Case Studies in Hazard Class Reductions

Implementation of NY's Guidance for Dam Hazard Classification

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Presentation Agenda

- Definitions of Hazard Classification
- Overview of NYS Guidance Document
- Technical Nuances
- Case Studies
  - Kingston's Reservoir No. 2
  - Cooperstown's Otsego Lake Dam
- Hazard Class Can Change
  - Magnolia Place Dam (State of Georgia)
- Q & A

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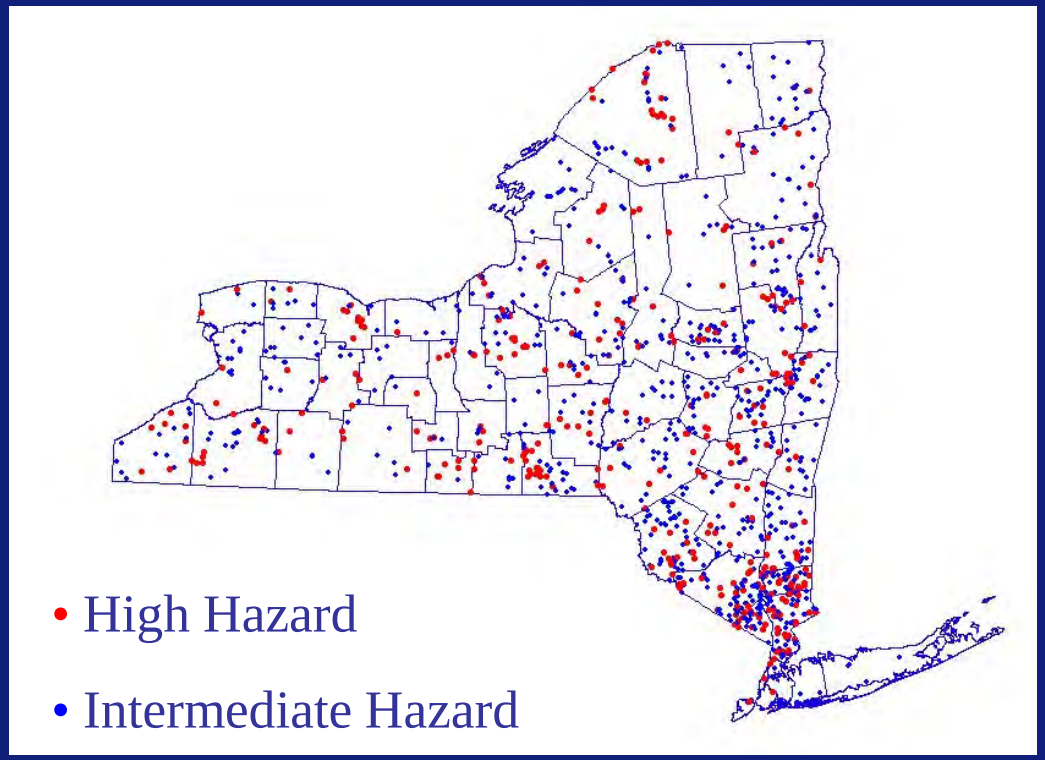
NYS Regulation Revisions – Part 673

- Regulations require dam safety program activities by owners
- Owner responsibilities increase with hazard classification
  - Design standards increase
  - Time, money and effort increase



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NYS Hazard Classifications

Hazard Classification	Definition	No. of Dams
High Hazard “C”	Failure may cause loss of human life substantial damage to homes, industrial or commercial buildings, main highways or railroads, important public utilities and/or cause extensive economic loss.	390
Intermediate Hazard “B”	Failure may damage isolated homes, main highways, minor railroads, interrupt use of public utilities and/or cause substantial economic loss or environmental damage.	760
Low Hazard “A”	Failure may damage nothing more than isolated buildings, undeveloped lands, or town or county roads and/or will cause no substantial economic loss or substantial environmental damage.	4,440

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Guidance for Dam Hazard Classification

- The goal is to assign the PROPER hazard classification
  - Regulator can better understand the potential impacts of dam failure
  - Owner can maintain dam appropriately
  - Introduces specific requirements to minimize subjectivity

http://www.dec.ny.gov/lands/4991.html

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Factors Influencing Hazard Class

- Potential for loss of human life
  - Flooding of structure
  - Damage to homes
- Impairment to Emergency Services
  - Impact on roads and highways
- Impact on railroads
- Interruption of utilities
- Environmental damage
- Downstream dams

Dam break assessment conducted by a NYS PE is required to characterize impacts

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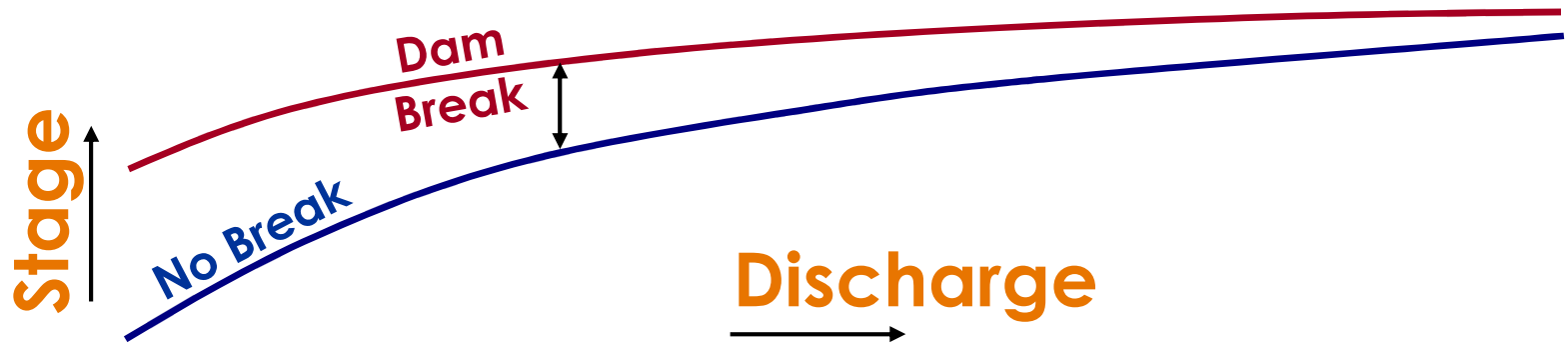
The incremental concept

Hazard class reduces as incremental difference diminishes



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Dam Break Assessment – The Basics

- Dam Breach Modeling / Inundation Mapping
  - Sunny day “piping” failure
  - Rainy day overtopping failure
  - Steady/Unsteady computer model
- Comparison of Breach and Non-Breach Scenarios
  - Incremental depth defines limits and impact (< 2 feet)
  - Impacted roadways
  - Impacted structures

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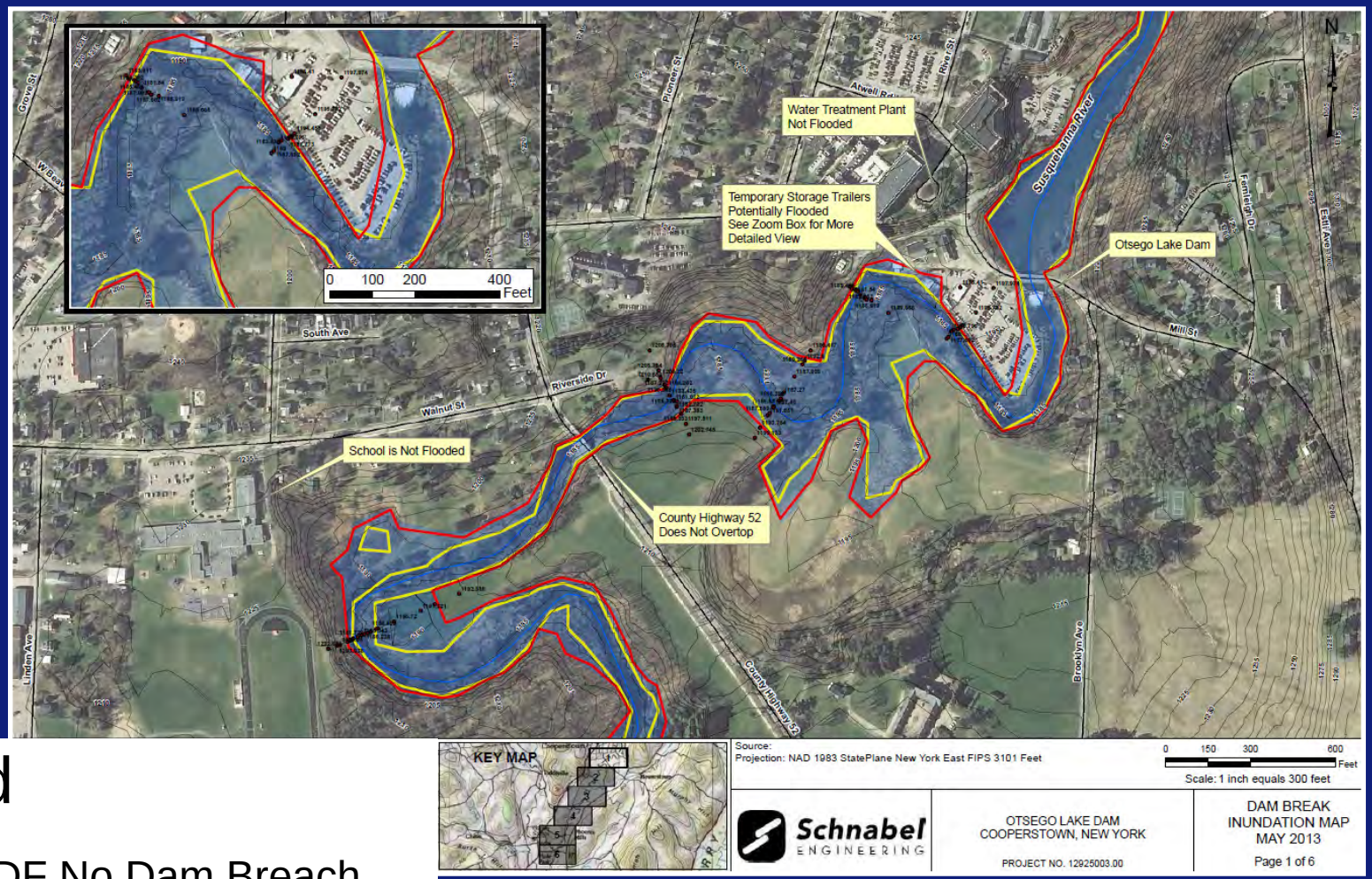
Typical Inundation Map



