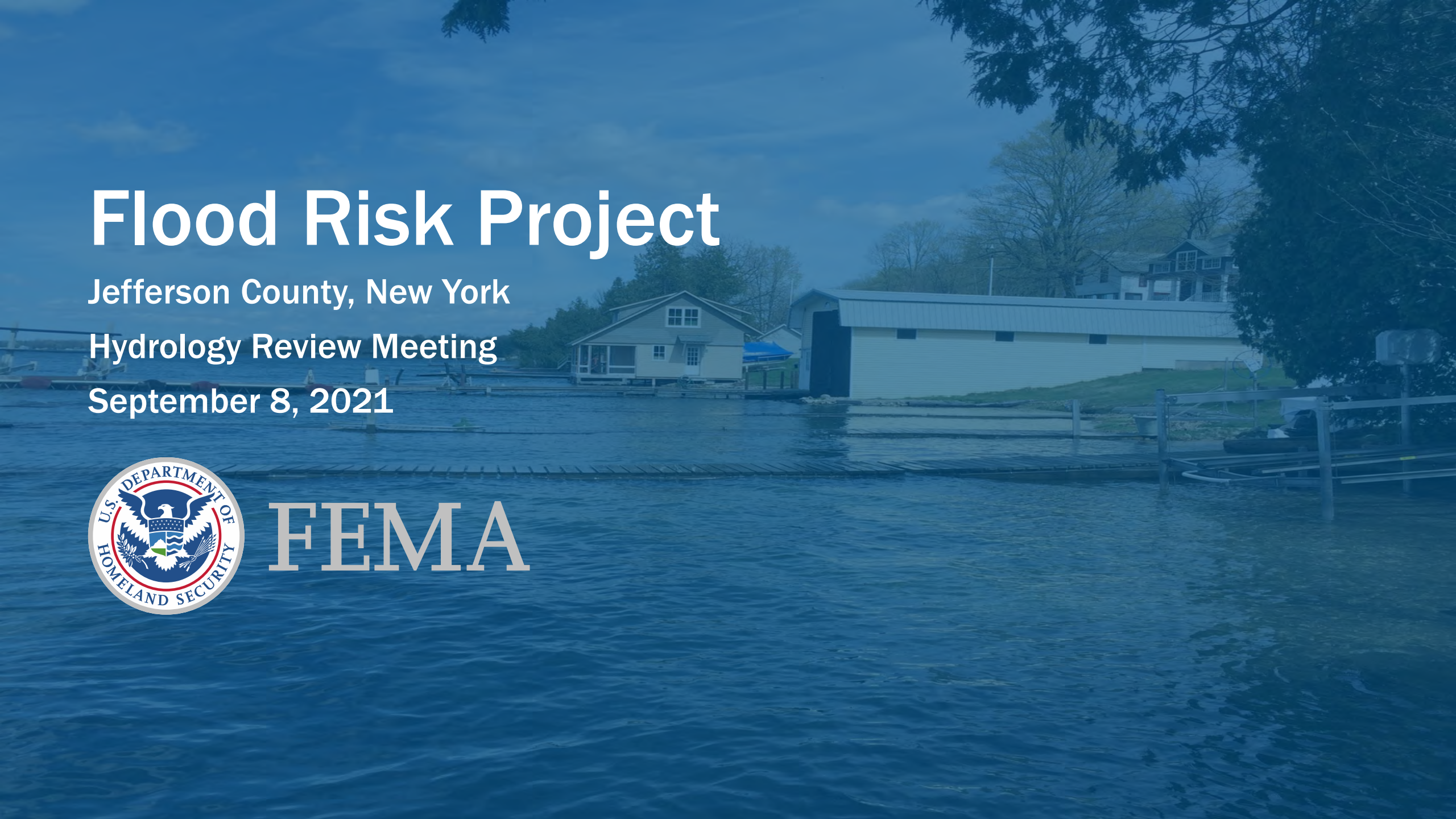


# Flood Risk Project

## Jefferson County, New York

## Hydrology Review Meeting

## September 8, 2021

FEMA

# Agenda

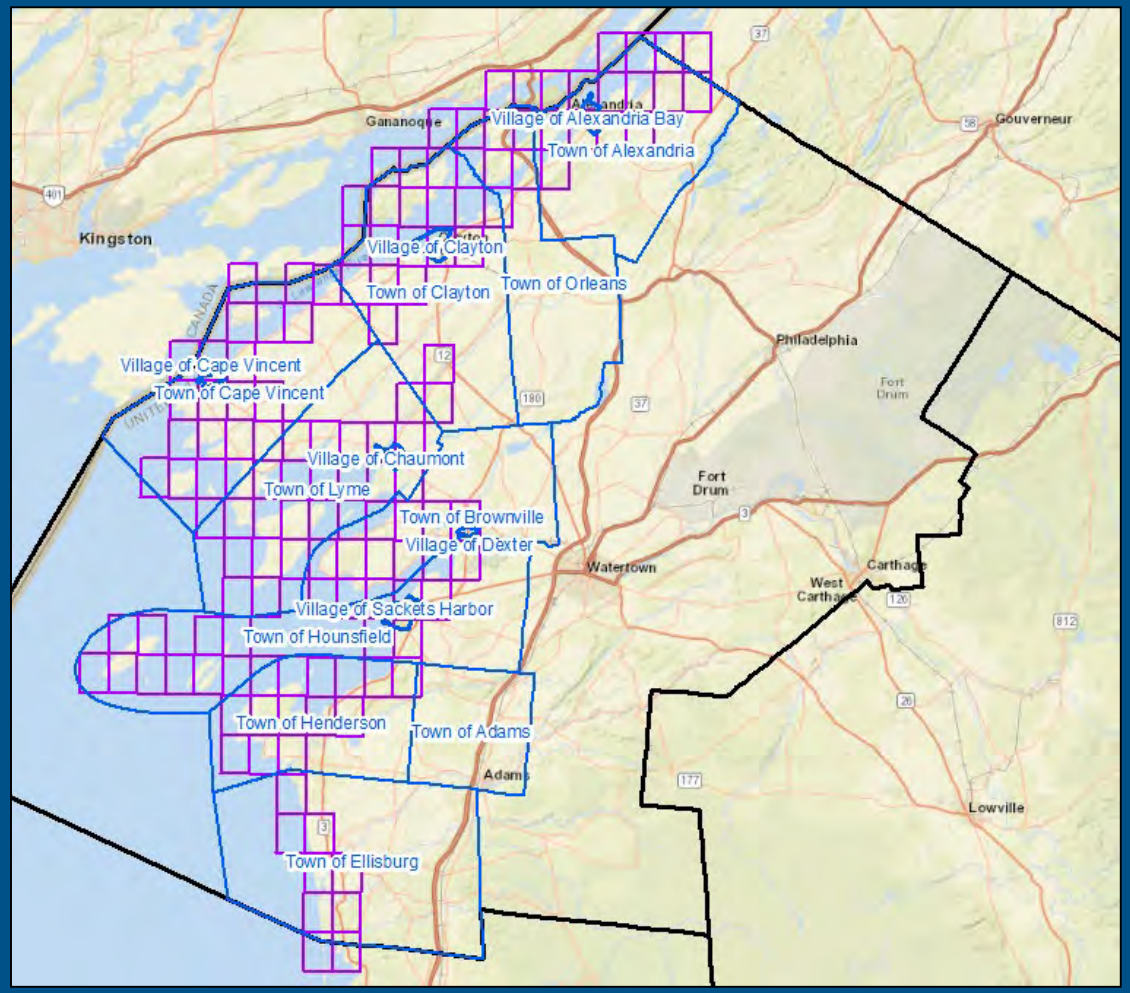
Recap/Refresh

Hydrology Analysis Review

Path Forward

# Project Recap

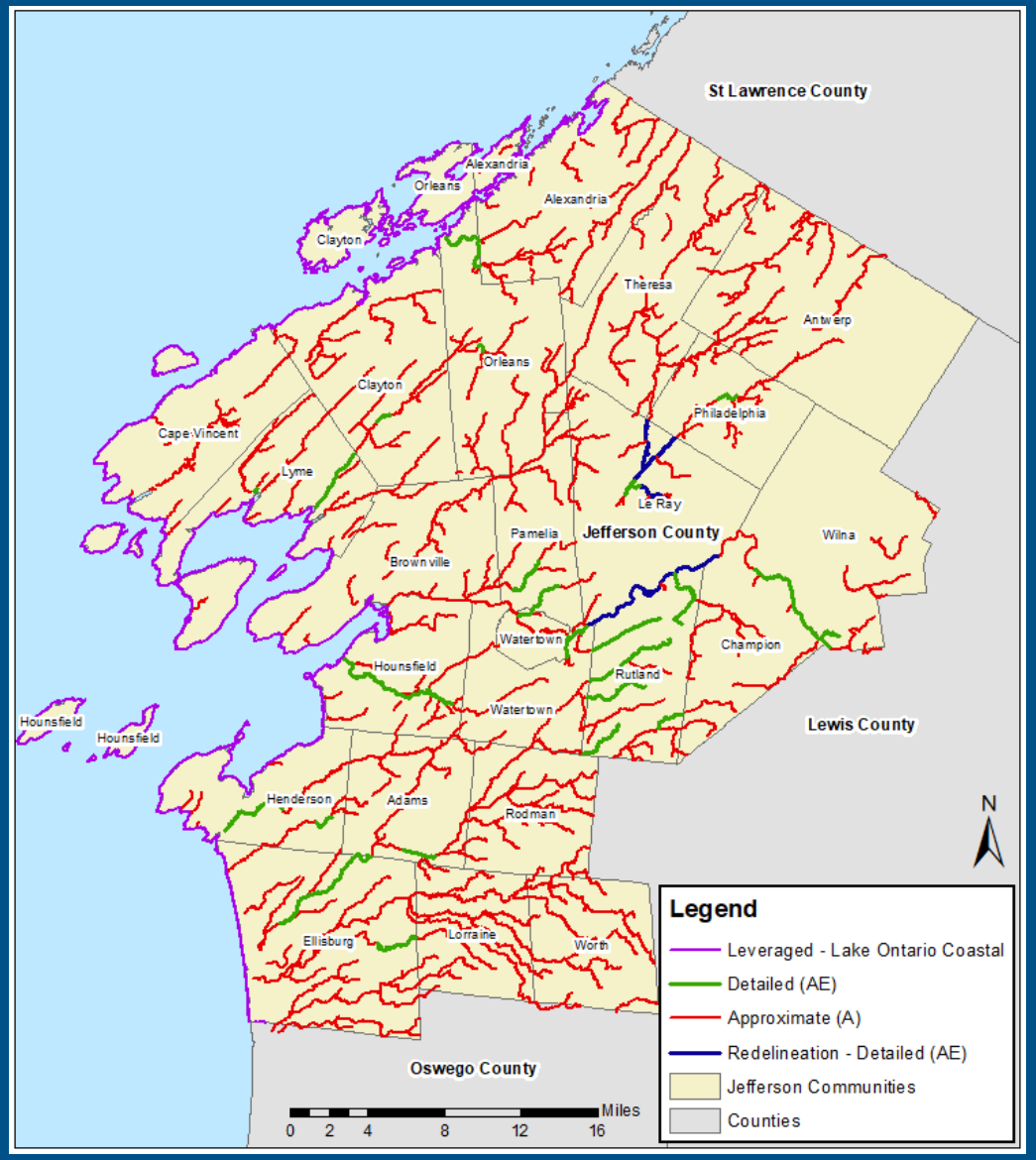
- **Projects in Jefferson County**
  - North Country Watersheds Discovery
    - Completed in March 2020
  - Great Lakes Coastal Study
    - Flood Risk Review meetings held in July 2017
  - Lake Ontario Watersheds Discovery
    - Completed in July 2016
- **Current Jefferson Study Progress**
  - Kickoff meeting: Held virtually February 9, 2021
  - Engineering models notification: February 17, 2021
  - Field survey: Spring 2021 – Fall 2022
  - Hydrologic analysis: June 2021 – Present




Coastal Data Available - Draft Data Viewer

# Project Scope

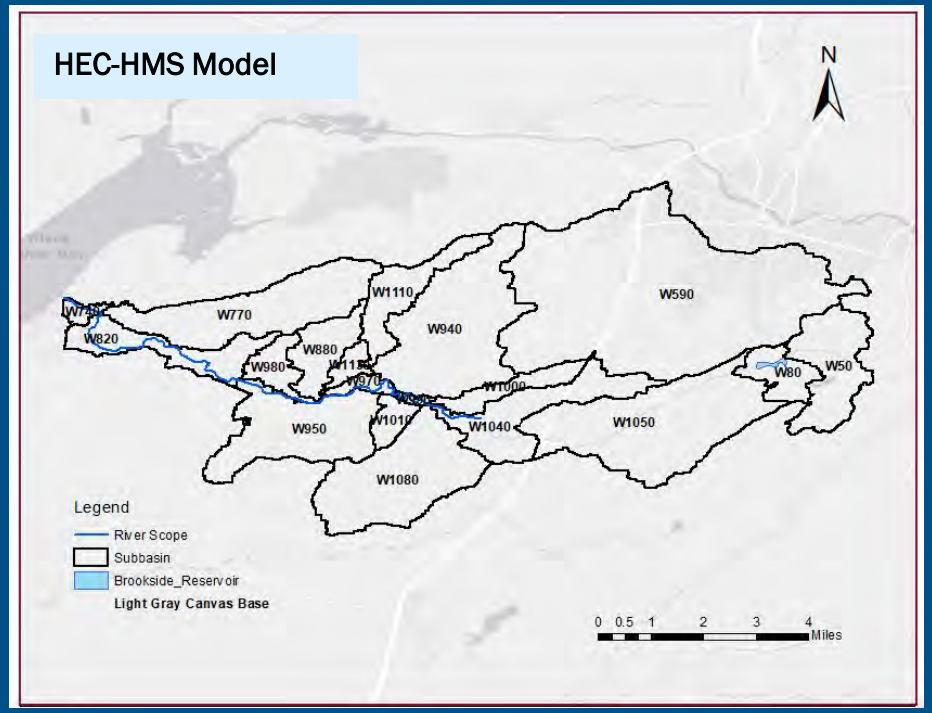
