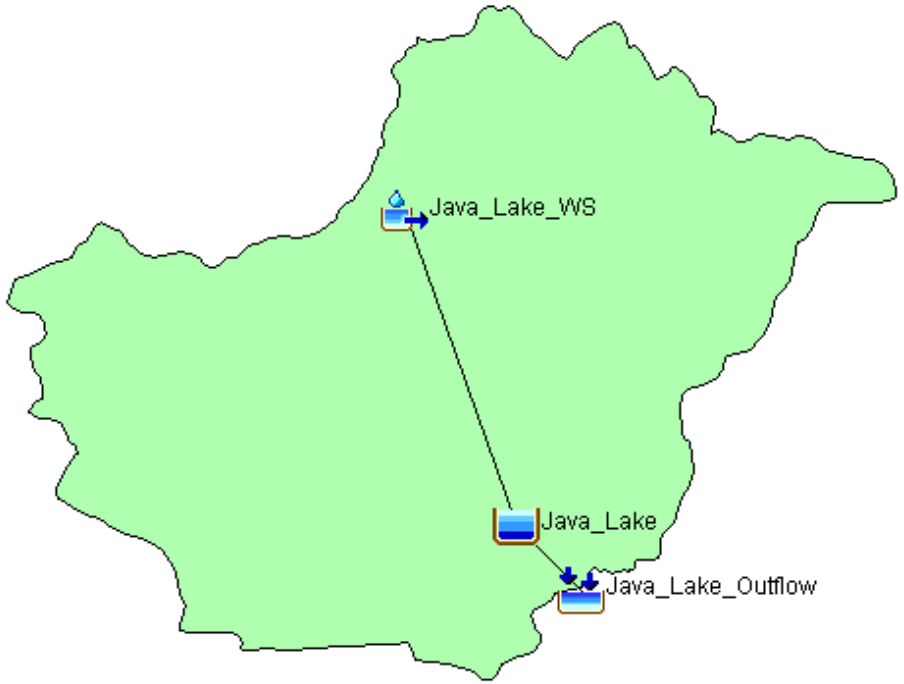
Rainfall-Runoff Methodology

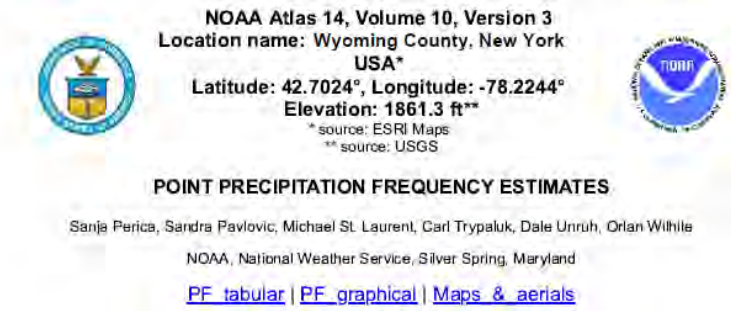
- HEC-HMS 4.8 was used
- Rainfall Depths: NOAA Atlas 14 Precipitation Frequency Data Server, 24-hour duration.
- Frequency Storm temporal distribution
- Loss Methodology: SCS Curve Number (TR-55), with average antecedent runoff condition
- Hydrograph Methodology: SCS Unit Hydrograph
  - Lag Time (60% of Time of Concentration)
- Channel Routing: Muskingum-Cunge using 8-point cross-sections
- Reservoir Routing: Stage-Discharge curve developed for all reservoirs/ Lakes using HECRAS
  - Reservoir/lakes then modeled as a function of storage (Elevation-Area-Discharge) method