Source:
Projection: NAD 1983 StatePlane New York East FIPS 3101 Feet

0 150 300 600 Feet

Scale: 1 inch equals 300 feet

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OTSEGO LAKE DAM
COOPERSTOWN, NEW YORK

PROJECT NO. 12925003.00

DAM BREAK
INUNDATION MAP
MAY 2013

Page 1 of 6

Legend

- SDF No Dam Breach
- Sunny Day Dam Breach
- SDF Dam Breach

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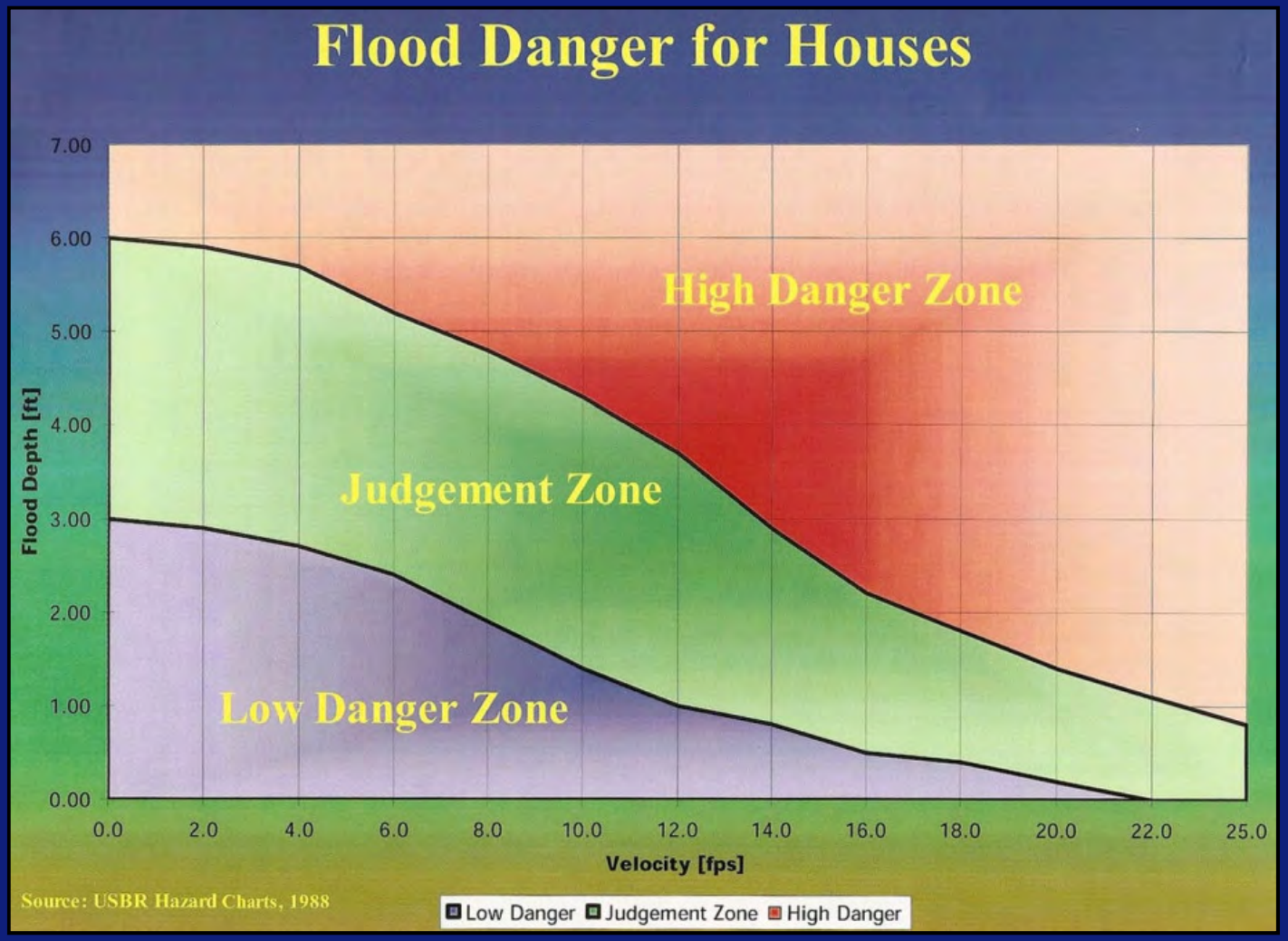
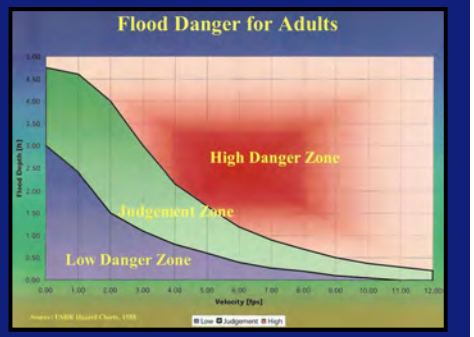
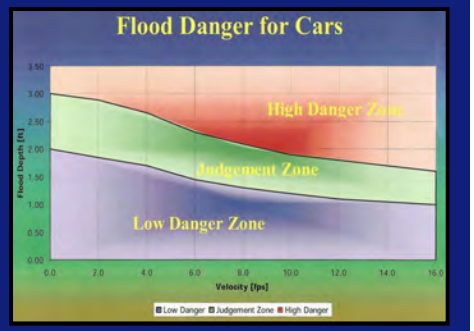
The Power of Water (ACER 11)







Source: USBR Hazard Charts - 1988

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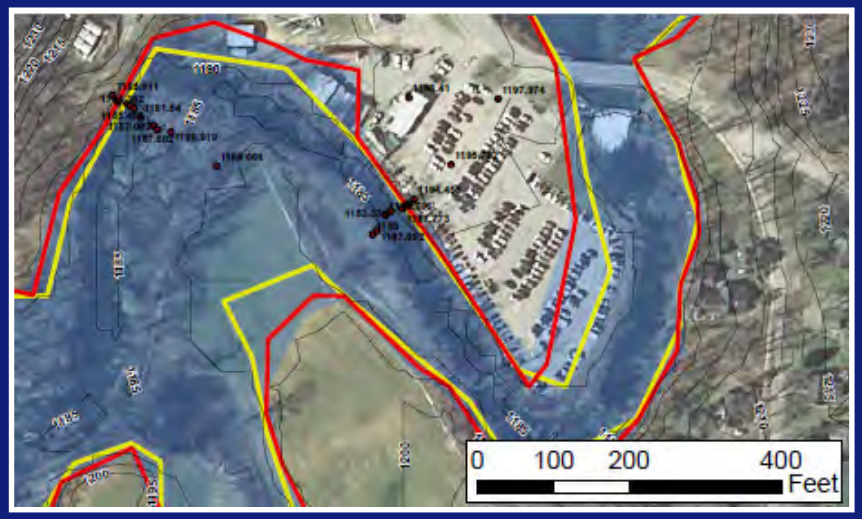
Eliminating the Subjectivity



Highways

NYSDOT Functional Class	DSS Road Type	Hazard Class
Urban – Principal Arterial Interstate	Main Highway	C
Rural – Principal Arterial Interstate	Main Highway	C
Urban – Principal Arterial Expressway	Main Highway	C
Urban – Principal Arterial Other	Main Highway	C
Urban –Minor Arterial	Main Highway	B
Rural – Principal Arterial – Other	Main Highway	B
Rural – Minor Arterial	Main Highway	B
Urban – Collector	Main Highway	B
Rural Major Collector	Main Highway	B
Rural Minor Collector	Minor Road	A
Rural Local	Minor Road	A
Urban Local	Minor Road	A