- First time digital maps
- Flooding sources analyzed
  - Detailed riverine studies (AE) – 23 streams, 76 miles
  - Detailed lake studies (AE) – 1 Lake, 1.3 miles
  - Approximate studies (A) – multiple streams, 855.6 miles
  - Will tie in to existing coastal mapping
- 40 Updated Communities – 255 Map Panels
- Review Meetings
  - Hydrology Meeting
  - Hydraulics Meeting
  - Flood Risk Review Meeting



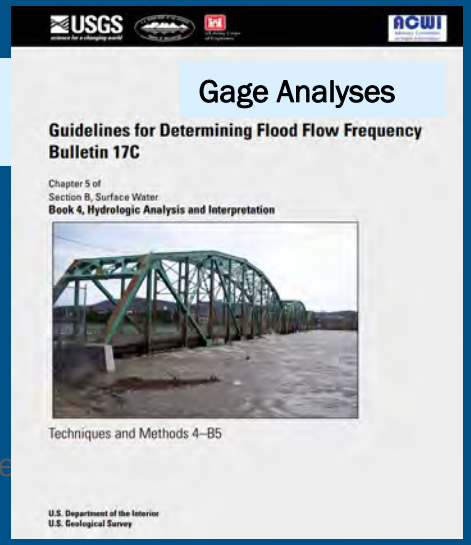

FEMA

# Hydrologic Analysis Methods

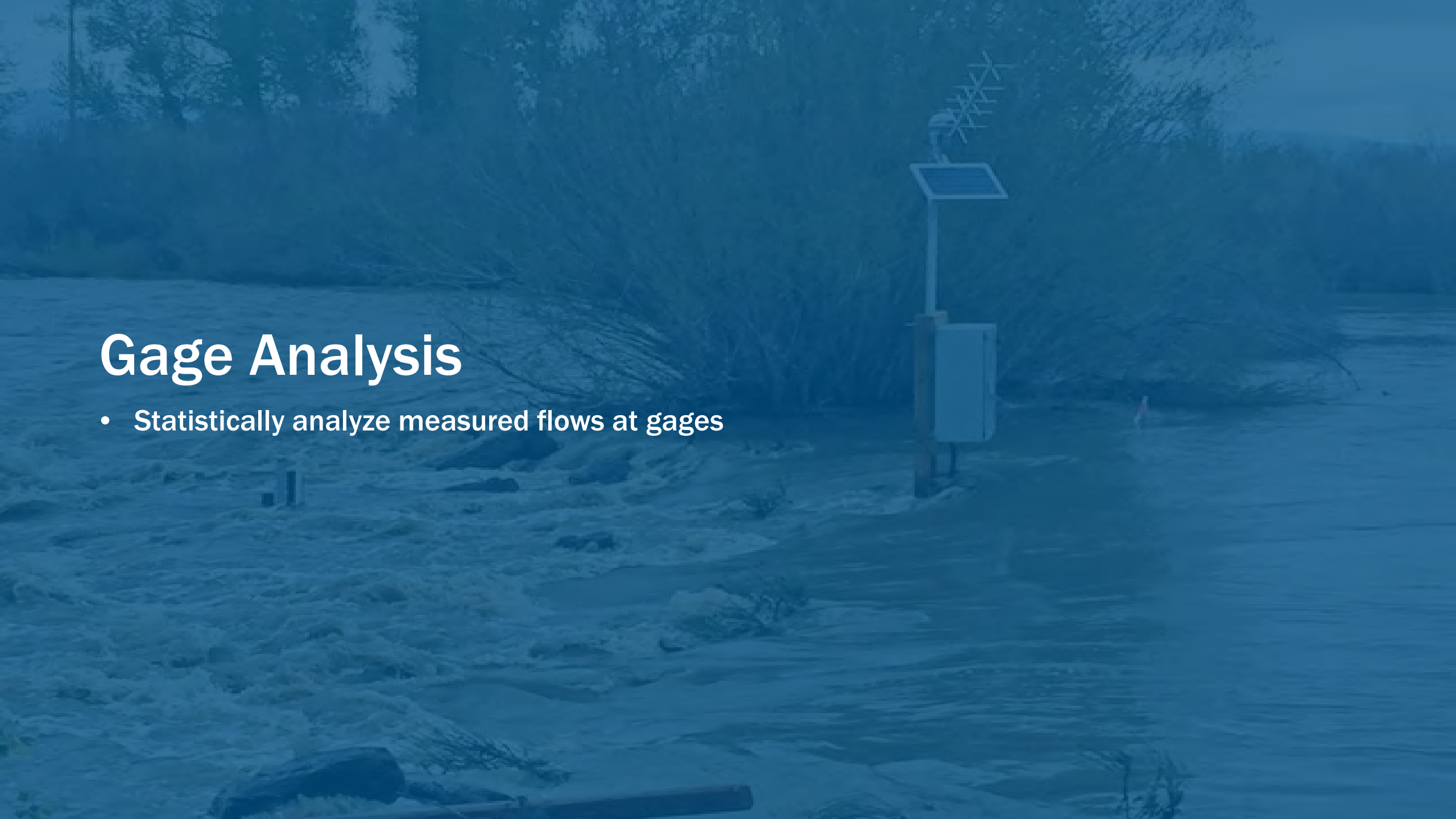
- Typical Methods FEMA utilizes
  - Statistical Gage Analyses
  - Regression Analyses
  - Rainfall Runoff Modeling
- Gage/Regression are based on availability stream gage data
- Rainfall-Runoff physical modeling chosen due to limited gage data
- Discharges developed for
  - 10%, 4%, 2%, 1%, 1%+, 1%-,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