Rainfall-Runoff Methodology

Java Lake HEC-HMS Model



NOAA Atlas 14 Rainfall Data



NOAA Atlas 14, Volume 10, Version 3
Location name: Wyoming County, New York USA*
Latitude: 42.7024°, Longitude: -78.2244°
Elevation: 1861.3 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.283 (0.223-0.355)	0.344 (0.271-0.432)	0.444 (0.348-0.559)	0.528 (0.411-0.668)	0.643 (0.485-0.843)	0.729 (0.539-0.970)	0.820 (0.589-1.13)	0.928 (0.625-1.28)	1.09 (0.706-1.54)	1.22 (0.775-1.76)
10-min	0.401 (0.315-0.503)	0.488 (0.383-0.613)	0.630 (0.494-0.793)	0.748 (0.583-0.946)	0.911 (0.687-1.19)	1.03 (0.763-1.38)	1.16 (0.835-1.60)	1.32 (0.887-1.82)	1.54 (1.00-2.19)	1.73 (1.10-2.50)
15-min	0.471 (0.371-0.592)	0.574 (0.451-0.721)	0.742 (0.582-0.935)	0.881 (0.686-1.11)	1.07 (0.808-1.41)	1.22 (0.898-1.62)	1.37 (0.982-1.88)	1.55 (1.04-2.14)	1.81 (1.18-2.58)	2.04 (1.29-2.94)
30-min	0.642 (0.505-0.805)	0.781 (0.614-0.980)	1.01 (0.789-1.27)	1.20 (0.932-1.51)	1.46 (1.10-1.91)	1.65 (1.22-2.20)	1.86 (1.33-2.55)	2.10 (1.42-2.91)	2.46 (1.60-3.50)	2.77 (1.75-3.99)
60-min	0.812 (0.639-1.02)	0.987 (0.776-1.24)	1.27 (0.998-1.60)	1.51 (1.18-1.91)	1.84 (1.39-2.41)	2.08 (1.54-2.78)	2.35 (1.69-3.23)	2.65 (1.79-3.67)	3.11 (2.02-4.42)	3.50 (2.21-5.04)
2-hr	1.01 (0.802-1.26)	1.23 (0.970-1.53)	1.58 (1.24-1.97)	1.86 (1.46-2.34)	2.26 (1.72-2.94)	2.56 (1.90-3.39)	2.88 (2.08-3.92)	3.25 (2.21-4.46)	3.80 (2.48-5.35)	4.26 (2.72-6.09)
3-hr	1.14 (0.908-1.42)	1.38 (1.09-1.71)	1.76 (1.39-2.20)	2.08 (1.64-2.60)	2.52 (1.92-3.27)	2.85 (2.13-3.75)	3.20 (2.32-4.34)	3.61 (2.46-4.93)	4.22 (2.76-5.90)	4.73 (3.02-6.71)
6-hr	1.39 (1.11-1.71)	1.66 (1.33-2.05)	2.11 (1.68-2.61)	2.48 (1.96-3.08)	2.99 (2.29-3.84)	3.37 (2.53-4.40)	3.78 (2.75-5.08)	4.25 (2.92-5.76)	4.95 (3.27-6.87)	5.54 (3.57-7.80)
12-hr	1.67 (1.34-2.05)	1.98 (1.59-2.43)	2.49 (1.99-3.06)	2.91 (2.32-3.59)	3.49 (2.69-4.45)	3.93 (2.97-5.09)	4.39 (3.22-5.85)	4.93 (3.40-6.62)	5.72 (3.80-7.87)	6.39 (4.14-8.91)
24-hr	1.99 (1.61-2.42)	2.34 (1.89-2.85)	2.92 (2.35-3.56)	3.39 (2.72-4.16)	4.05 (3.14-5.12)	4.54 (3.45-5.83)	5.07 (3.73-6.69)	5.67 (3.94-7.54)	6.54 (4.37-8.92)	7.27 (4.74-10.1)

Rainfall-Runoff Modeling – SCS Curve Numbers

- Soil Data from USGS SSURGO database
- Land use data from National Land Use Database (NLCD)
- Composite CN calculated for each sub-basin (TR-55 Methodology)
- Land use compared to recent aerial imagery to confirm
- Calculated composite Curve Numbers range from 50-81

