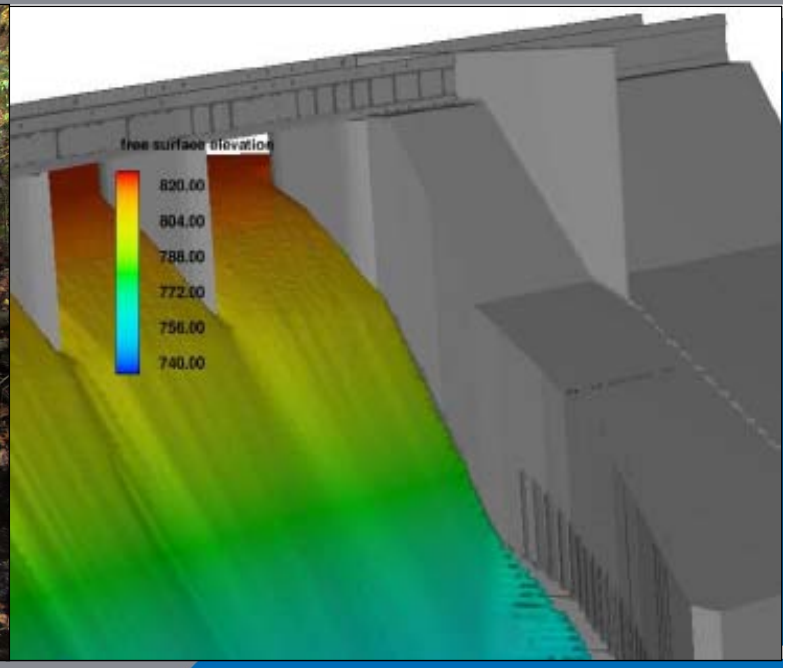
WCAMPWA

LUNCH AND LEARN
DAM SAFETY PRESENTATION
REGULATORY REQUIREMENTS FOR DAM ENGINEERING ASSESSMENTS IN NEW YORK

Allan Estivalet, PE



September 10, 2015

WSP

NEW YORK STATE DAM SAFETY REGULATIONS

Following the failure of Hadlock Dam in Fort Ann, NY in 2005, the New York Code of Rules and Regulations, Part 673: Dam Safety Regulations was revised.

Revisions to New York's Dam Safety Regulations became effective on August 19, 2009.

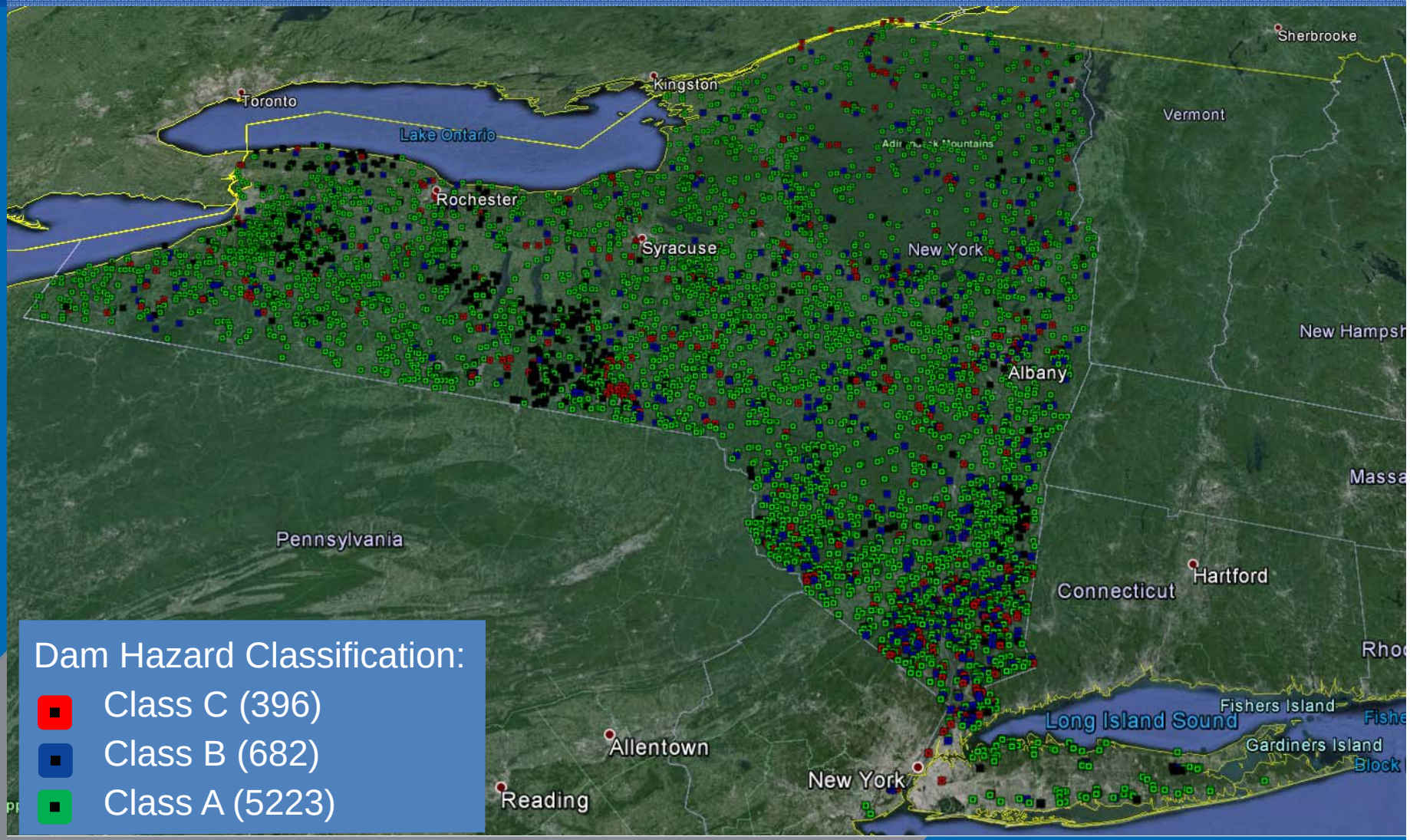
NEW YORK STATE DAM SAFETY REGULATIONS

NY Dam Safety Program oversees owners to protect downstream lives, property, and natural resources. The Program's core mission includes:

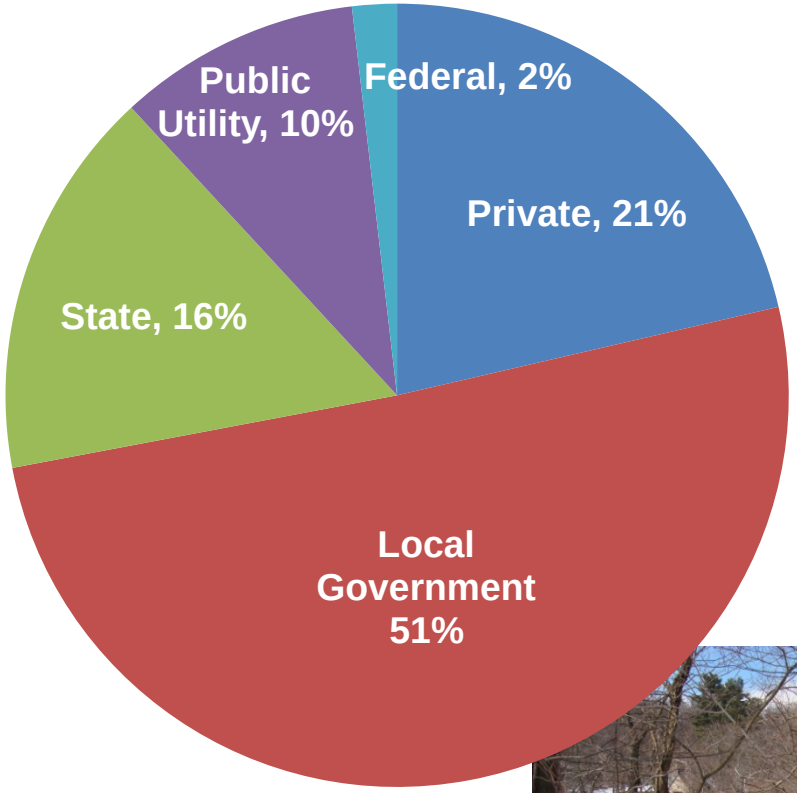
- Regulatory dam inspection by NYSDEC engineers
- Technical review of proposed work
- Enforcement
- Repair or removal of unsafe dams
- Emergency planning