Homes

Flood Depth Category	1 – 10 Homes	11 – 99 Homes	100 or More Homes
Up to 1 ft above lowest occupied floor	A	B	C
Greater than 1 ft above lowest occupied floor	B	B	C
Above the Low Danger Zone	C	C	C

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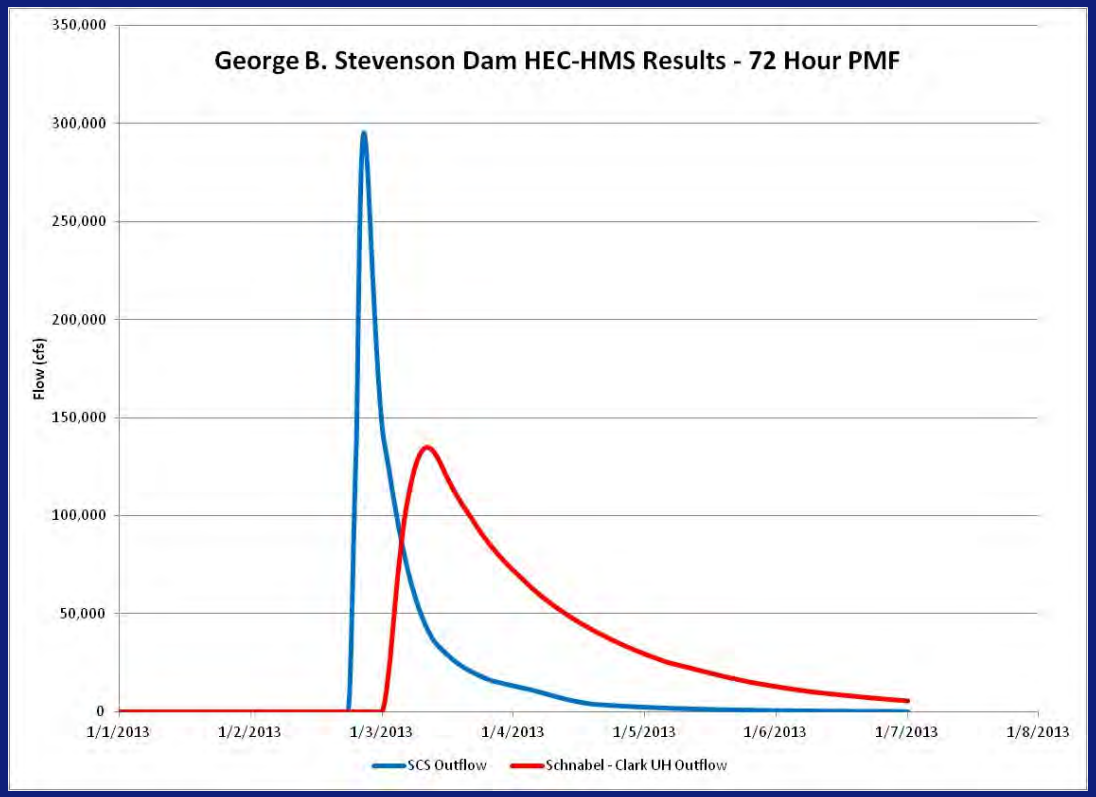
Dam Break Assessment – The Nuances

Technical decisions can influence the apparent hazard classification



- Spillway Design Flood
  - Volume of Storm vs Reservoir
  - What is “conservative”
  - Calibrated hydrologic model
- Downstream Tributaries
  - Inflow may be more influential than reservoir volume
  - Timing

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Case Study – City of Kinston Reservoir #2

New York State Inventory of Dams

Name of Dam: Kingston Reservoir #2 Dam
State ID: 192-0908

Hazard Code: B
See below for hazard code definition

Year Completed: 1910
Most Recent Inspection: 2/7/2012

Location Information:				
County	Municipality	River or Stream	Latitude	Longitude
Ulster	Town of Woodstock	SAW KILL	42° 2' 18.0" N	74° 5' 31.0" W

Type:	
Type of Construction	Purpose
CN - Concrete Gravity, RE - Earth	Recreation

Technical Information:	
Federal ID Number	NY00080
Dam Length (feet)	750
Dam Height (feet)	40
Spillway Width (feet)	130
Maximum Discharge (cubic feet per second)	14200
Maximum Storage (acre-feet)	125
Normal Storage (acre-feet)	95
Reservoir Surface Area (acres)	6
Drainage Area (square miles)	0
Basin	LOWER HUDSON
Date of Data Update	8/2/2012

- ***Former*** Class C Dam

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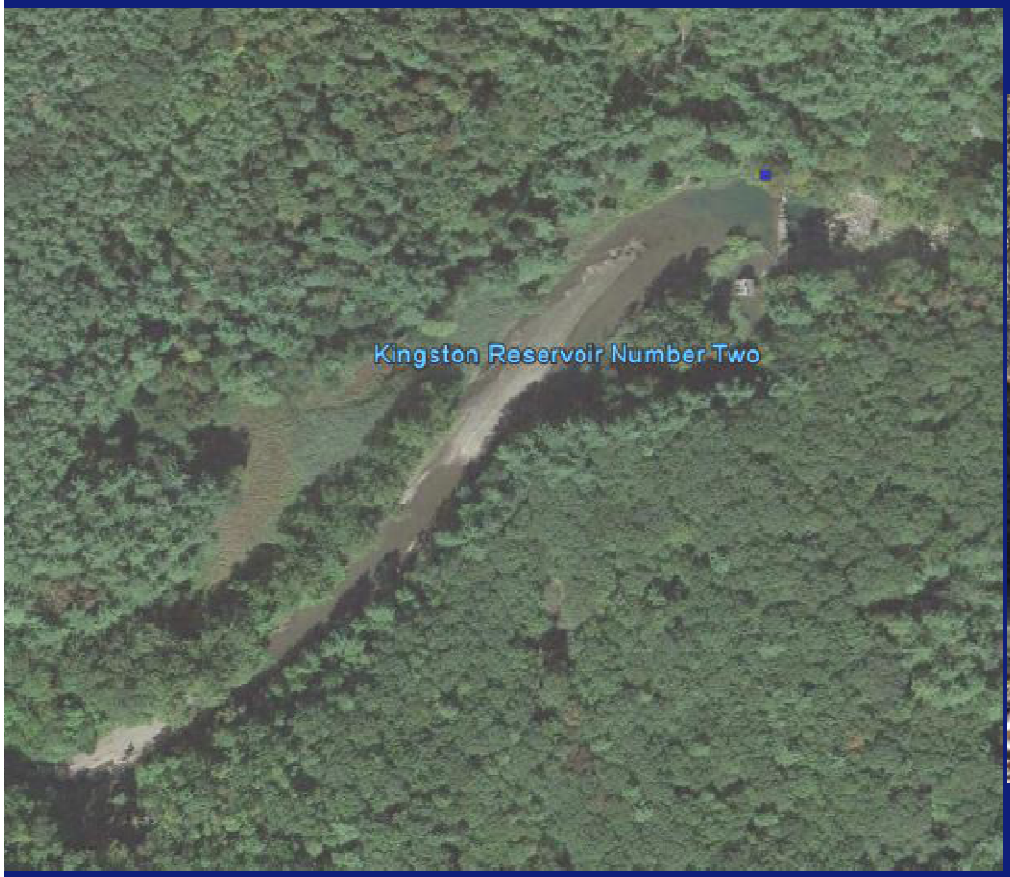
Case Study – City of Kinston Reservoir #2