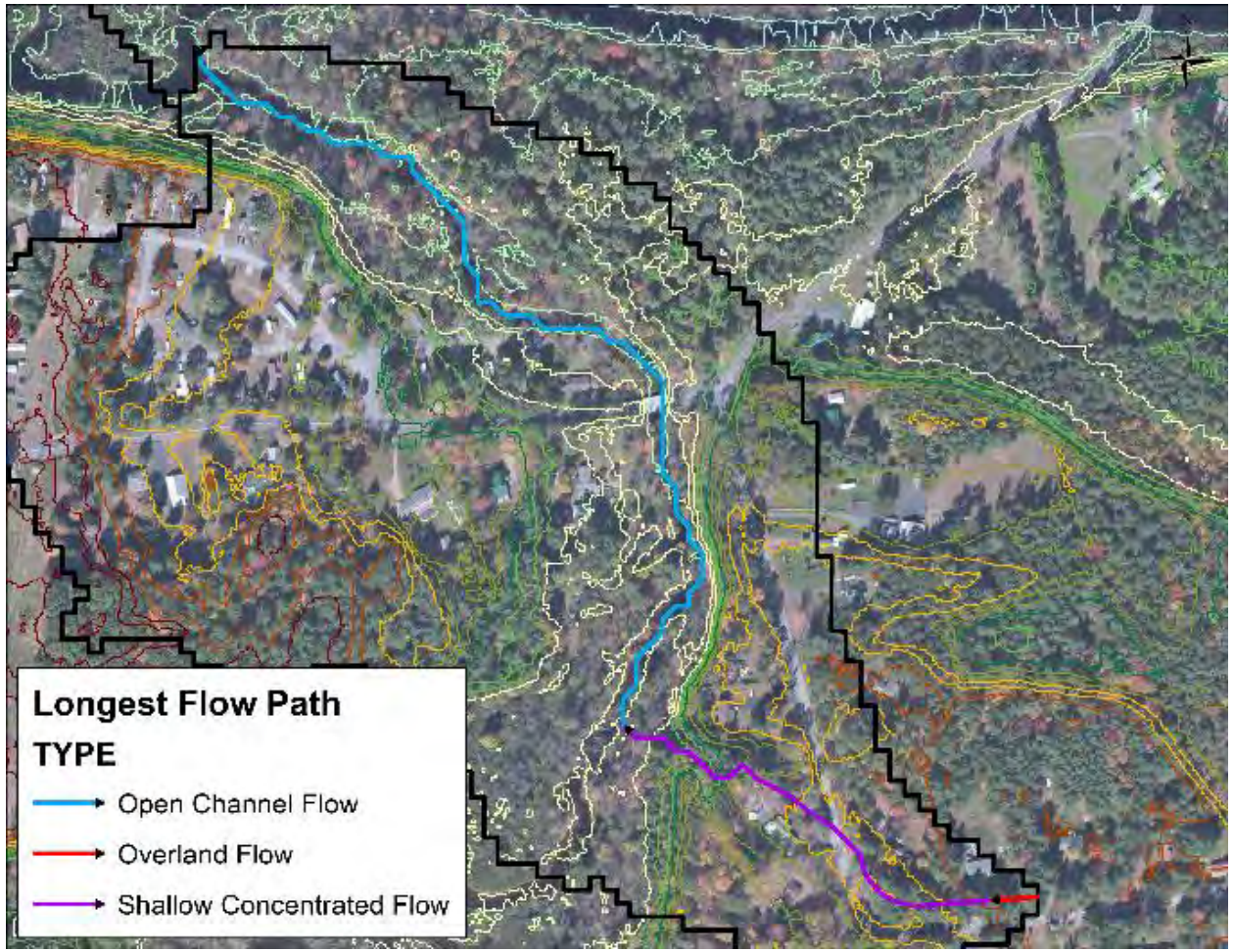
Table 2-2a Runoff curve numbers for urban areas [1/]

Cover description		Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	Average percent impervious area [2/]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3/]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89

Rainfall-Runoff Modeling – Time of Concentration (Tc) / Lag Time

- Longest flow path = longest time that a drop of water would take to travel through a watershed
- Developed from 10-meter Digital Elevation Model (DEM) data and HEC-GeoHMS extensions
- Flow paths split into different types:
  - Sheet flow maximum = 100 ft
  - Shallow concentrated flow: from end of sheet flow segment to visual open channel
  - Channel flow: begins at end of shallow concentrated flow segment and ends at sub-basin outlet
- Lag times = 60% of Time of Concentration

Longest Flow Path Example



Model Validation / Results

- Check computed flows against results from Effective FIS

Gage Analysis

Gage Analysis results – Comparison with FIS values

USGS Gage No.	Description	Drainage Area (square miles)	1-pct Discharge (cfs)	
			17C	FIS
04223000	Genesee River at Portageville, NY	984	62,420	67,000
04216500	Little Tonawanda Creek at Linden, NY	22.1	3,015	NA
04230380	Oatka Creek at Warsaw, NY	39.5	3,967	2,920
04216418	Tonawanda Creek at Attica, NY	76.9	8,303	10,100
04216400	Tonawanda Creek near Johnsonburg, NY	23.7	2,127	NA
04222600	Wiscoy Creek at Bliss, NY	22	2,313	NA

- No discharge was published in effective FIS for the gages on Little Tonawanda, Tonawanda (near Johnsonburg), and Wiscoy Creek