NYSDEC DAMS INVENTORY

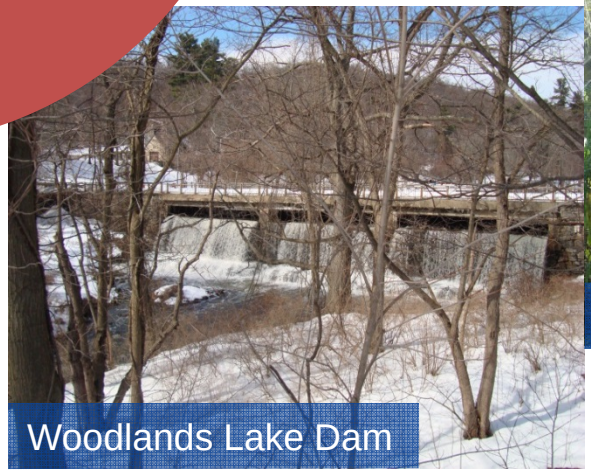
~7,000 Dams



NEW YORK STATE REGULATED DAM OWNER TYPES




Mills Lower Dam


Woodlands Lake Dam


Glass Lake Dam

NYSDEC DAM HAZARD CLASSIFICATION

Class A – Low Hazard Dam

Dam failure is **unlikely** to result in damage to anything more than isolated and unoccupied buildings and undeveloped lands.

Class B – Intermediate Hazard Dam

Dam failure is **likely** to pose the threat of personal injury or result in substantial economic, environmental, or infrastructure loss.
Loss of human life is not expected.

Class C – High Hazard Dam

Dam failure is **likely** to result in widespread substantial economic, environmental, or infrastructure loss. Loss of human life is likely.

NYSDEC DAM SAFETY REGULATIONS (Updated Aug. 19, 2009)

REQUIREMENT	FREQUENCY	DAM HAZARD CLASSIFICATION		
		C High	B Interm.	A Low
Inspection & Maintenance Plan (I&M Plan)	On-going	X	X	X
Annual Certification	Annually by January 31	X	X	X
Emergency Action Plan (EAP)	Annual review and update	X	X	N/A
Dam Safety Inspection	2 years for Class C 4 years for Class B	X	X	N/A
Engineering Assessment (EA)	Every 10 years	X	X	N/A

ENGINEERING ASSESSMENTS PROCESS

Records Review

- Design and construction records
- Operation and maintenance records
- Previous engineering inspection reports

On-site Engineering Inspection and Investigation

- Dam Safety Inspection
- Hazard classification reconnaissance
- Other investigations as necessary

Engineering Review, Calculations, and Conclusions

- Hazard Classification
- Hydrology & Hydraulic analysis
- Structural stability analysis
- Review of the dam's Emergency Action Plan (EAP)
- Conclusions and recommendations

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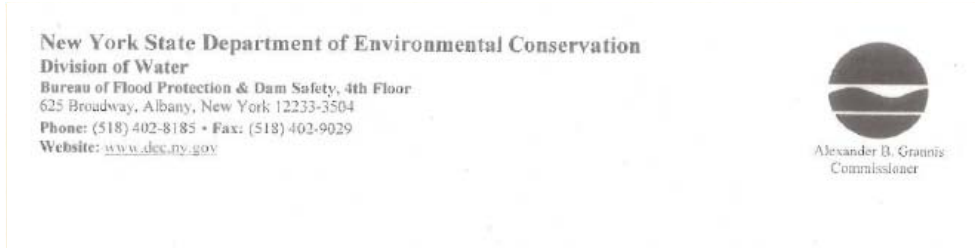
RECORDS REVIEW


New York State Department of Environmental Conservation
Division of Water
Bureau of Flood Protection & Dam Safety, 4th Floor
625 Broadway, Albany, New York 12233-3504
Phone: (518) 402-8185 • Fax: (518) 402-9029
Website: www.dec.ny.gov

Alexander B. Grannis
Commissioner

- Become fully acquainted with the dam and its appurtenant structures as well as construction and performance history through review of the dam's design, construction, and operational records.
- Owner's Dam File:
  - Reports related to design, repairs, geology, engineering analyses, inspections, etc.
  - Inspection and Maintenance (I&M) Plan
  - Records for maintenance and completed and/or planned repairs
  - Emergency Action Plan including inundation maps

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ENGINEERING ASSESSMENTS PROCESS

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ON-SITE ENGINEERING INSPECTION & INVESTIGATION
DAM SAFETY INSPECTION

Visual Inspection:

- ↗ Perform a comprehensive examination of visible physical features of the dam and its appurtenant structures

Assign a condition rating:

- ↗ "Unsafe" ↗ "Deficiently maintained"
- ↗ "Unsound" ↗ "No deficiencies noted"

Prepare a Safety Inspection Report, including:

- ↗ Review and evaluation of data generated
- ↗ Narrative results of the visual inspection
- ↗ Schedule for any corrective actions necessary to resolve deficiencies

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DAM SAFETY INSPECTION FOR NYSDEC

Louis Enten Pond Dam #1, Putnam Valley, NY

Madison Reforestation Dam , Town of Nelson, NY

NYSDEC at Howlands Dam, Conquest, NY

Schoonmaker Lake Dam, Blooming Grove, NY

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ON-SITE ENGINEERING INSPECTION & INVESTIGATION
FLOODPLAIN INSPECTION

Dam Hazard Classifications are assigned based on the potential impact of a dam failure on downstream areas.

Features in the floodway's path identified during field reconnaissance include:

- Buildings
- Roads
- Railroads
- Environmentally sensitive areas

ON-SITE ENGINEERING INSPECTION & INVESTIGATION

On-Site Investigations (for engineering analyses)

- Subsurface investigation
- Survey
  - Topographic
  - Bathymetric

ENGINEERING ASSESSMENTS PROCESS

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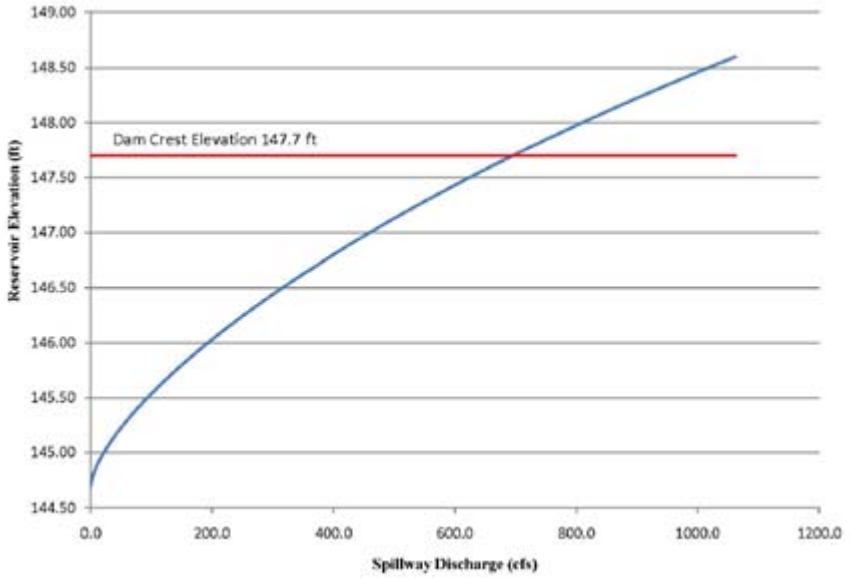
ENGINEERING REVIEW, CALCULATION & CONCLUSIONS
HYDROLOGIC AND HYDRAULIC ANALYSIS

Evaluation of the dam's spillway capacity

- The spillway should have adequate capacity to pass the Spillway Design Flood (SDF)
- Assuming no inflow, the spillway should have sufficient discharge capacity to evacuate 75% of the storage between the maximum design high water and the spillway crest within 48 hours.
- Velocities in spillway should not exceed the maximum permissible velocities (non-erodible velocities) of the spillway materials.