- Small Pool – Significant Sedimentation
- Damage From Hurricane Irene

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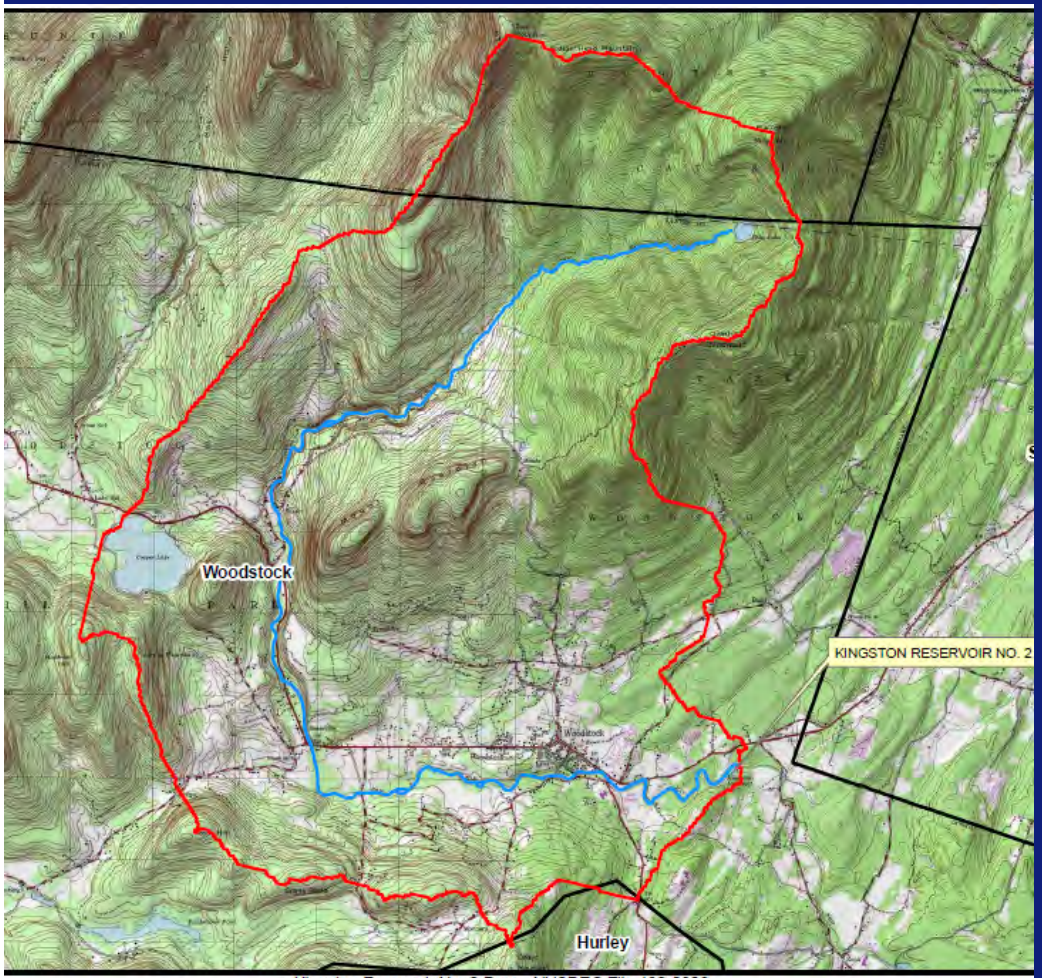
Hydrologic Modeling



Kingston Reservoir No. 2 Dam - NYSDEC File 192-0908
HYDROLOGIC AND HYDRAULIC ANALYSIS
WATERSHED MAP
Figure 3-1

- 23 sq. mi. watershed
- HEC-HMS
- 50% PMF – 20,400 cfs, EL 461.5
- Embankment Crest – EL 460.0
- 50% PMF overtops by 1.5 ft. for over 4 hours
- Spillway Out of Compliance (Class C)

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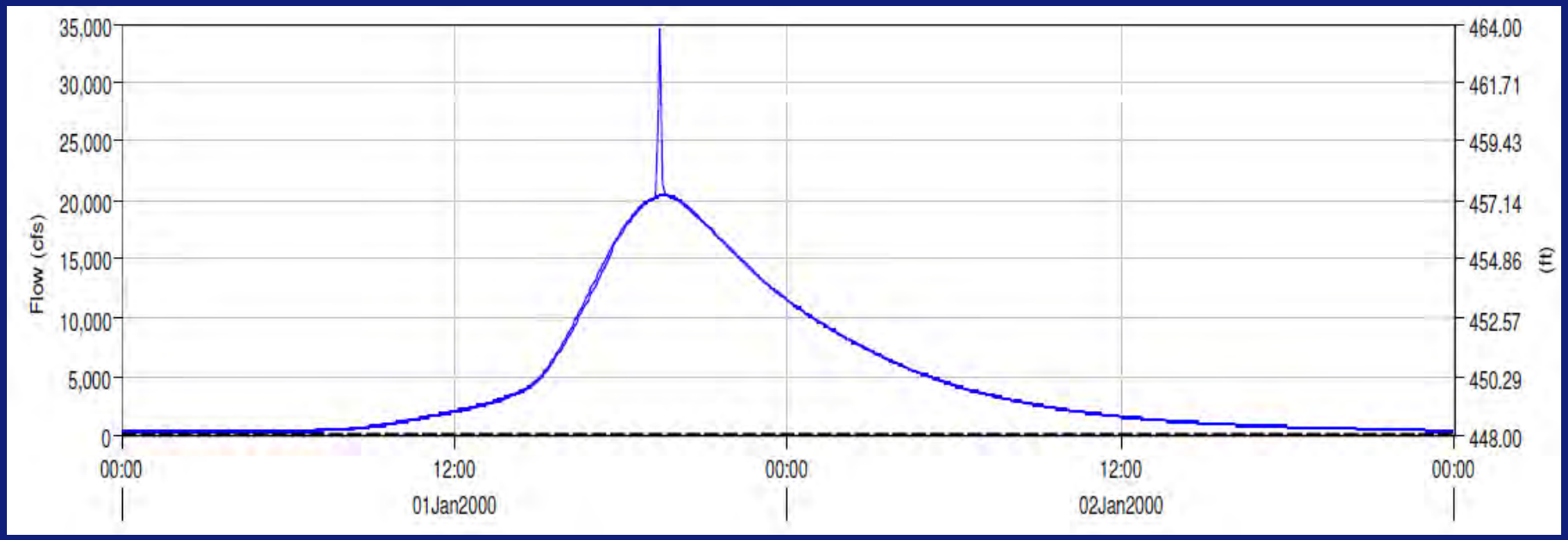
Breach Hydrograph Generation

- HEC-HMS
- Breach Entire Masonry Spillway Section (130 ft)
- Formation Time – 15 minutes



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Breach Hydrograph Routing

- FEMA FIS HEC-RAS Model
- Refined with LiDAR Based topographic mapping (NYCDEP 2009)
- ~ 8 miles in downstream reach to Esopus
- Sunny Day and Wet Weather dam breach
- FEMA 100-year inflows from D/S Tributaries
- Unsteady Flow Analysis