Rainfall-Runoff Modeling – Model Validation

HEC-HMS results – Comparison with Regression Values

Water Name	Drainage Area (square miles)	HMS 1% Discharge (cfs)	Regression 1% Discharge (cfs)
Akron Reservoir	2.28	562.00	543.00
Attica Reservoir	3.57	882.00	621.00
Beaver Dam Lake	0.58	93.00	58.00
Dream Lake	1.41	301.00	232.00
East Koy	1.01	172.00	125.00
Elm Creek/Bush Brook Dam	2.33	571.00	699.00
Java Lake	1.31	255.00	187.00
Lake Leroy	1.88	405.00	296.00
Silver Lake	17.60	2,710.00	2,315.00

Rainfall-Runoff Modeling – Model Validation

Stage Frequency Analysis Results

Flooding Source	Elevation (ft)					
	50%-Annual Chance	10%-Annual Chance	4%-Annual Chance	2%-Annual Chance	1%-Annual Chance	0.2%-Annual Chance
Akron Reservoir	1219.1	1219.6	1219.8	1220	1220.1	1220.6
Attica Reservoir	1599.8	1600.3	1600.6	1600.8	1601.1	1601.7
Beaver Dam	1469	1469.3	1469.4	1469.5	1469.6	1470
Dream Lake Dam	1745.9	1746.3	1746.5	1746.6	1746.7	1747
East Koy Creek	1590.7	1591.4	1592	1592.3	1592.6	1593.3
Elm Creek/Bush Brook	1585	1585.8	1586.1	1586.2	1586.3	1586.4
Java Lake	1651	1651.6	1651.9	1652	1652.2	1652.6
Lake Leroy	1292.2	1292.7	1292.9	1293.1	1293.2	1293.6
Silver Lake	1355.2	1355.9	1356.3	1356.7	1357.1	1358.2

- No elevations published in the effective FIS reports.

Rainfall-Runoff Modeling - Comparison to Effective Flows

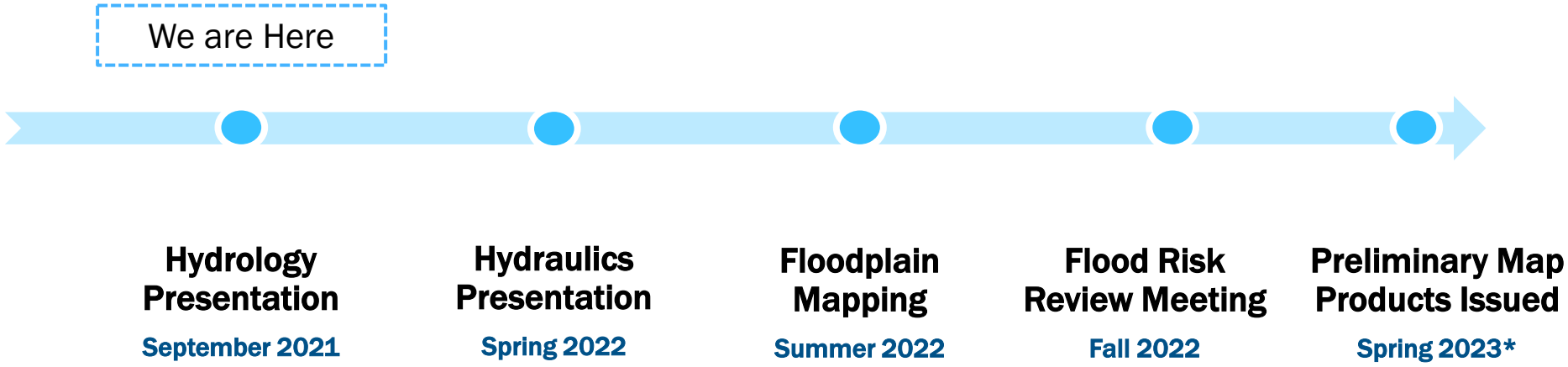
- Study results found to be:
  - Consistent with Flood Insurance Study (FIS) flows
  - Consistent with gage analysis flows
  - Compare well with regression analysis

Wyoming County Next Steps

Wyoming County Next Steps

- Field reconnaissance
- Hydraulic analysis
  - Hydraulic modeling/report/submittal
  - Hydraulic analysis webinar
- Floodplain Mapping
- Flood Risk Review meeting
  - Comment period for communities

Project Timeline towards Preliminary Issuance



*Current timeline could be impacted by Flood Risk Review or Preliminary Map Comments

Graphic Above Not to Scale

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Thank you!

FEMA