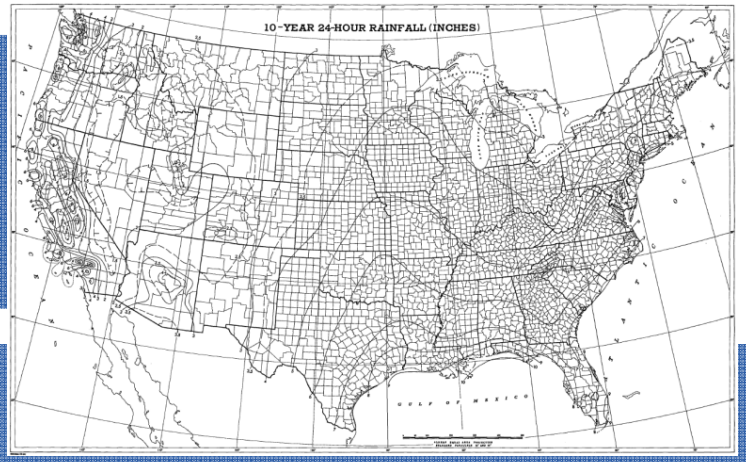


Hazard Classification	Spillway Design Flood (SDF)
A	100 year
B	150% of 100 year
C	50% of PMF

TECHNICAL PAPER (TP) 40 vs. NORTHEAST REGIONAL CLIMATE CENTER (NRCC) PRECIPITATION ESTIMATES

TP-40

- ↗ Published in 1963
- ↗ Nation-wide maps



NRCC

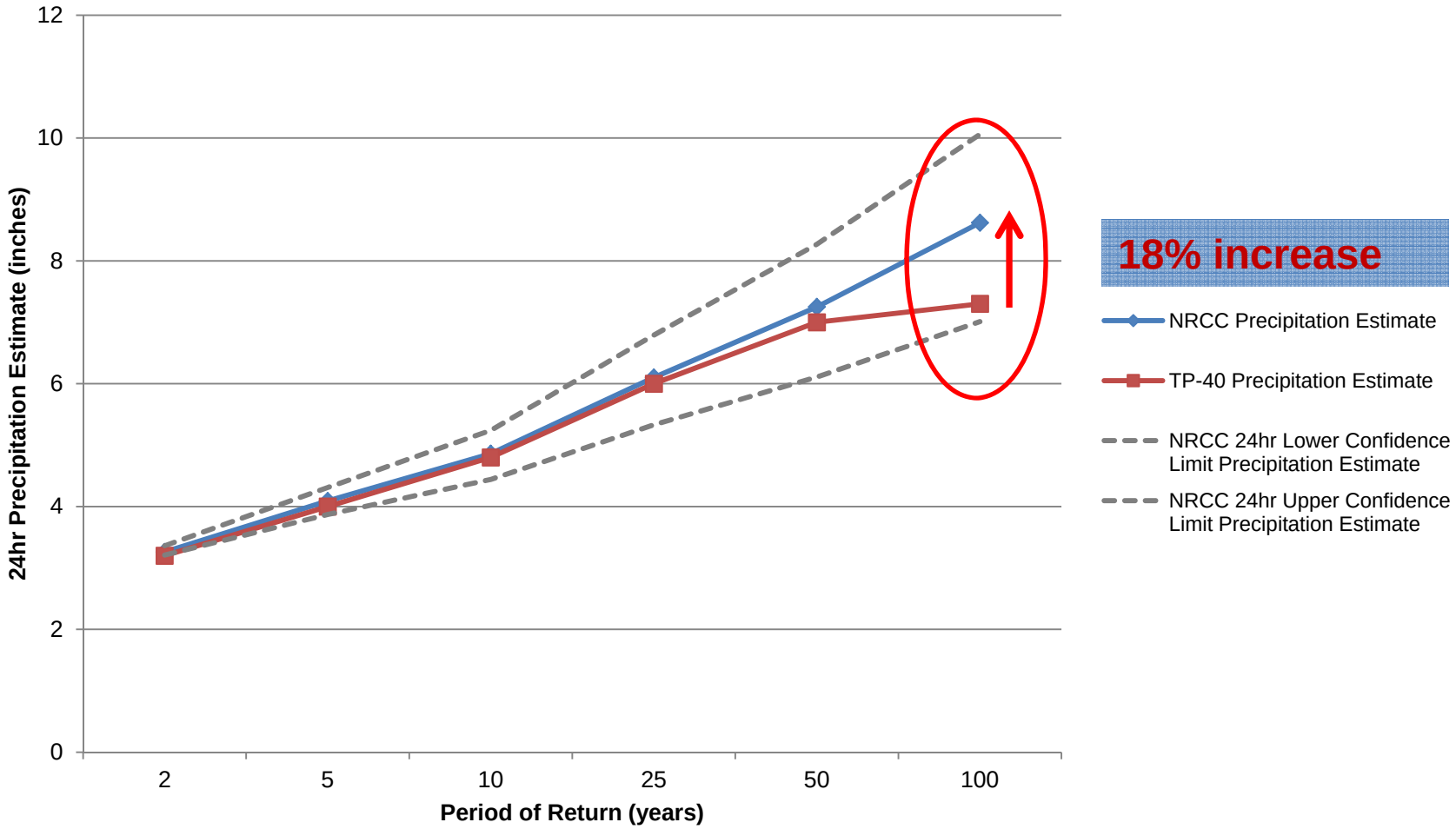
- ↗ Data based on 900 data-collection stations with improved rainfall collection technology
- ↗ Precipitation tables continually updated every two months

Climate projections performed by NRCC for the Northeast predict an **increase in precipitation** of:

- ↗ Up to 5% by 2020, 10% by the 2050's, 15% by the 2080's

COMPARISON OF NRCC vs. TP-40 PRECIPITATION ESTIMATES

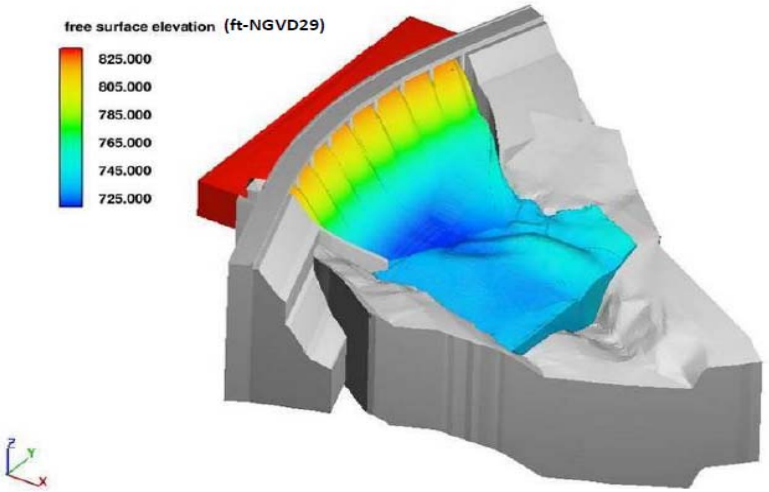
Comparison of Precipitation Estimates according to NRCC and TP-40 for 100 Year 24 Hour Rainfall in Westchester County, NY