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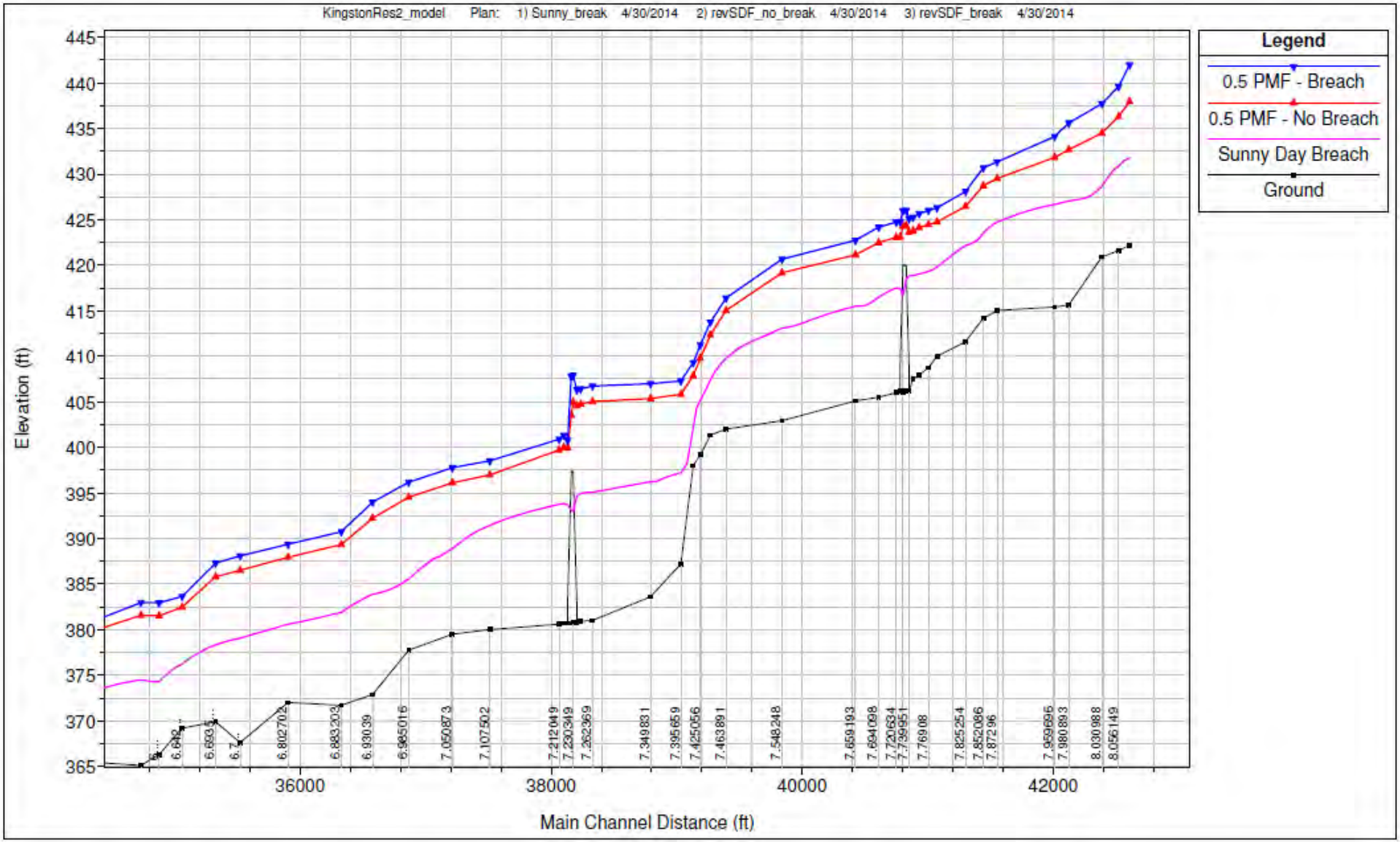
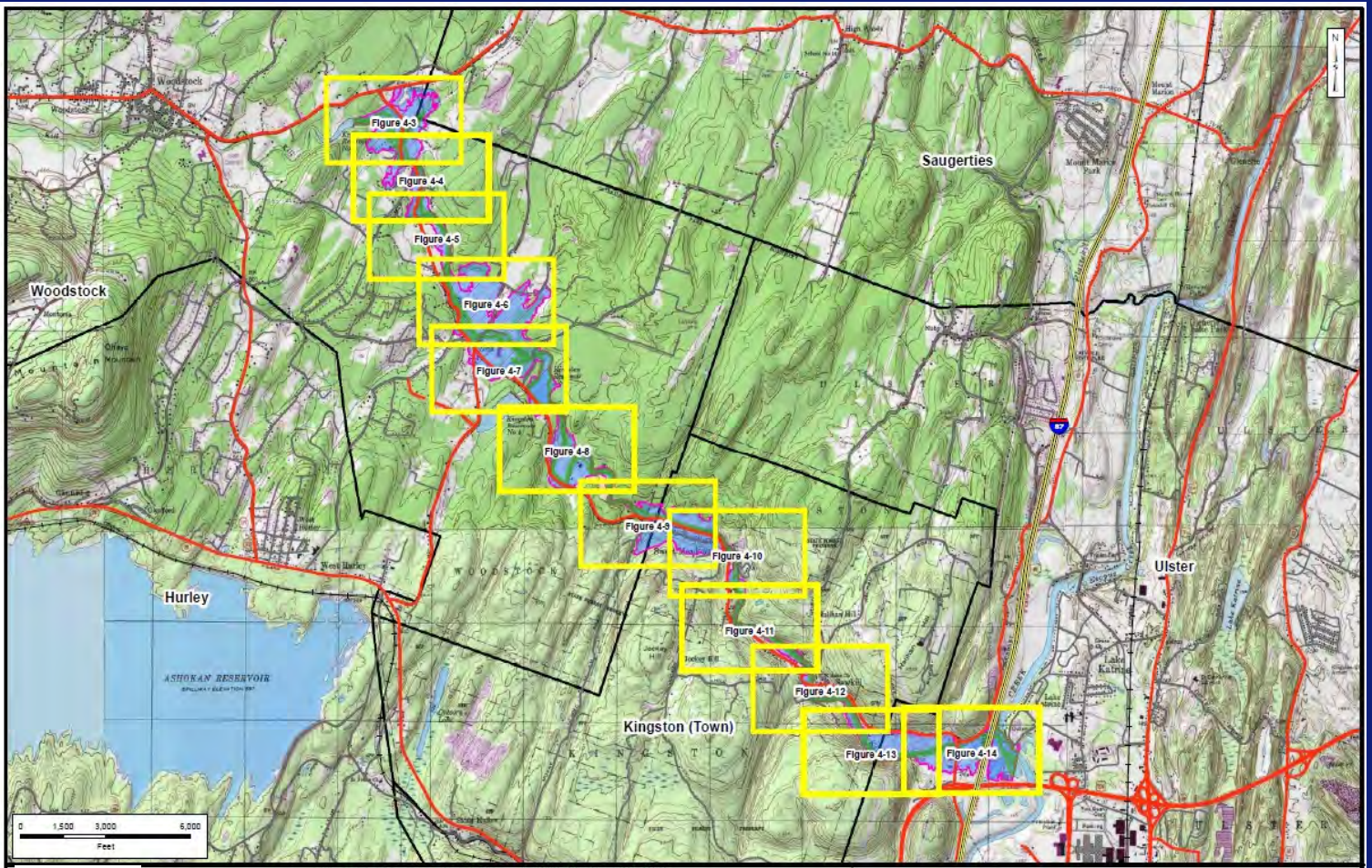
Peak Flood Profiles



Inundation Mapping Overview



Kingston Reservoir No. 2 Dam - NYSDEC File 192-0908
HYDROLOGIC AND HYDRAULIC ANALYSIS
DAM BREAK INUNDATION KEY MAP
Figure 4-2

Legend
- SDF No Breach Inundation Area
- SDF Breach Inundation Area
- Sunny Day Inundation Area
- Municipality
- Figure Extent

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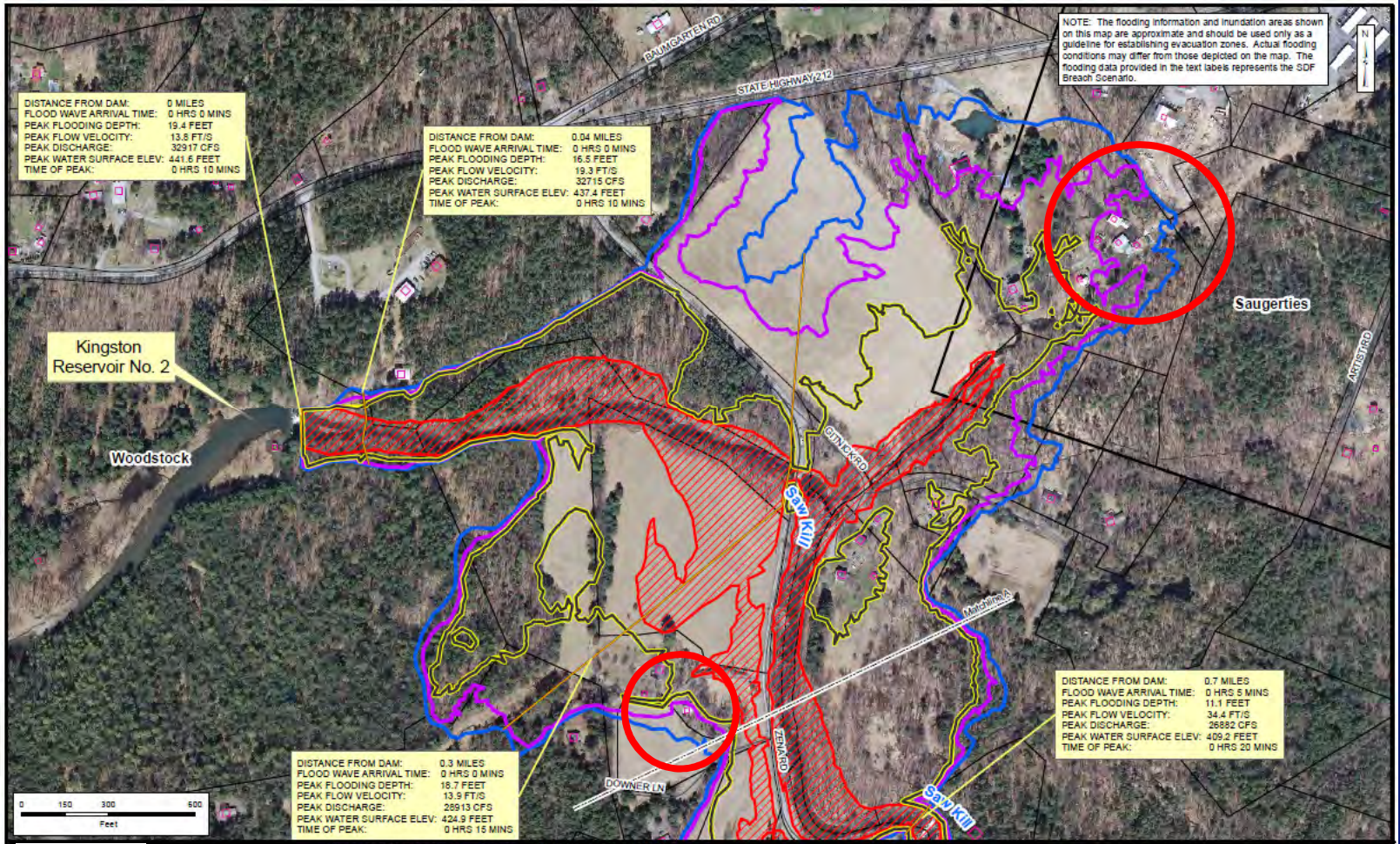
Inundation Map 1 of 12



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Incremental House Impacts

Buildings Affected By Kingston Reservoir No. 2 Dam Breach

Flood Scenario	Number of Buildings Affected		
	Breach	No Breach	Incremental Difference
50% PMF	269	264	5

Buildings Affected By 50% PMF Dam Breach Not Affected by 50% PMF With No Breach

Depth (ft)	Velocity (ft/s)	Property ID	Address Number	Street
0.5	< 0.5	27.4-5-16.1*	1835	RT 212
< 0.1	< 0.5	27.4-5-16.1*	1835	RT 212
< 0.1	< 0.5	27.4-2-29.2	127	JOHN JOY RD
< 0.1	< 0.5	27.4-2-26	119	JOHN JOY RD
< 0.1	< 0.5	38.2-1-61.1	837	ZENA RD

*Property is listed multiple times as several structures are located on the lot with the property ID 2734-5-16.1.