FEMA



# Gage Analysis

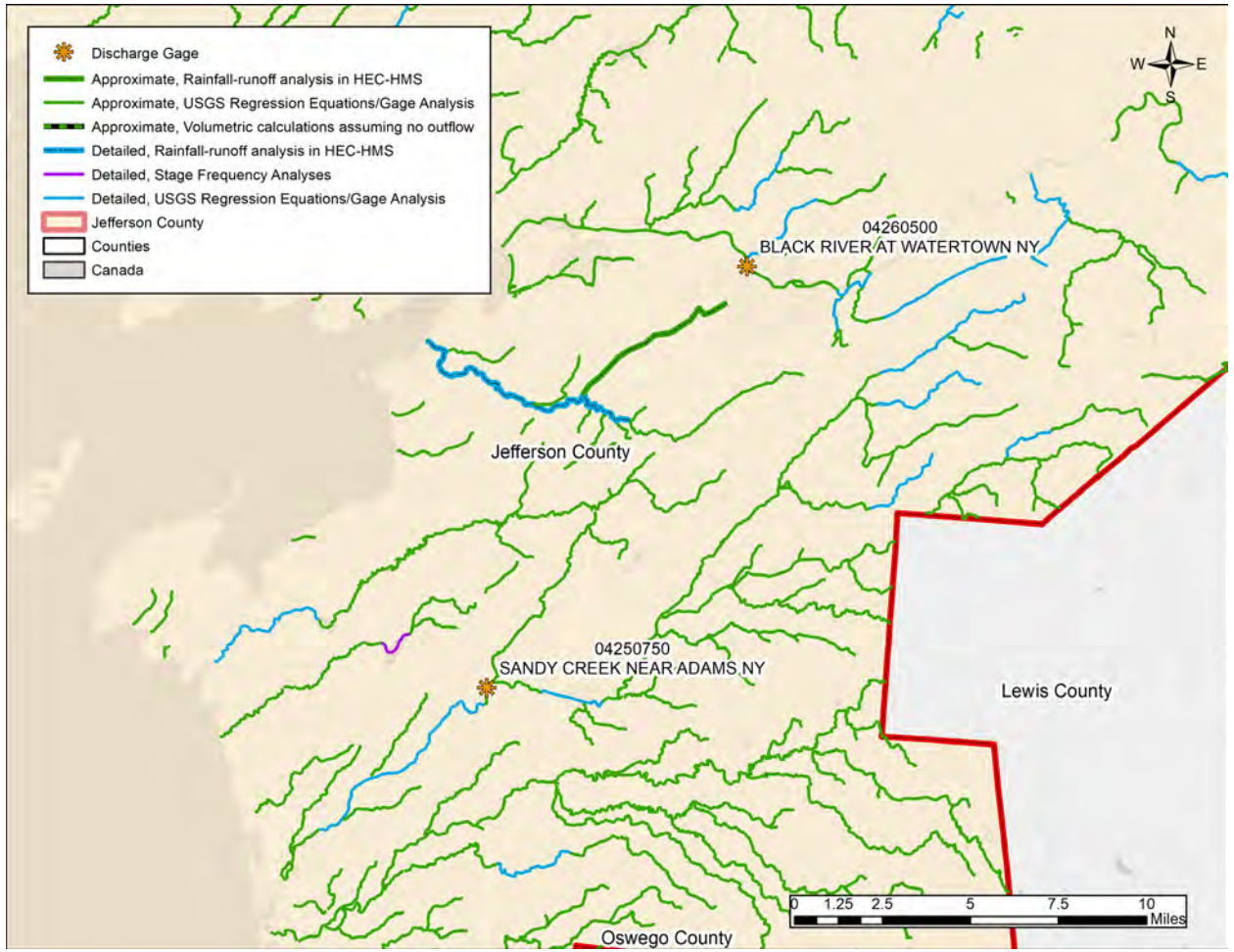
- Statistically analyze measured flows at gages

# Hydrology – Gage Analysis

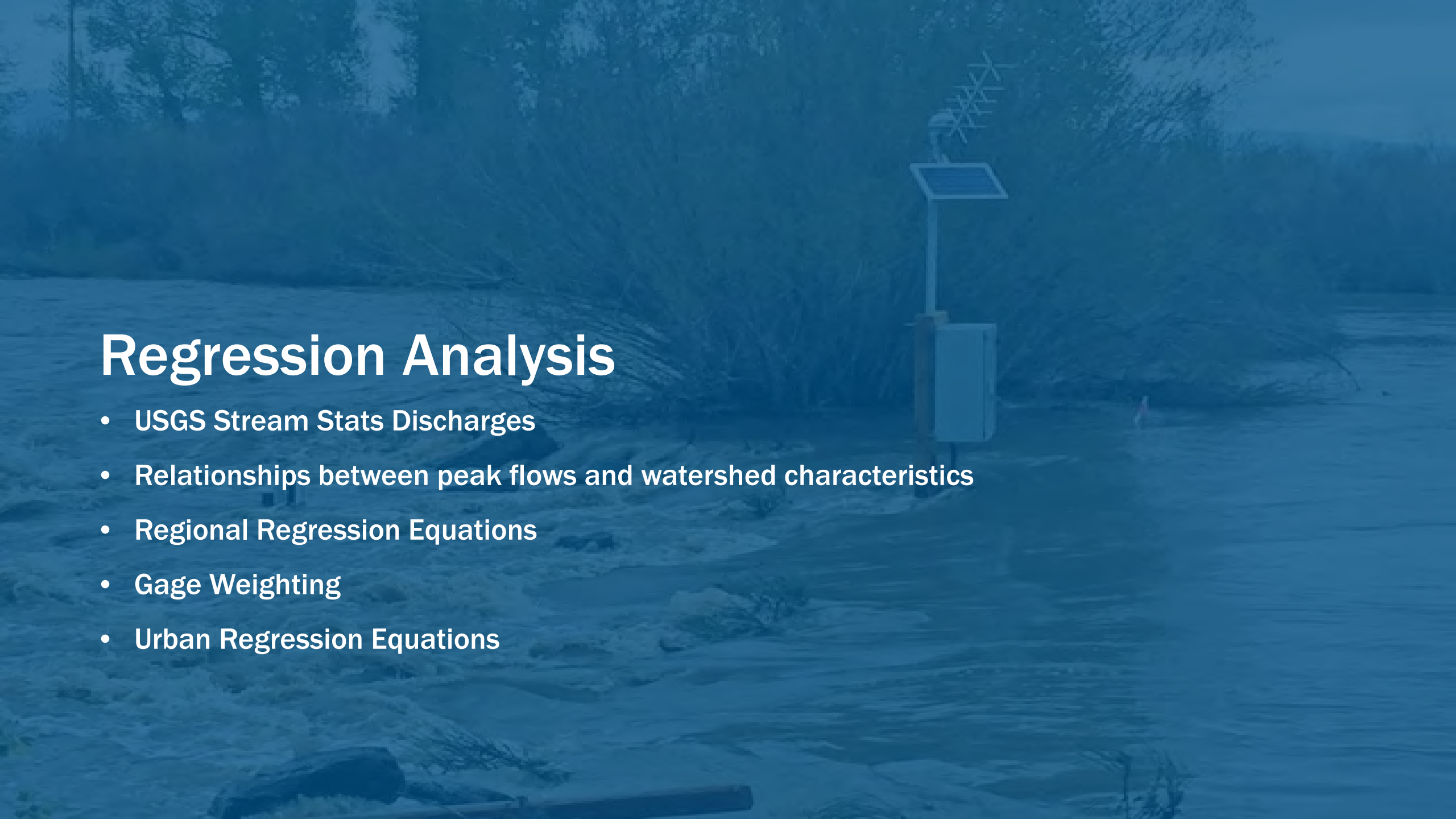
| Gage Type | USGS Gage No. | Description | Drainage Area (sq. mi) | Period of Record | Number of Records |
|---|---|---|---|---|---|
| Discharge | 04260500 | Black River At Watertown NY | 1864 | 1869-2020 | 121 |
| | 04250750 | Sandy Creek Near Adams NY | 137 | 1958-2020 | 62 |