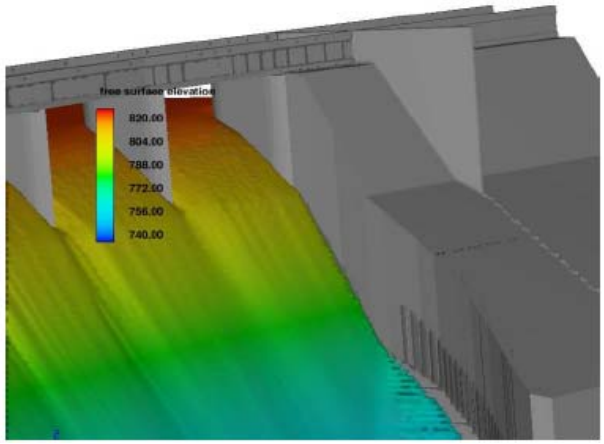


ENGINEERING REVIEW, CALCULATION & CONCLUSIONS
HYDROLOGIC AND HYDRAULIC ANALYSIS

Evaluation of the dam's spillway capacity

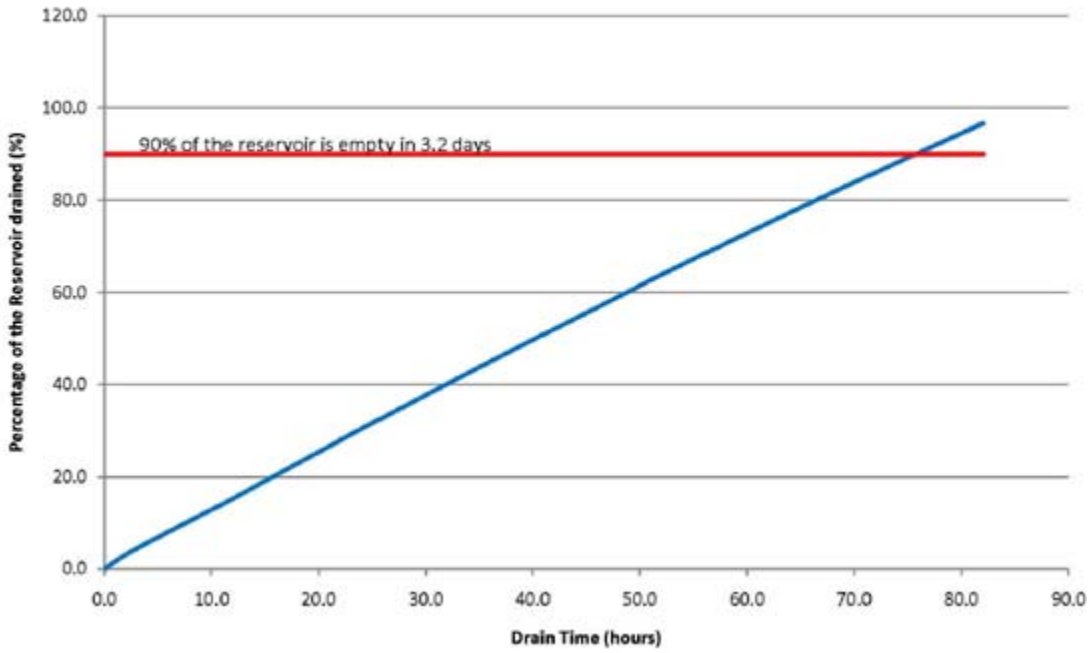
Rio Dam Project, Forestburgh, New York (2014-ongoing)
Computational Fluid Dynamic (CFD) Flow 3D analysis

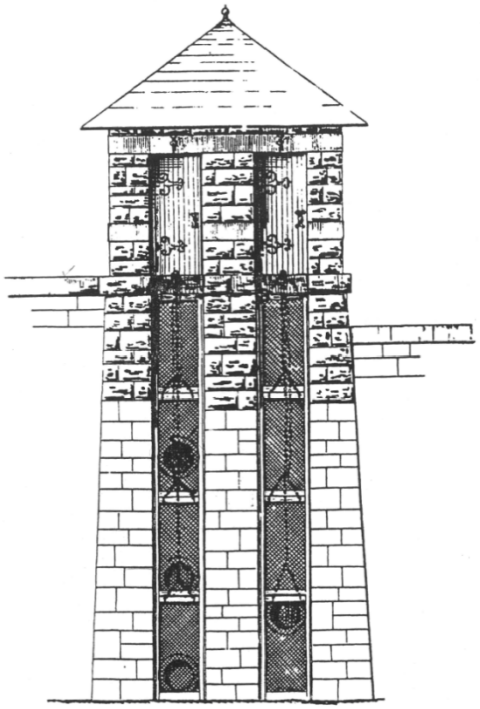




ENGINEERING REVIEW, CALCULATION & CONCLUSIONS
HYDROLOGIC AND HYDRAULIC ANALYSIS

Evaluation of the dam's outlet works (reservoir drain) capacity



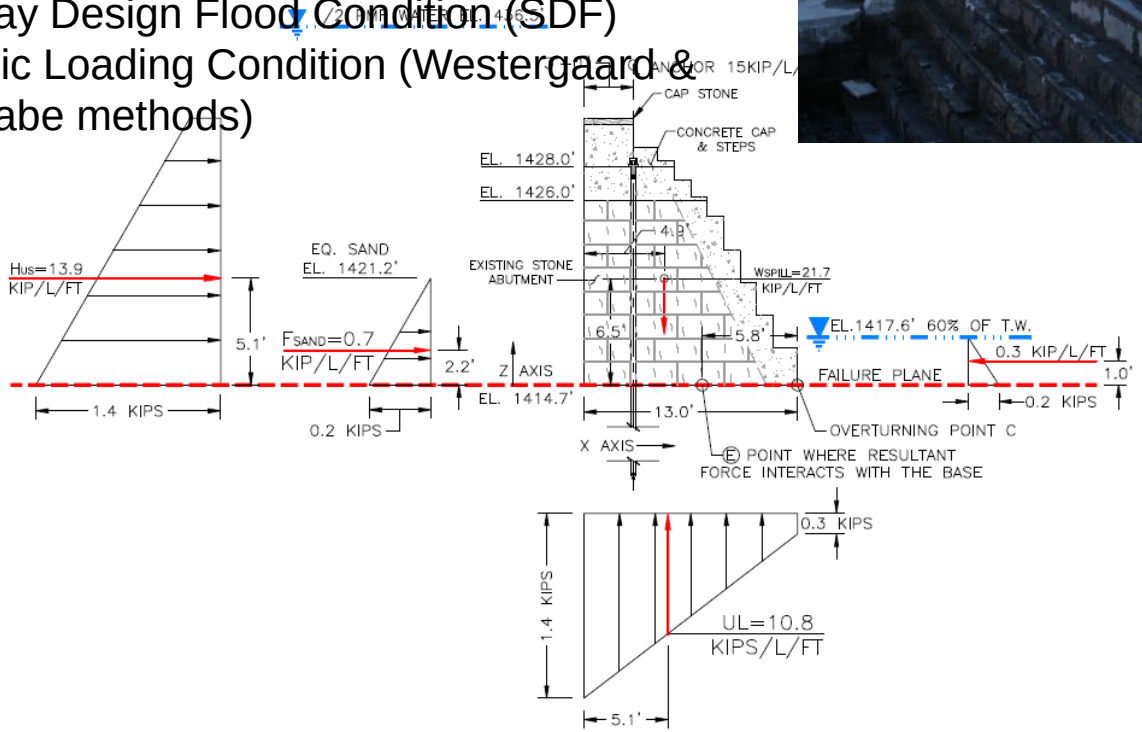


Wilkie Dam Gate House, Margaretville, New York

ENGINEERING REVIEW, CALCULATION & CONCLUSIONS
STRUCTURAL STABILITY ANALYSIS

Evaluation of the dam's structural stability for the following loading cases:

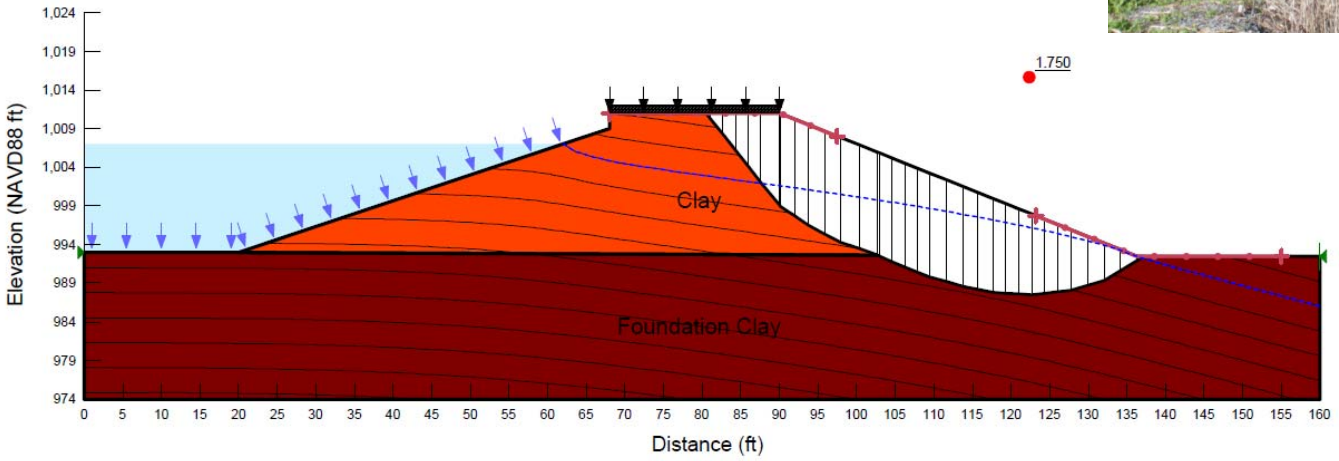
- Case 1: Normal Loading Condition
- Case 2: Normal Loading Condition + Ice
- Case 3: Spillway Design Flood Condition (SDF)
- Case 4: Seismic Loading Condition (Westergaard & Mononobe-Okabe methods)