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NYSDEC & ACER 11 Guidance

Hazard Class Based On Flooding Depth and Number of Homes

Flood Depth	1 -10 Homes	11 – 99 Homes	100 or More Homes
Up to 1 foot above lowest occupied floor	A	B	C
Greater than 1 foot above lowest occupied floor	B	B	C
Above the Low Danger Zone	C	C	C

Based on NYSDEC DOW TOGS 3.1.5.

Building Affected By 150% of the 100-Year Dam Breach Not Affected by 150% of the 100-Year With No Breach

Property ID	27.19-1-3
Address Number	795
Street	ZENA RD
Owner Name	Berger, Craig L
Depth (ft), 150% 100-Year Breach	1.1
Velocity (ft/s), 150% 100-Year Breach	0.7

- Class B

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Road Impacts

Roadway Overtopping Information

Roadway Crossing	Model Station	Bridge Deck / Dam Crest Elevation (1)	Storm Event	Max Water Surface Elevation	Overtopping	Depth of Water
		ft		ft		ft
Zena Road	7.73087	422.3	SDF Breach	425.9	YES	3.6
			SDF No Breach	424.3	YES	2
			Sunny Day Breach	418.5	NO	NA
Mellert Road	7.23035	397.8	SDF Breach	407.6	YES	9.8
			SDF No Breach	405.0	YES	7.2
			Sunny Day Breach	392.8	NO	NA
John Joy Road	5.97054	368.6	SDF Breach	371.0	YES	2.4
			SDF No Breach	370.7	YES	2.1
			Sunny Day Breach	362.6	NO	NA
Zena Highwoods Road	5.540322	363.9	SDF Breach	366.25	YES	2.4
			SDF No Breach	365.0	YES	1.1
			Sunny Day Breach	355.4	NO	NA
Jockey Hill Road	2.806806	238.2	SDF Breach	238.3	YES	0.1
			SDF No Breach	238.2	NO	NA
			Sunny Day Breach	221.3	NO	NA
Sawkill Road	1.624243	184.3	SDF Breach	182.2	NO	NA
			SDF No Breach	182.2	NO	NA
			Sunny Day Breach	170.1	NO	NA
Sawkill Road (Route 30)	0.309203	146.1	SDF Breach	142.6	NO	NA
			SDF No Breach	142.3	NO	NA
			Sunny Day Breach	136.5	NO	NA
I – 87	0.065177	147.1	SDF Breach	138.8	NO	NA
			SDF No Breach	139.6	NO	NA
			Sunny Day Breach	133.8	NO	NA

(1) - Bridge Deck / Dam Crest elevations and widths estimated from FEMA hydraulic model, aerial photographs and topographical data.

- None of impacted roads are highlighted in NYSDOT Functional Class Viewer
- Traffic Count Less than 400 vehicles/day
- “Minor Road” Impacts

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NYSDEC Hazard Class Guidelines

NYSDOT Functional Class	DSS Road Type	Hazard Class
Urban – Principal Arterial Interstate	Main Highway	C
Rural – Principal Arterial Interstate	Main Highway	C
Urban – Principal Arterial Expressway	Main Highway	C
Urban – Principal Arterial Other	Main Highway	C
Urban –Minor Arterial	Main Highway	B
Rural – Principal Arterial – Other	Main Highway	B
Rural – Minor Arterial	Main Highway	B
Urban – Collector	Main Highway	B
Rural Major Collector	Main Highway	B
Rural Minor Collector	Minor Road	A
Rural Local	Minor Road	A
Urban Local	Minor Road	A

- Road Impacts – Class A
- House Impacts – **Class B**
- Spillway Capacity OK!

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Case Study – Otsego Lake Dam

Otsego Lake Dam NID Data

Attribute	Value
Hazard Classification	B - Intermediate
Latitude	42.6941° N
Longitude	74.9213° W
State ID	144-0918
NID ID	NY00361
Year Completed	1900
Approximate Length	70 feet
Structural Height	11 feet
Max Spillway Capacity	1,750 cfs
Max Storage	345,320 acre-feet
NWL Storage	341,094 acre-feet
NWL Surface Area	4,225 acres
Approximate Spillway Width	68 feet

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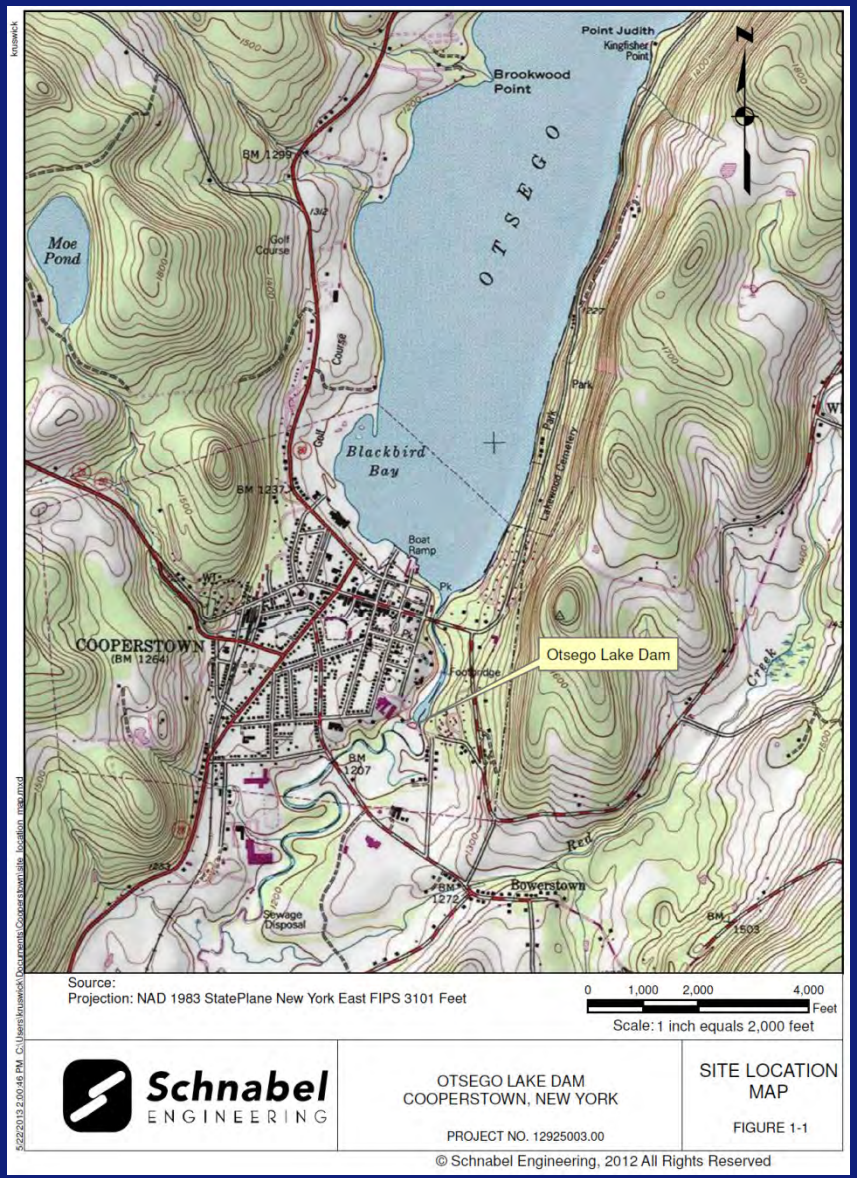
Otsego Lake



- Natural Lake
- Dam to better manage water levels
- Water Supply
- Headwaters of Susquehanna River

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Channel Between Lake and Dam

- 1/2 Mile Long Upstream Channel

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Constrictions in Upstream Channel