- Flow gage analysis performed in support of regression analysis
- Viable gage = minimum 10 years current record
- Bulletin 17C methodology

# Hydrology – Gage Analysis




FEMA

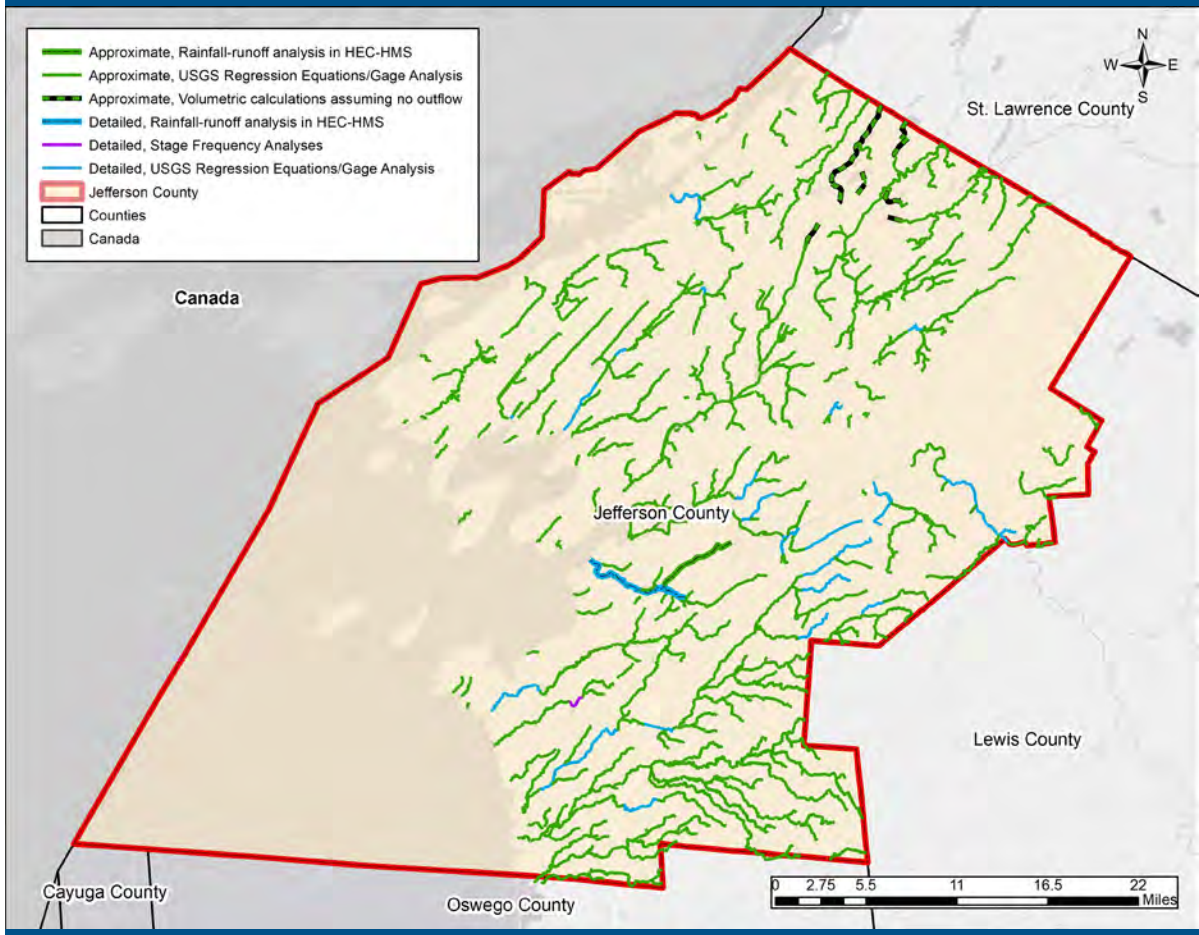


# Regression Analysis

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

# Hydrology – Regression Analysis

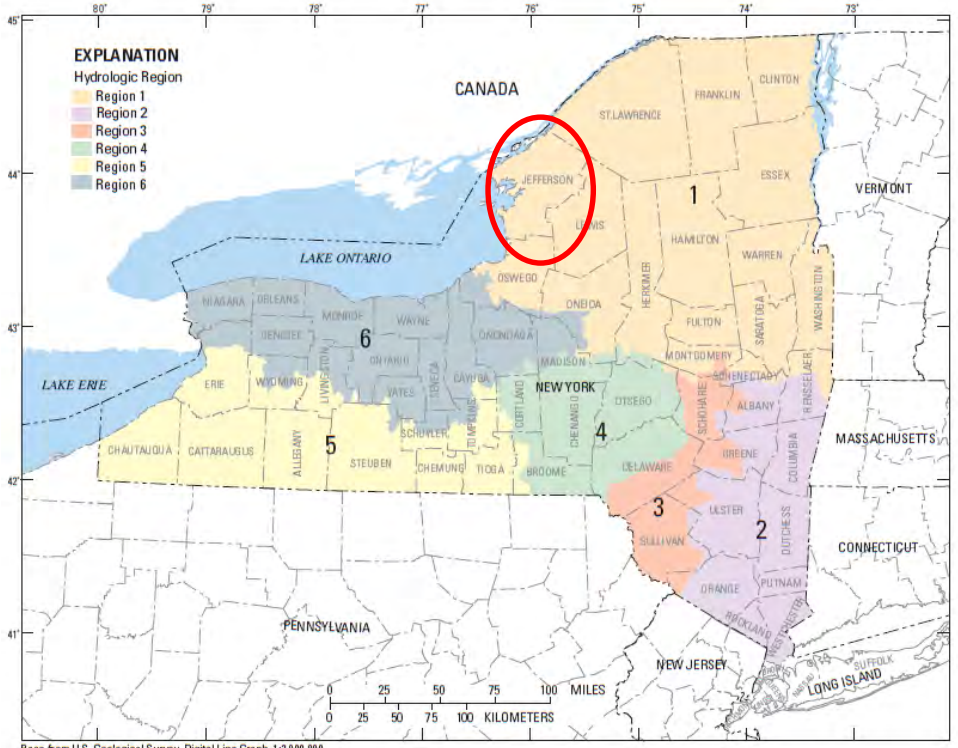
- Regression Analysis = Jefferson (923.1 miles)
  - 67.5 miles of Detailed streams (AE Zone)
  - 855.6 miles of Approximate streams (A Zone)




FEMA

# Hydrology – Regression Analysis

- USGS New York regression equations
  - SIR 2006-5112
- Study area falls within USGS NY regression Region 1
- USGS StreamStats v5.02 p7
- Primary method for Zone A streams and for some Zone AE streams



Base from U.S. Geological Survey, Digital Line Graph, 1:2,000,000
Universal Transverse Mercator projections, zone 18, NAD83

**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

- Drainage area (square miles)
- Basin storage (percentage of total drainage area)
- Mean annual precipitation (inches per year)
- Lag factor (Main-channel stream length, in miles)
  - Slope of lower half of main channel (feet/mile)
  - Slope of upper half of main channel (feet/mile)
- Basin forested area (% total area)