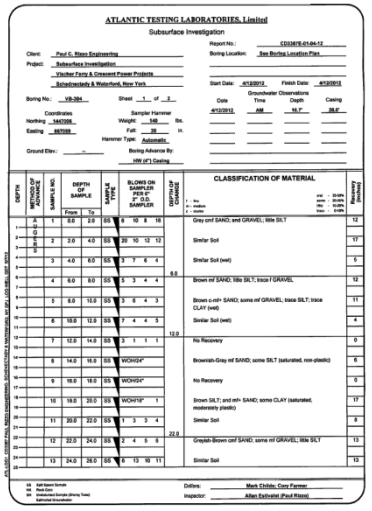


ENGINEERING REVIEW, CALCULATION & CONCLUSIONS
STRUCTURAL STABILITY ANALYSIS

Evaluation of the dam's structural stability for the following loading cases:

- Case 1: Normal Loading Condition (steady seepage)
- Case 2: Spillway Design Flood Condition (steady seepage)
- Case 3: Sudden drawdown
- Case 4: Earthquake/liquefaction




ATLANTIC TESTING LABORATORIES, Limited
Subsurface Investigation

Chauncey Stillman Embankment Dam, Amenia, New York
Subsurface investigation & embankment slope stability analysis

EMERGENCY ACTION PLAN (EAP)

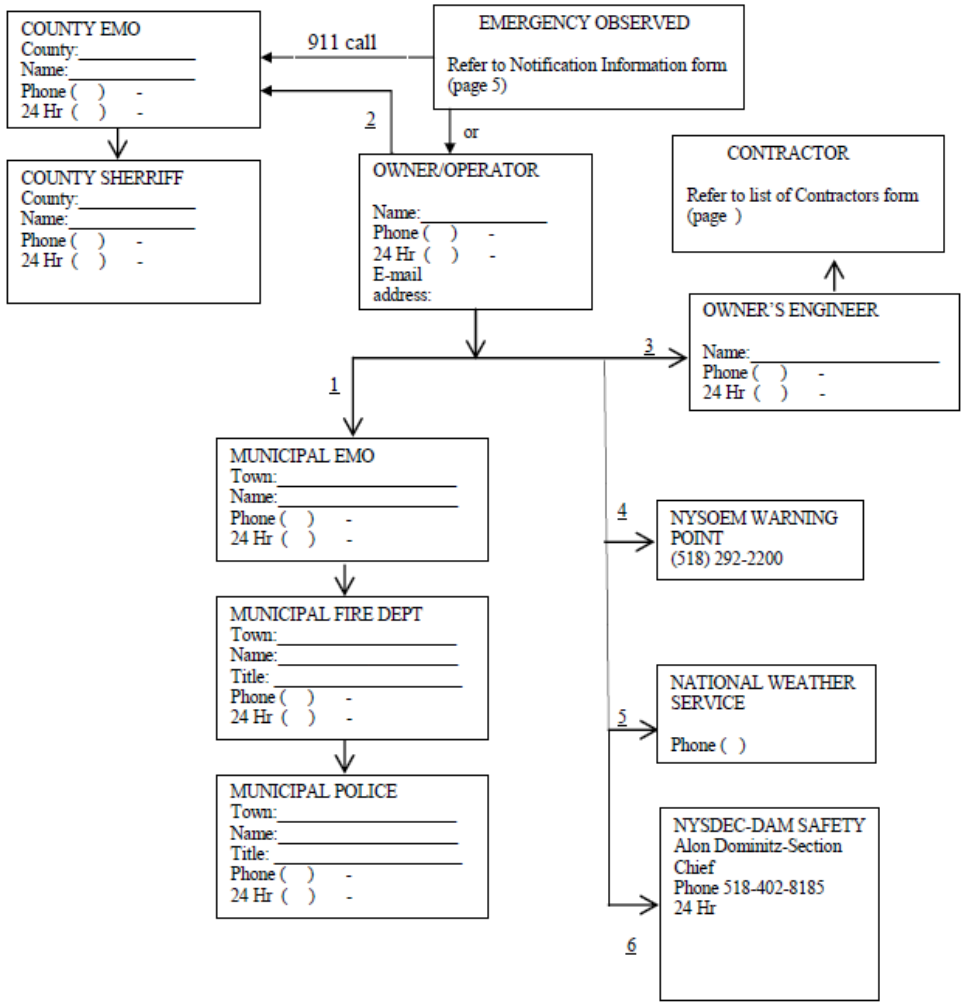
Owners of Class B and C dams are required to develop an EAP.

Critical components of an EAP:

- Emergency notification procedures
- Inundation maps

I. Emergency Notification

SAMPLE EMERGENCY NOTIFICATION FLOWCHART



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ENGINEERING ASSESSMENT REPORT FILED WITH NYSDEC

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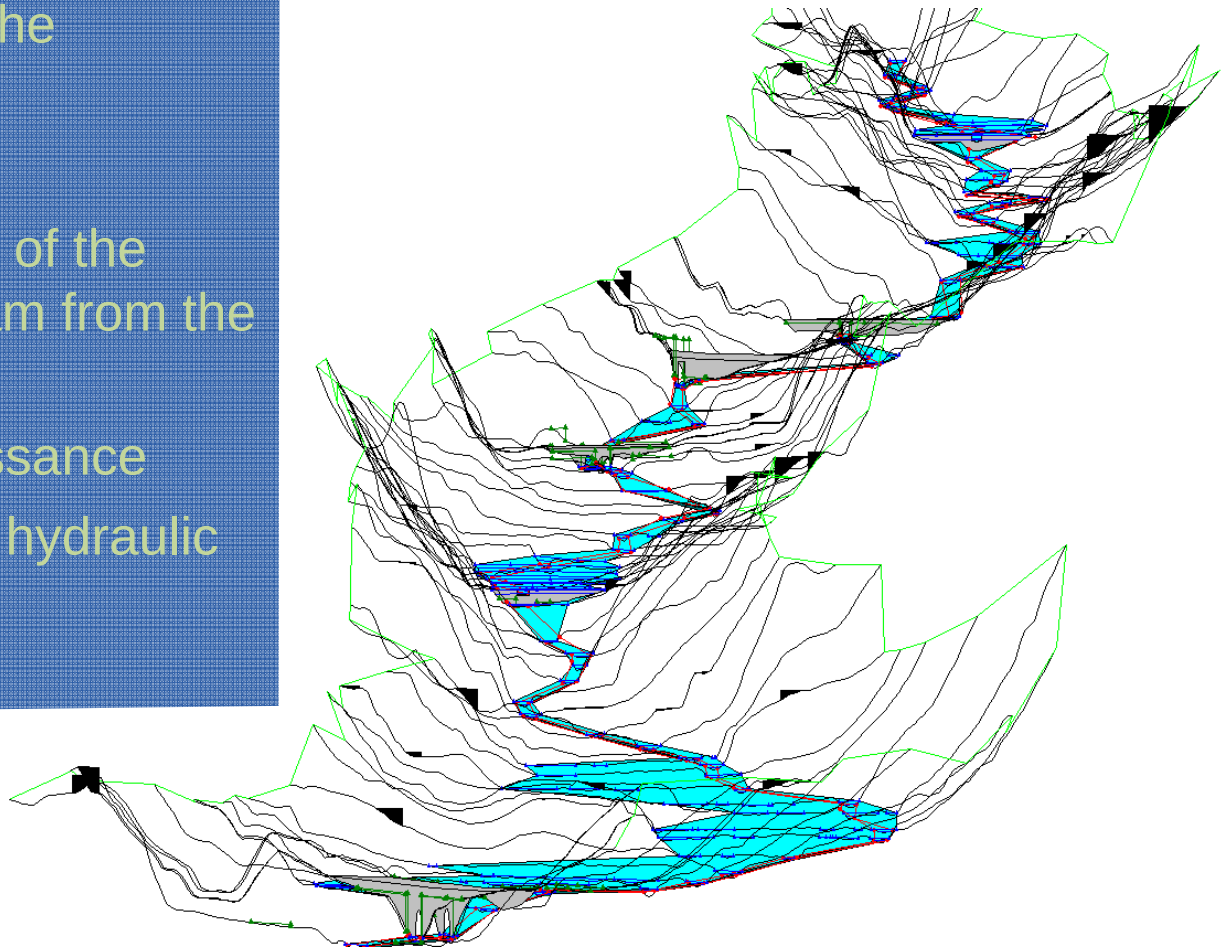
DAM HAZARD CLASSIFICATION – CASE STUDY
Louis Enten Pond Dam #1, Putnam Valley, NY