Stone Arch Bridge

Main St. Bridge

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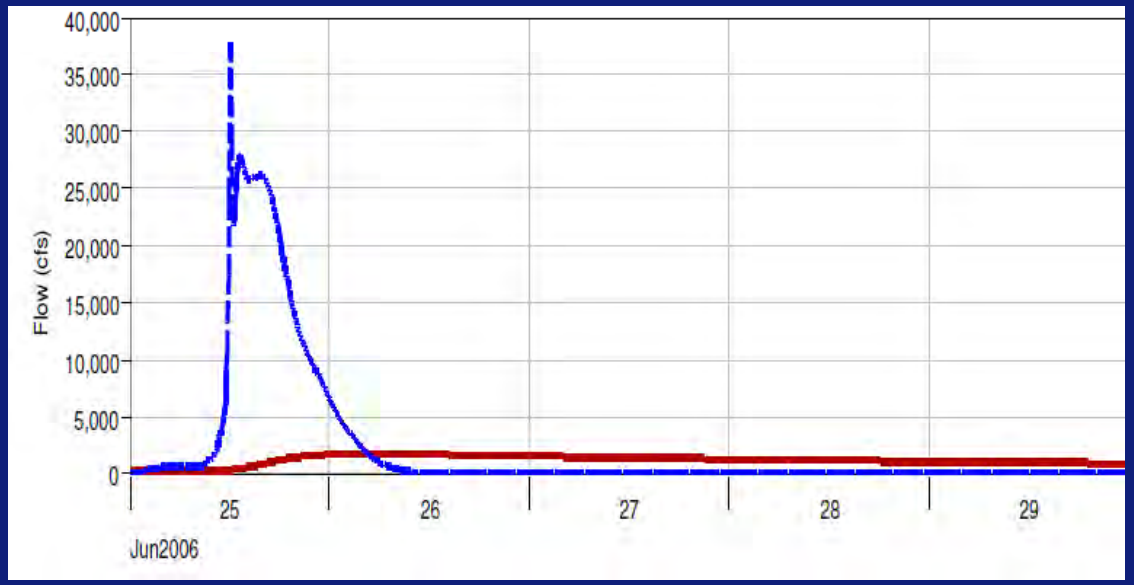
Otsego Lake Dam Hydrology

- 77.6 sq. mi. watershed
- HEC-HMS Model
- SDF - 150% of 100-Year Storm



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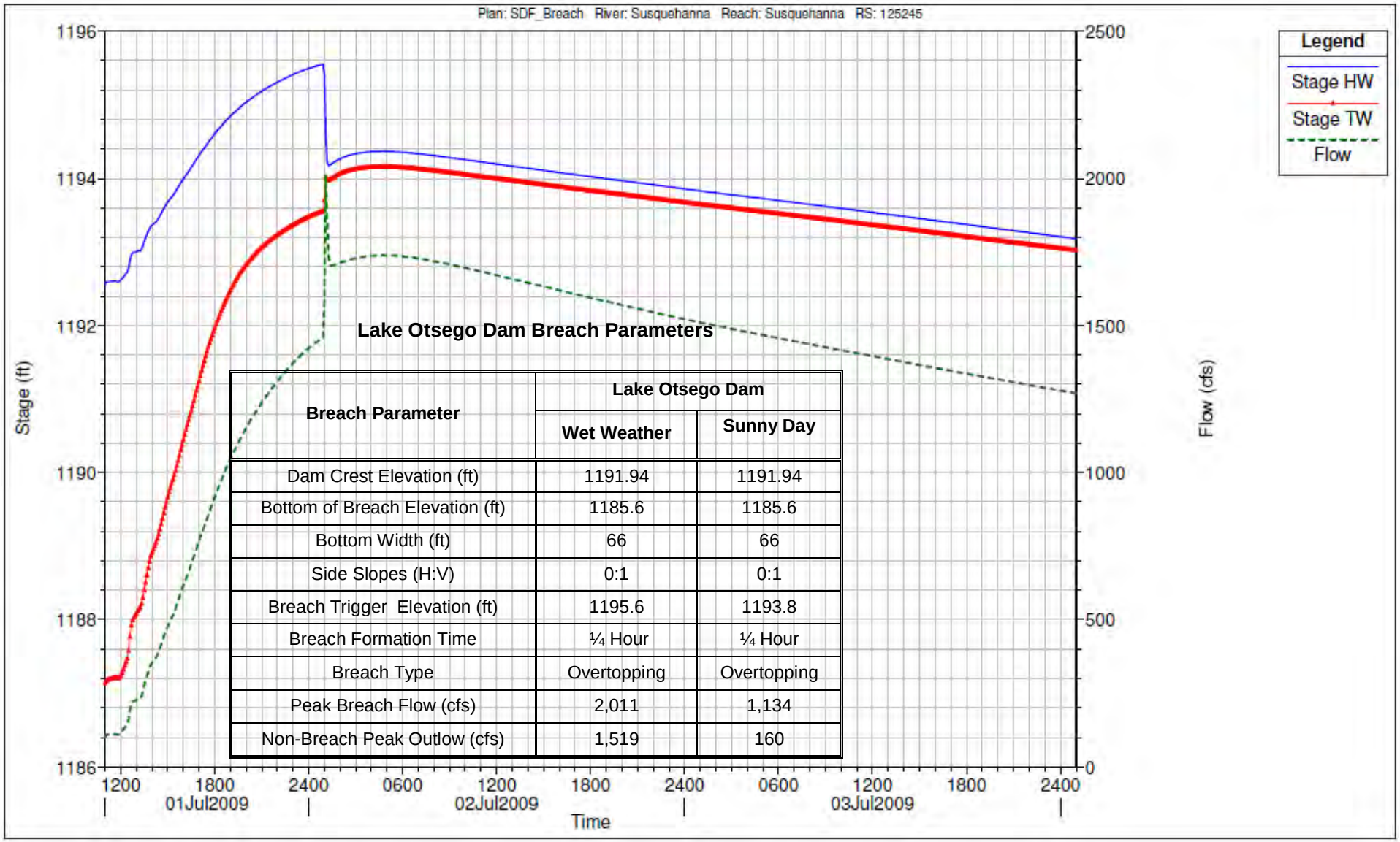
Dam Breach Hydrograph



Lake Otsego Dam Breach Parameters

Breach Parameter	Lake Otsego Dam	
	Wet Weather	Sunny Day
Dam Crest Elevation (ft)	1191.94	1191.94
Bottom of Breach Elevation (ft)	1185.6	1185.6
Bottom Width (ft)	66	66
Side Slopes (H:V)	0:1	0:1
Breach Trigger Elevation (ft)	1195.6	1193.8
Breach Formation Time	¼ Hour	¼ Hour
Breach Type	Overtopping	Overtopping
Peak Breach Flow (cfs)	2,011	1,134
Non-Breach Peak Outlow (cfs)	1,519	160

Dam Break - Hydraulic Modeling

- No FEMA FIS Hydraulic Model
- No LiDAR Topographic Mapping
- 5-ft contour mapping within Village Limits
- NYSDOT drawings for most bridges
- Field measurements of remaining bridges
- Field survey of downstream areas of concern (School, Treatment Plant)