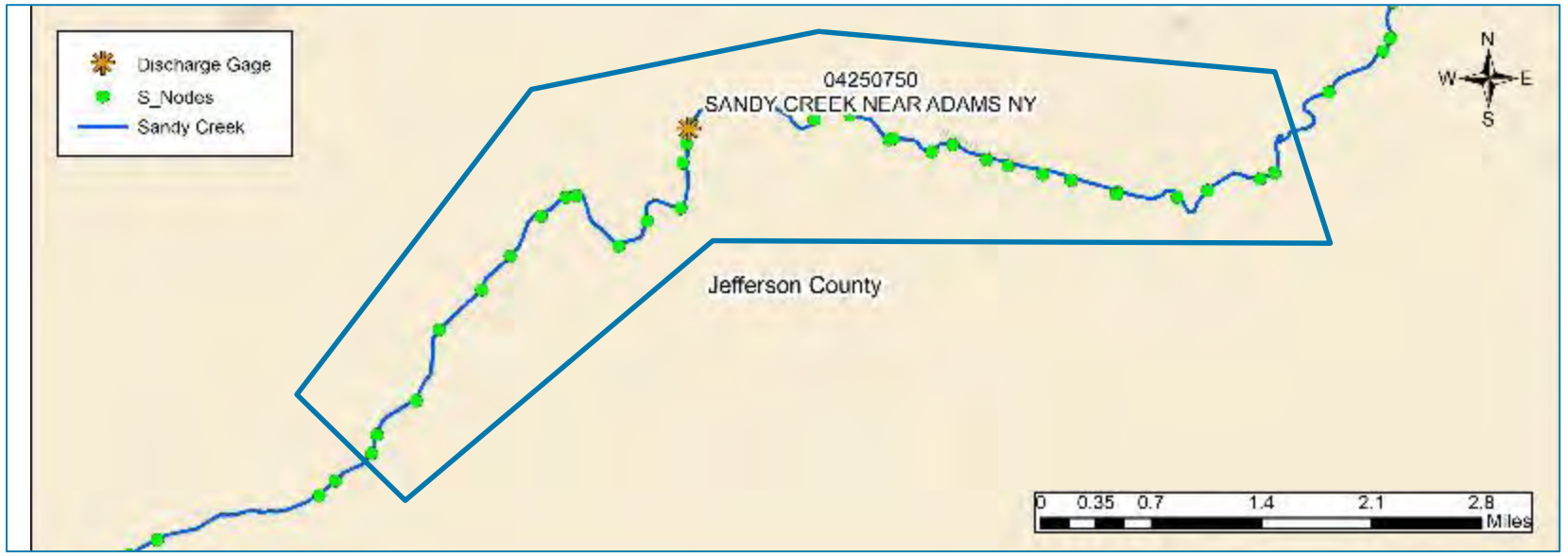
# Summary of Gage Weighting Streams with Regression Discharges

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

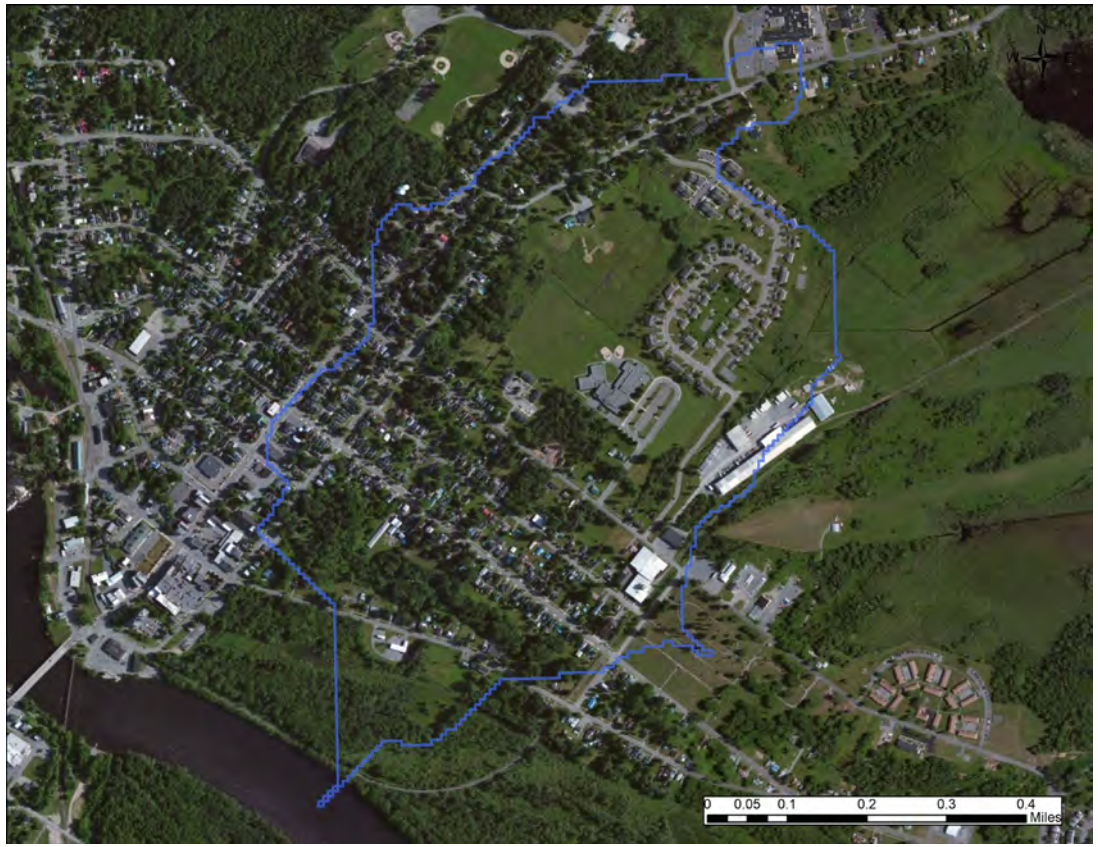
Example stream gage. Source: USGS/ Robert Swanson

# 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
  - For regulated streams, the gage discharge is transferred to other flow change locations using the drainage area ratio of the gage and the ungaged site.

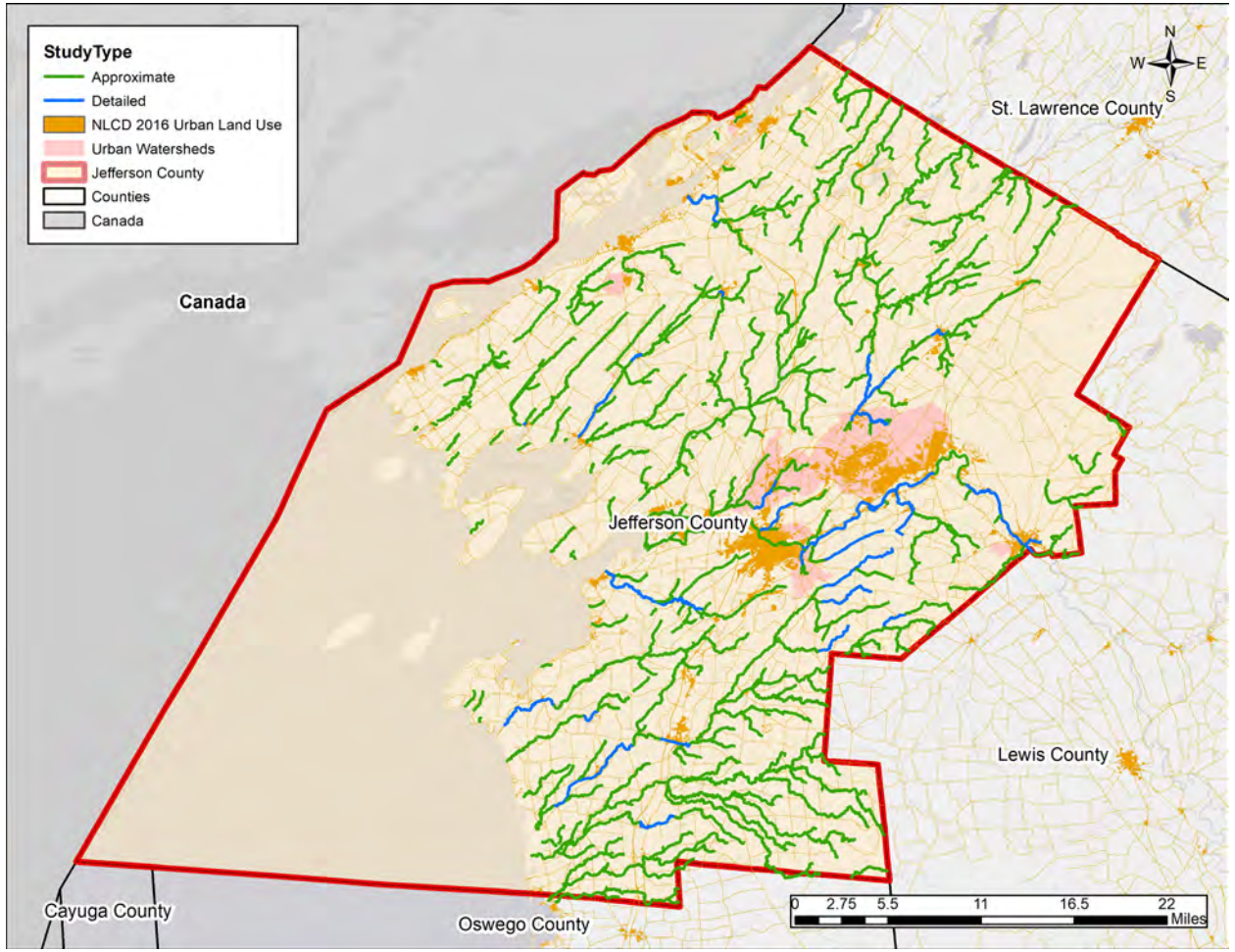


# Urban Adjustment




- Base regression equations not applicable to urban areas
- Peak flows adjusted for basins with >15% urban land use (from NLCD layer) based on USGS WSP 2207 (1983)
- Affected Detailed Reaches:
  - Black River, Black River Main Tributary, Chaumont River, Cold Creek, Philomel Creek, Pleasant Creek, West Creek
- Affected Approximate Reaches:
  - Twelve unnamed streams