Critical component of the assessment

Hazard Classification:

- Desktop review of the area downstream from the dam
- River reconnaissance
- Hydrologic and hydraulic analysis



DAM HAZARD CLASSIFICATION – CASE STUDY

Louis Enten Pond Dam #1 (State ID # 213-3354)

↗ Desktop review of the area downstream from the dam

DAM HAZARD CLASSIFICATION – CASE STUDY

- River reconnaissance/data collection

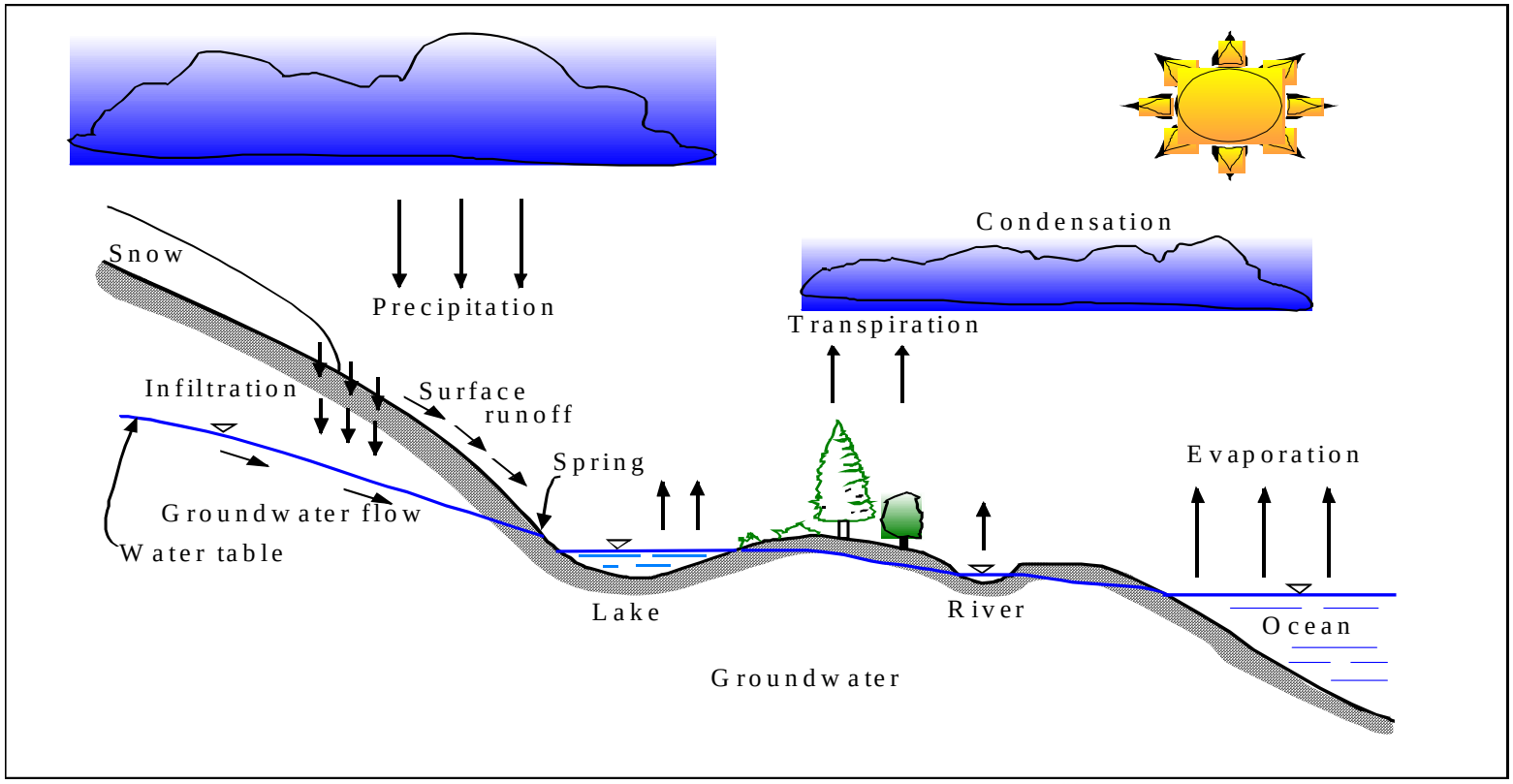




DAM HAZARD CLASSIFICATION – CASE STUDY

Louis Enten Pond Dam #1 (State ID # 213-3354)

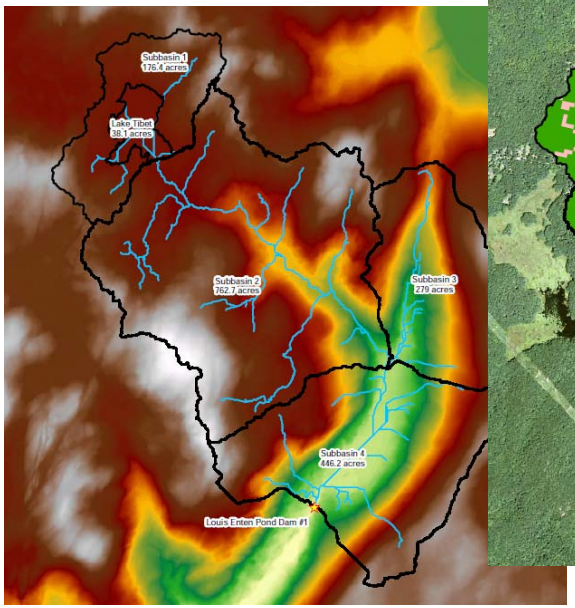
↗ Hydrologic & Hydraulic analysis (Hydrologic Cycle)



DAM HAZARD CLASSIFICATION – CASE STUDY

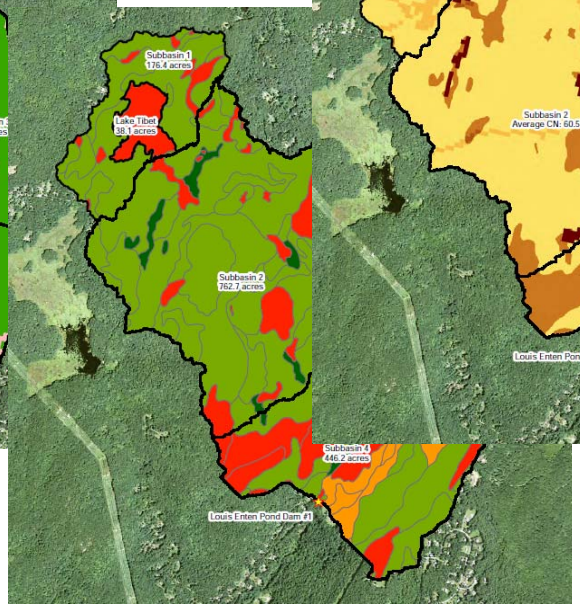
Louis Enten Pond Dam #1 (State ID # 213-3354)

↗ Hydrologic & Hydraulic analysis (Hydrologic Analysis)

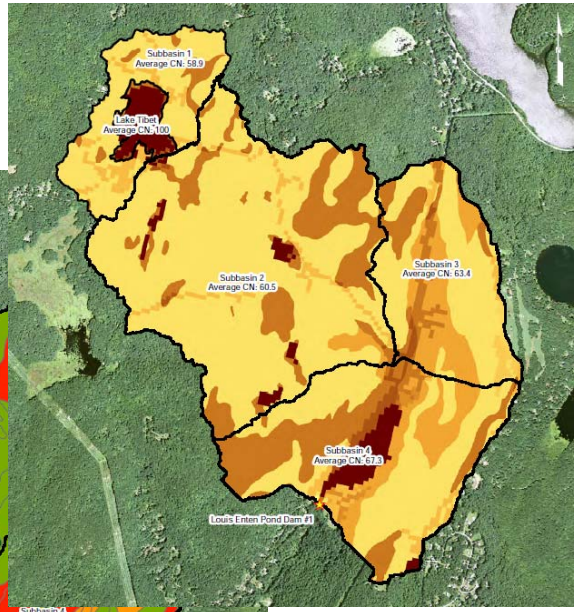


Digital Elevation Model

Land Use Land Cover Data



Hydrologic Soil Types



CN numbers

DAM HAZARD CLASSIFICATION – CASE STUDY

Louis Enten Pond Dam #1 (State ID # 213-3354)