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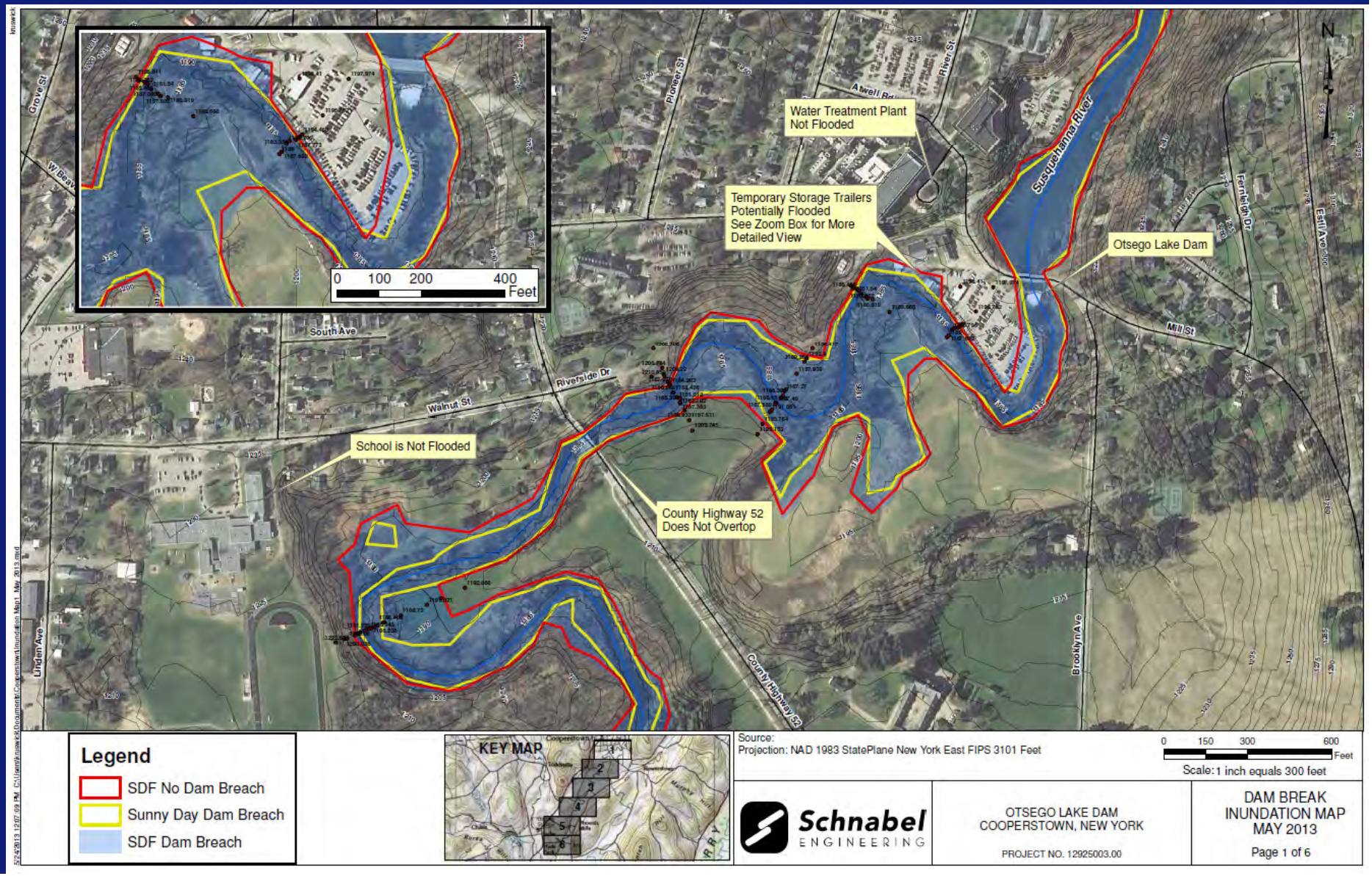
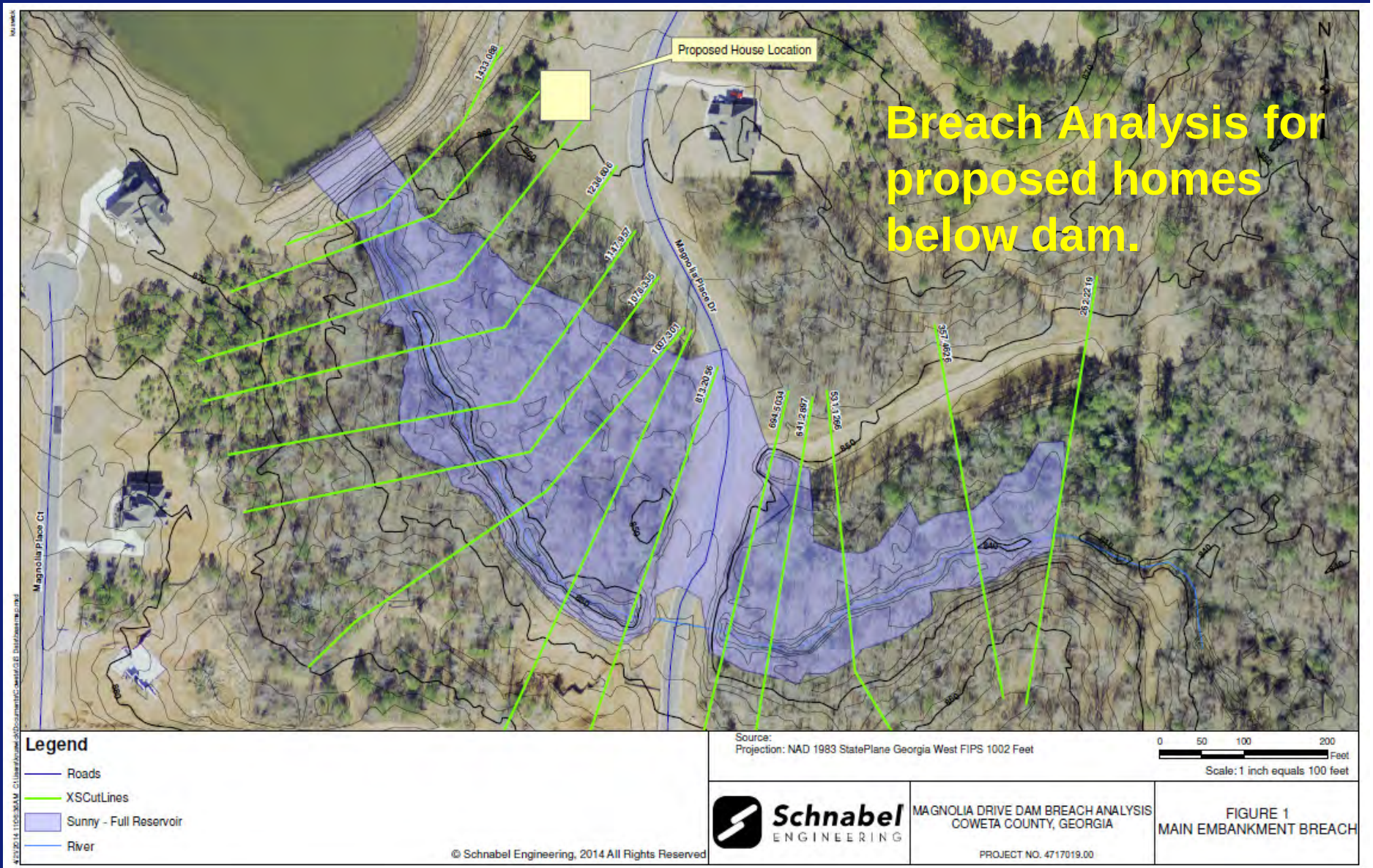
Dam Break – Peak Flood Profiles

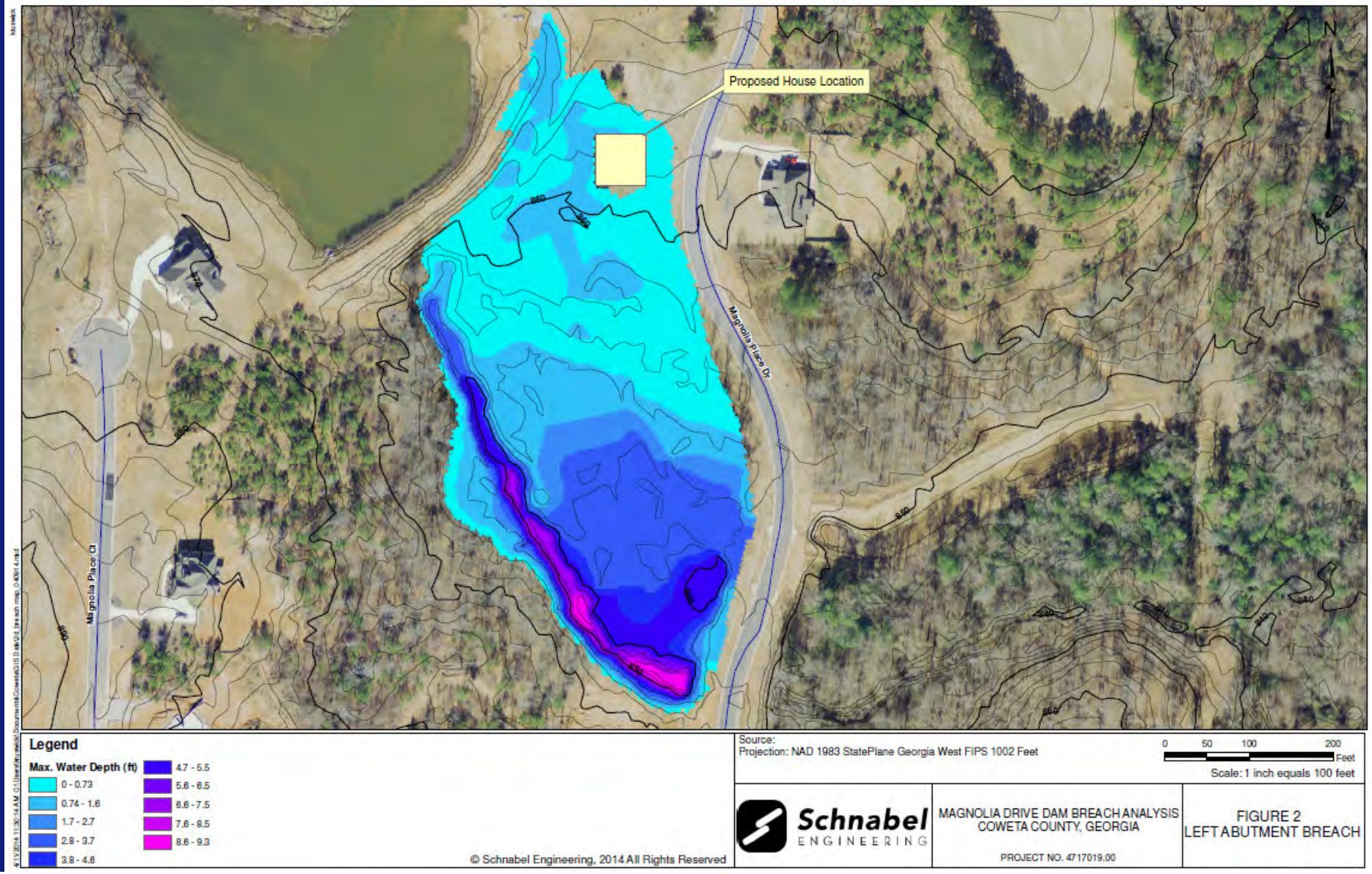
No Dam Break Impact – Class A Dam



Magnolia Place Dam (Georgia)



Left Abutment Breach (2-D Modeling)



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Any Dam Questions?

Stop by our booth for additional discussion

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Hoover Dam