# Urban Adjustment Factor – Basin Level View



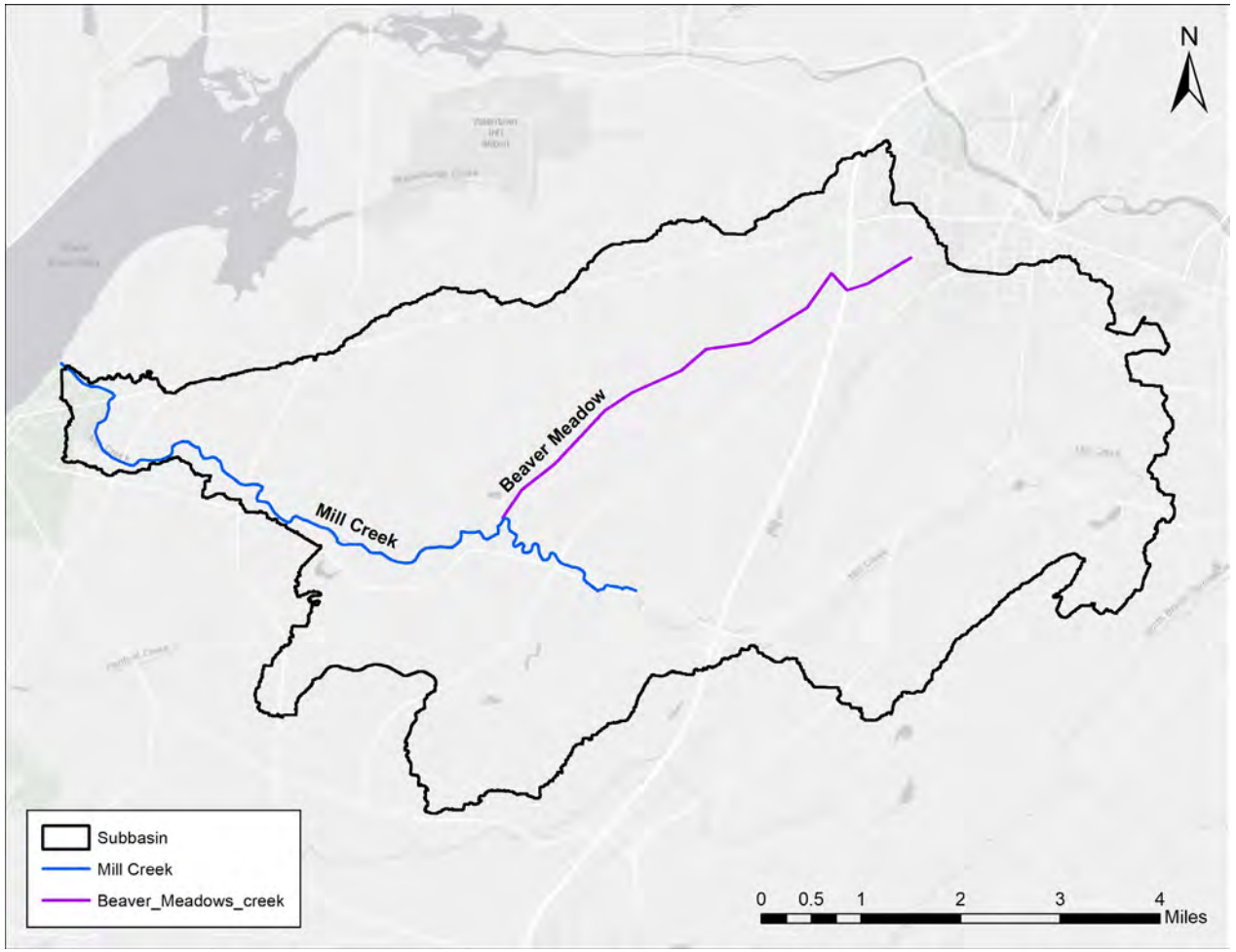

FEMA

# 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

- Total 2 streams (39.6 sq. mi)
  - Mill Creek - 8.7 miles
  - Beaver Meadow – 5.2 miles
- Crystal Lake
  - Scoped to be studied using stage frequency analysis.
  - No gage data – HECHMS rainfall runoff model used to estimate frequency stages.



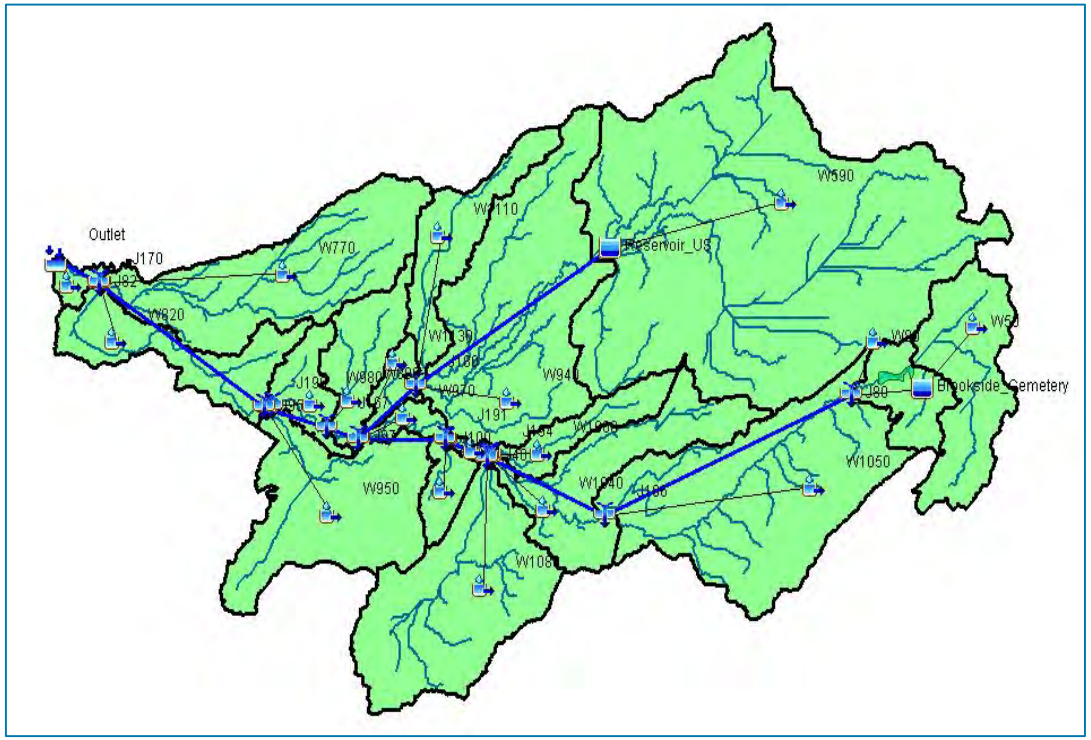
# Rainfall-Runoff Methodology

- 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

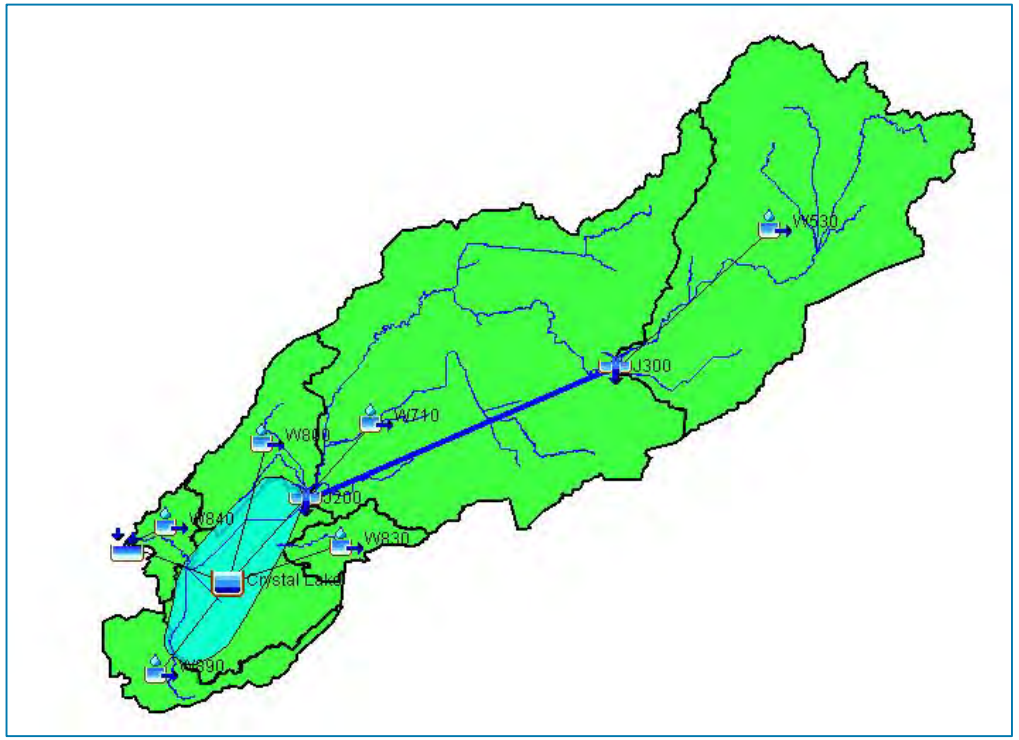
## Mill Creek HEC-HMS Model

- 19 Subbasins studied




## Crystal Lake HEC-HMS Model

- 7 Subbasins studied




FEMA

# NOAA Atlas 14 Rainfall Data

- Area Reduction Factors were applied as appropriate for watersheds greater than 10 sq. mi