- ↗ Hydrologic & Hydraulic analysis (Hydrologic Analysis)

Bathymetric survey data data

Bathymetric map

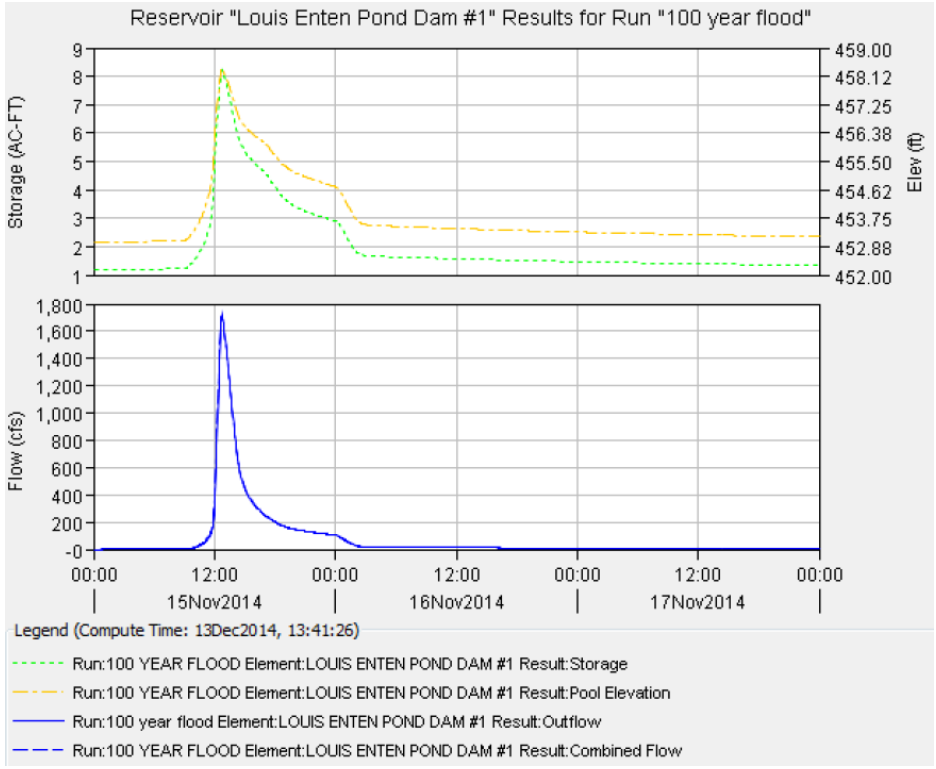
Elevation	Area	
[NAVD88]	[sq ft]	[acres]
446.5	6	0.00
448	67.85	0.002
449	177.25	0.004
450	2128.96	0.05
451	9780.87	0.22
452	22054.03	0.51
453	36291.96	0.83
454	44882.88	1.03
455	52135.75	1.20
456	60751.88	1.39
457	68451.03	1.57
458	73782.17	1.69
459	78558.53	1.80
460	83032.37	1.91
461	87624.04	2.01
462	92679.25	2.13
463	99671.83	2.29
464	105241.75	2.42
465	111812.32	2.57
466	119470.92	2.74
467	126472.72	2.90
468	131930.21	3.03
469	137366.22	3.15
470	142001.64	3.26

DAM HAZARD CLASSIFICATION – CASE STUDY

Louis Enten Pond Dam #1 (State ID # 213-3354)

↗ Hydrologic & Hydraulic analysis (Hydrologic Analysis)

HEC-HMS Model

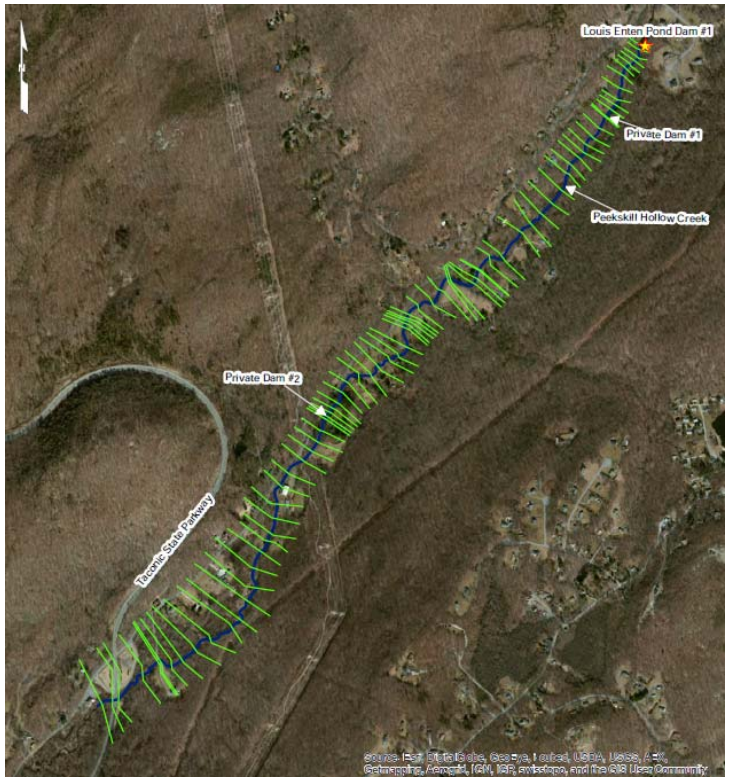


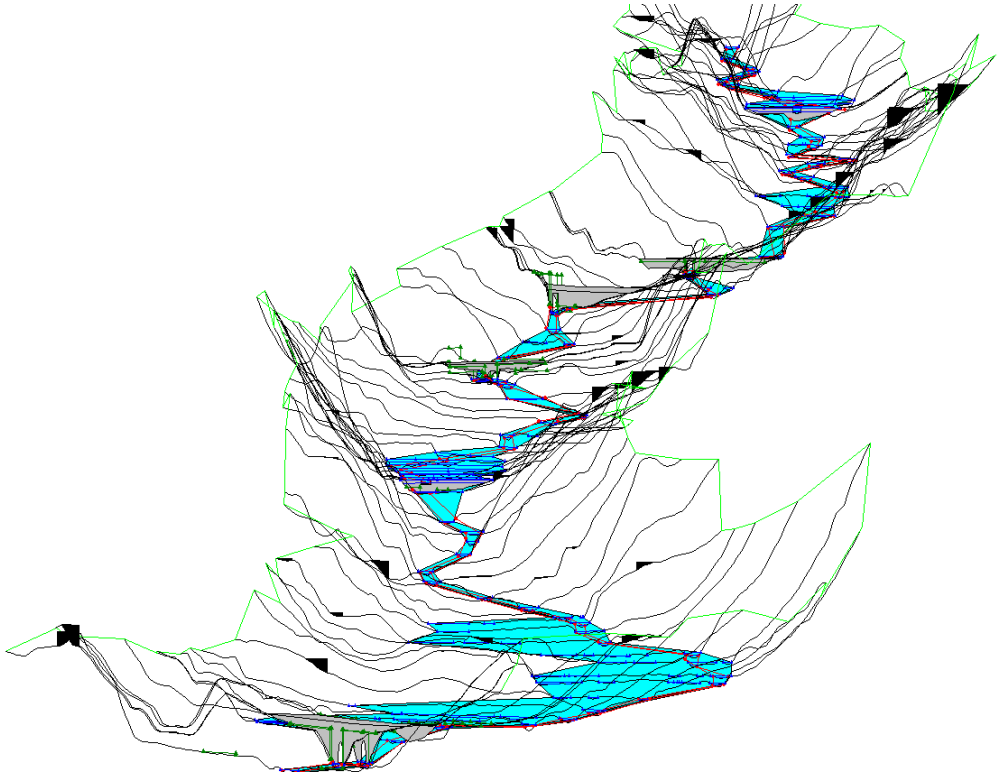
Flood Hydrograph at the dam (HEC-HMS output)