NOAA Atlas 14, Volume 10, Version 3
Location name: Town of Hounsfield, New York, USA*
Latitude: 43.9394°, Longitude: -75.9838°
Elevation: 434.69 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 | 0.316 (0.260-0.385) | 0.376 (0.308-0.457) | 0.473 (0.387-0.577) | 0.553 (0.449-0.677) | 0.663 (0.519-0.835) | 0.746 (0.570-0.952) | 0.833 (0.615-1.09) | 0.930 (0.647-1.23) | 1.07 (0.711-1.44) | 1.18 (0.765-1.62) |
| 10-min | 0.448 (0.368-0.546) | 0.532 (0.437-0.648) | 0.669 (0.547-0.817) | 0.783 (0.636-0.958) | 0.939 (0.735-1.18) | 1.06 (0.807-1.35) | 1.18 (0.871-1.54) | 1.32 (0.917-1.74) | 1.52 (1.01-2.04) | 1.67 (1.08-2.29) |
| 15-min | 0.527 (0.433-0.642) | 0.626 (0.514-0.762) | 0.787 (0.644-0.961) | 0.921 (0.748-1.13) | 1.11 (0.864-1.39) | 1.24 (0.950-1.59) | 1.39 (1.02-1.82) | 1.55 (1.08-2.05) | 1.78 (1.19-2.40) | 1.97 (1.27-2.69) |
| 30-min | 0.692 (0.569-0.842) | 0.821 (0.674-1.00) | 1.03 (0.844-1.26) | 1.21 (0.981-1.48) | 1.45 (1.13-1.82) | 1.63 (1.24-2.08) | 1.82 (1.34-2.38) | 2.03 (1.41-2.68) | 2.34 (1.56-3.15) | 2.59 (1.67-3.53) |
| 60-min | 0.857 (0.704-1.04) | 1.02 (0.834-1.24) | 1.28 (1.04-1.56) | 1.49 (1.21-1.83) | 1.79 (1.40-2.26) | 2.02 (1.54-2.57) | 2.25 (1.66-2.94) | 2.52 (1.75-3.32) | 2.89 (1.92-3.90) | 3.20 (2.07-4.38) |
| 2-hr | 1.08 (0.889-1.30) | 1.29 (1.06-1.56) | 1.63 (1.34-1.97) | 1.91 (1.56-2.33) | 2.31 (1.82-2.89) | 2.60 (2.01-3.30) | 2.91 (2.17-3.79) | 3.27 (2.29-4.29) | 3.79 (2.55-5.08) | 4.23 (2.77-5.74) |
| 3-hr | 1.22 (1.01-1.47) | 1.46 (1.21-1.76) | 1.85 (1.53-2.24) | 2.18 (1.79-2.64) | 2.63 (2.08-3.28) | 2.96 (2.30-3.75) | 3.32 (2.50-4.32) | 3.74 (2.64-4.88) | 4.35 (2.94-5.80) | 4.85 (3.20-6.56) |
| 6-hr | 1.49 (1.24-1.78) | 1.78 (1.48-2.13) | 2.25 (1.87-2.70) | 2.64 (2.18-3.18) | 3.18 (2.54-3.94) | 3.58 (2.80-4.50) | 4.01 (3.04-5.17) | 4.50 (3.22-5.84) | 5.22 (3.58-6.91) | 5.82 (3.89-7.80) |
| 12-hr | 1.78 (1.50-2.12) | 2.11 (1.77-2.51) | 2.64 (2.21-3.15) | 3.08 (2.57-3.69) | 3.69 (2.97-4.53) | 4.15 (3.27-5.16) | 4.63 (3.53-5.90) | 5.16 (3.73-6.64) | 5.92 (4.11-7.78) | 6.54 (4.42-8.70) |
| 24-hr | 2.09 (1.77-2.47) | 2.44 (2.06-2.88) | 3.01 (2.53-3.56) | 3.48 (2.92-4.13) | 4.13 (3.35-5.03) | 4.63 (3.67-5.70) | 5.14 (3.94-6.46) | 5.68 (4.15-7.25) | 6.44 (4.52-8.40) | 7.05 (4.83-9.30) |

FEMA

# 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

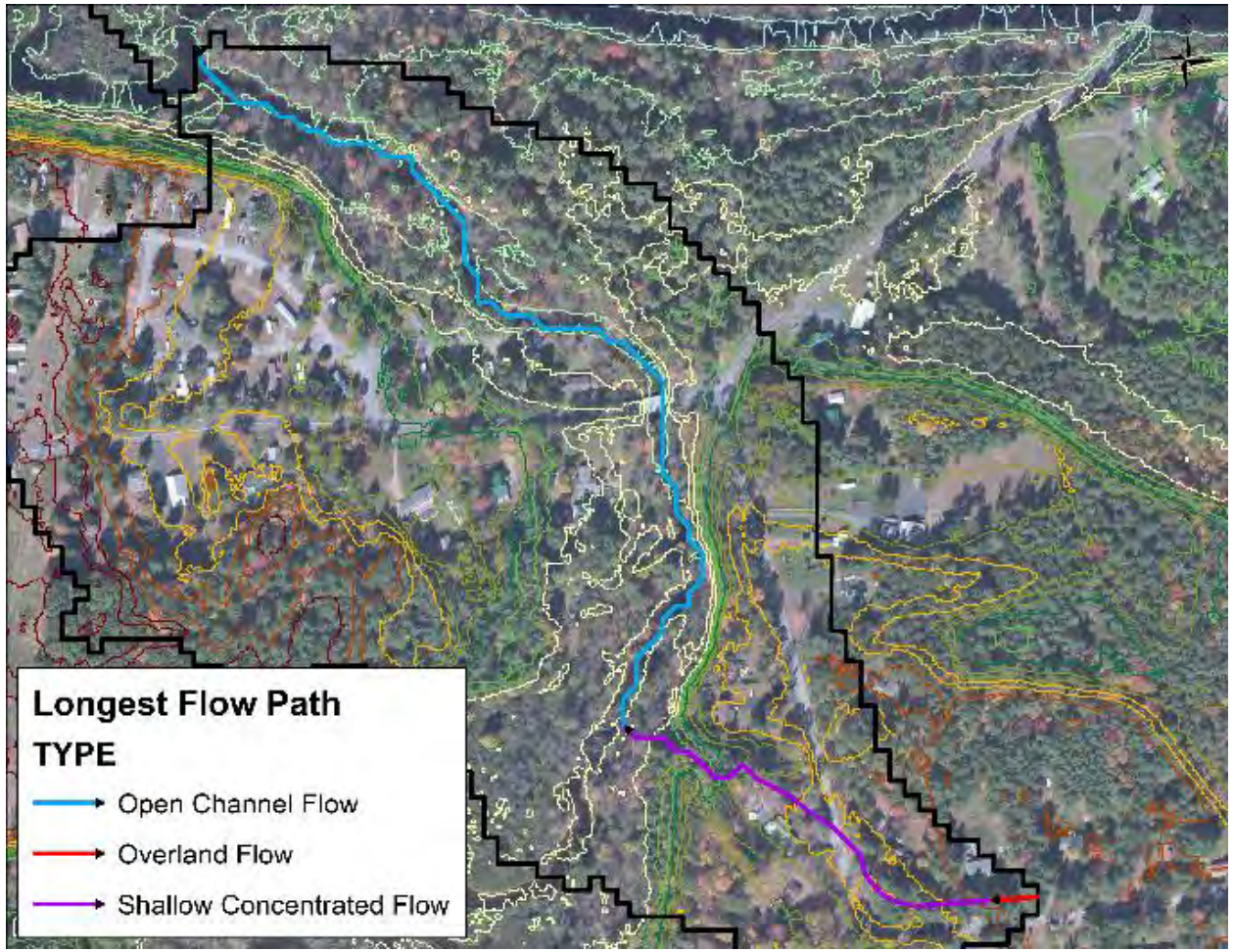
**Table 2-2a** Runoff curve numbers for urban areas [1/]

| 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 & LPIII values

# Gage Analysis

## Gage Analysis results – Comparison with FIS values

| Gage Type | USGS Gage No. | Description | Drainage Area (sq. mi) | 1-pct Discharge (cfs) | |
|---|---|---|---|---|---|
| | | | | LPIII | FIS |
| Discharge | 04260500 | Black River At Watertown NY | 1,864 | 44,930 | 41,300 |
| | 04250750 | Sandy Creek Near Adams NY | 137 | 9,299 | N/A |

- No discharge was published in effective FIS for the gage on Sandy Creek.

# Rainfall-Runoff Modeling – Model Validation

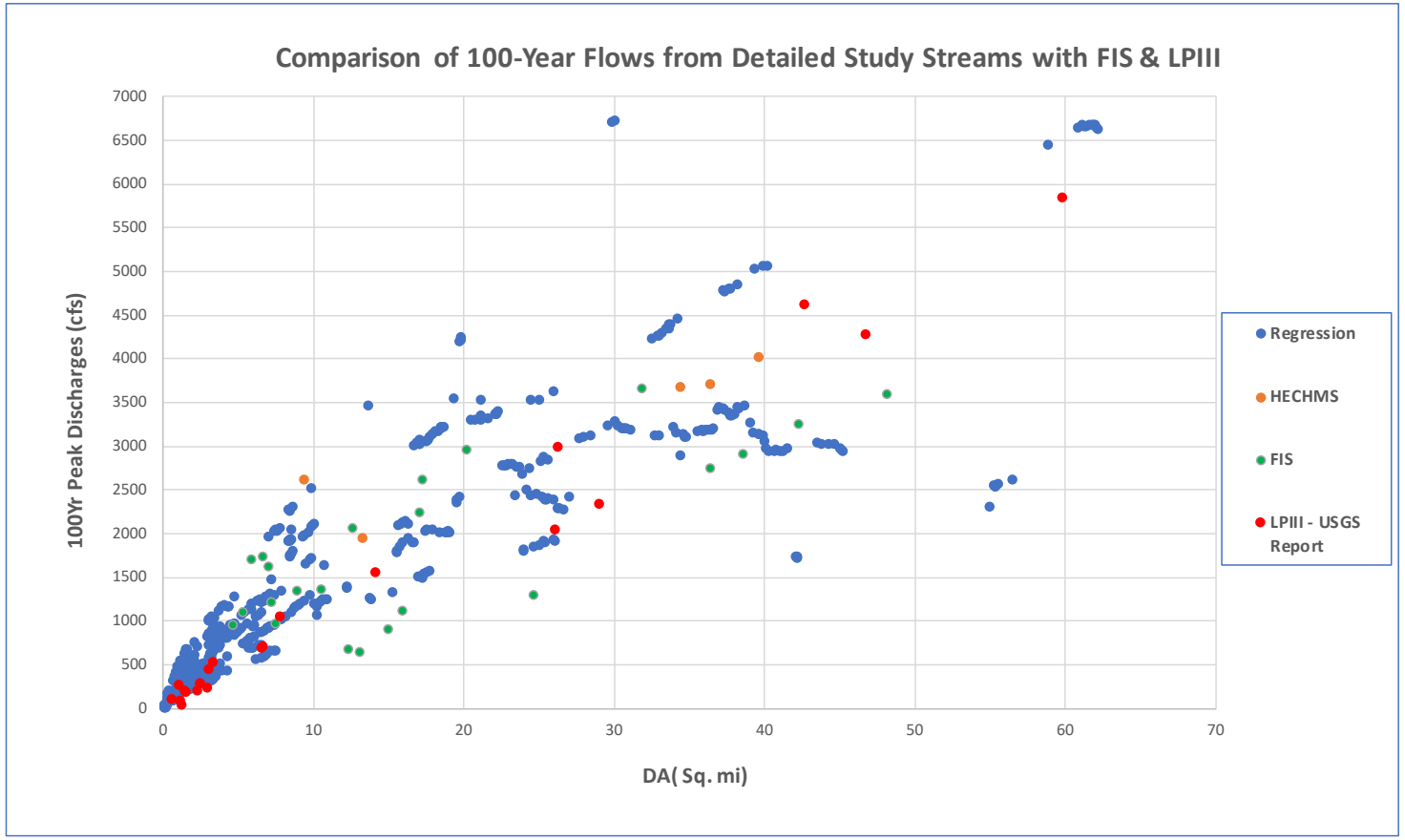
HEC-HMS results – Comparison with Regression & FIS values

| Flooding Source | Location | HEC-HMS | | Regression Equation | | Effective FIS | |
|---|---|---|---|---|---|---|---|
| | | DA(Sq.mi) | Q(cfs) | DA(Sq.mi) | Q(cfs) | DA(Sq.mi) | Q(cfs) |
| Mill Creek | 324 ft US of Massey St(J40) | 9.4 | 2,616 | 10.5 | 1,510 | 10.5 | 1,355 |
| | 2400 ft DS of Massey St(J100) | 13.3 | 1,958 | 13.6 | 2,180 | N/A | N/A |
| | 3500 ft US of Salt Point Rd(J95) | 34.4 | 3,678 | 35.6 | 4,120 | N/A | N/A |
| | 260 ft DS of Dogde Ave (J82) | 36.4 | 3,712 | 37.7 | 4,700 | 38.6 | 2,915 |
| | At Mouth | 39.6 | 4,027 | 40.7 | 5,220 | 42.3 | 3,255 |

- Mill Creek field inspection data - Dam failed and was never rebuilt/fixed
- No impoundment of water – causes higher discharges at mouth

# Rainfall-Runoff Modeling – Model Validation

Comparison of Q100 vs DA for Detailed reaches with Effective FIS & LP-III




FEMA

# Rainfall-Runoff Modeling – Model Validation

Stage Frequency Analysis Results – Crystal Lake

| Flooding Source | Percent Chance Exceedance | Elevation (ft) | |
|---|---|---|---|
| | | HEC HMS (NAVD88) | FIS (NAVD88) |
| Crystal Lake | 10 | 425.7 | 425.9 |
| | 4 | 426.2 | N/A |
| | 2 | 426.5 | 426.4 |
| | 1 | 426.9 | 426.7 |
| | 0.2 | 427.7 | 428.1 |

# Rainfall-Runoff Modeling - Comparison to Effective Flows

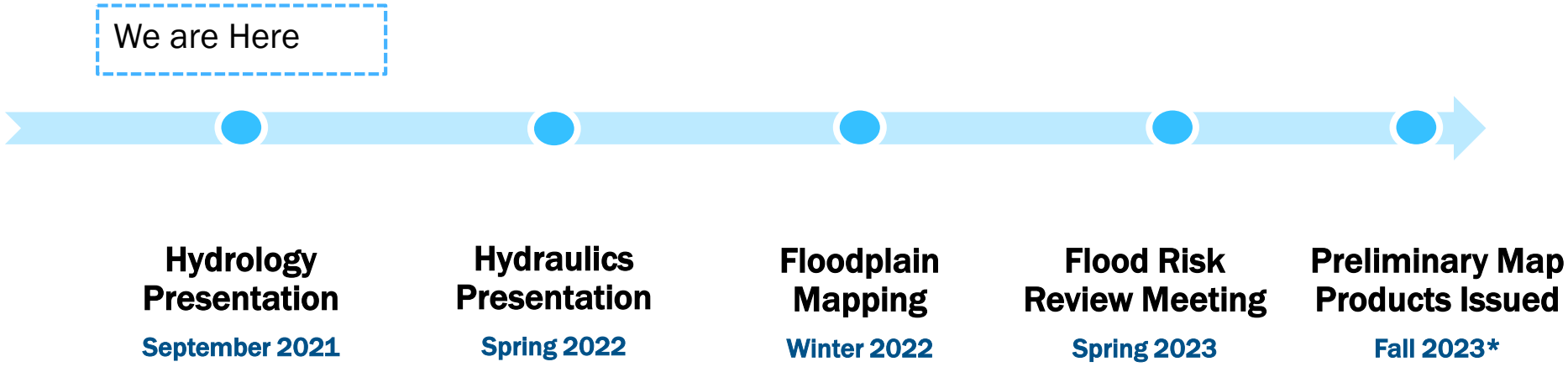
- Study results found to be:
  - Consistent with Flood Insurance Study (FIS) flows
  - Consistent with gage analysis flows
  - Compare well with regression analysis

# Jefferson County Next Steps

# Jefferson 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

# Contacts

Shudipto Rahman
Project Monitor
Risk Analysis Branch, FEMA Region II
shudipto.rahman@fema.dhs.gov

Thomas Song
Resiliency Specialist
Risk Analysis Branch, FEMA Region II
thomas.song@fema.dhs.gov

David Sutley, PE
STARR II Project Manager/
Task Order Manager
dsutley@dewberry.com

Rosemary Bolich
STARR II Regional Support Center/
Deputy Task Order Manager
rosemary.bolich@stantec.com

Mary Binder, CFM
NY State Department of Environmental Conservation
Region 6 Contact
Mary.Binder@dec.ny.gov

FEMA

# Thank you!

FEMA