DAM HAZARD CLASSIFICATION – CASE STUDY

Louis Enten Pond Dam #1 (State ID # 213-3354)

↗ Hydrologic & Hydraulic analysis (Hydraulic modeling)





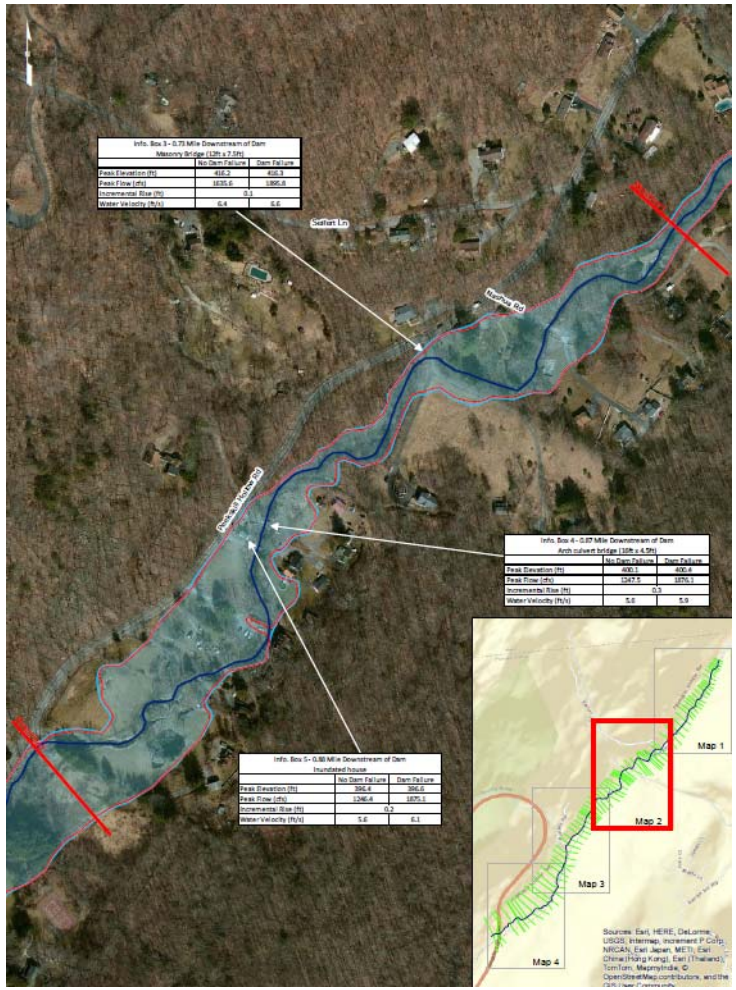
Peekskill River – HEC-RAS Model

DAM HAZARD CLASSIFICATION – CASE STUDY

Louis Enten Pond Dam #1 (State ID # 213-3354)

↗ Hydrologic & Hydraulic analysis
(Dam Break Analysis and Inundation Mapping)

Info. Box 5 - 0.88 Mile Downstream of Dam Inundated house		
	No Dam Failure	Dam Failure
Peak Elevation (ft)	396.4	396.6
Peak Flow (cfs)	1246.4	1875.1
Incremental Rise (ft)	0.2	
Water Velocity (ft/s)	5.6	6.1

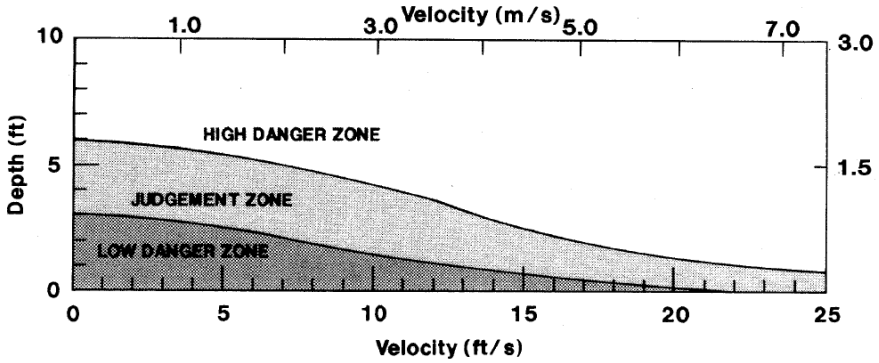


DAM HAZARD CLASSIFICATION – CASE STUDY

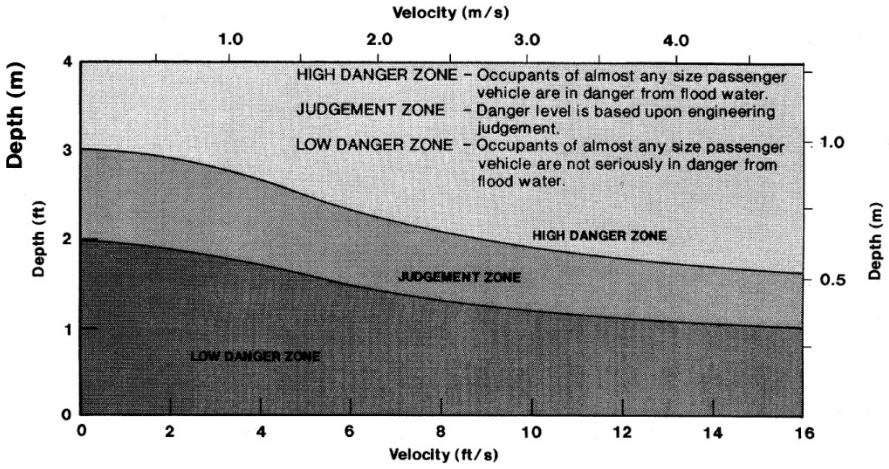
Louis Enten Pond Dam #1 (State ID # 213-3354)

↗ Hydrologic & Hydraulic analysis (Hazard Classification Determination)

The effects of the potential dam failure floods on downstream lives, property and the environment determine the hazard classification.



Depth-velocity flood danger level relationship for houses built on foundations (ACER Technical Memorandum No. 11 from USBR)



Depth-velocity flood danger level relationship for passenger vehicles (ACER Technical Memorandum No. 11 from USBR)

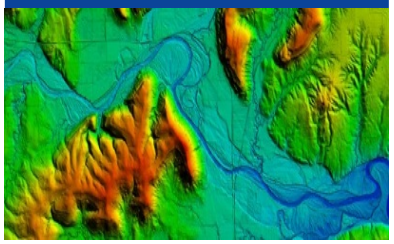
WSP DAMS AND WATER RESOURCES GROUP

SURVEY

STRUCTURAL ENGINEERING

CONSTRUCTION MANAGEMENT

GEOSPATIAL



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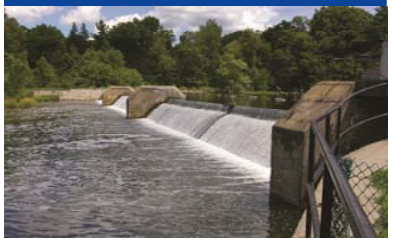
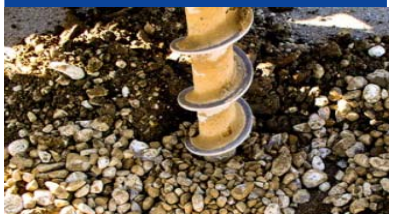
WATER RESOURCES



CIVIL ENGINEERING

GEOTECHNICAL ENGINEERING



ENVIRONMENTAL

WSP

WSP DAMS AND WATER RESOURCES GROUP

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Dams and Water Resources Group Leader

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Briarcliff Manor, NY 10510
Direct: 914-449-9110
Main: 914-747-1120
Mobile: 718-473-2427

QUIZ QUESTIONS

1. How many state-regulated dams are there in New York?

   ↗ Approximately 7,000

2. What was the catalyzer for the change in NYSDEC dam safety regulations in 2009?

   ↗ Failure of the Hadlock Dam in 2005

3. What is the highest hazard classification category for state-regulated dams?

   ↗ Class ‘C’

QUIZ QUESTIONS (continued)

4. What are the two areas that raise the most concerns for dam engineers?

   - ↗ Spillway capacity
   - ↗ Structural stability

5. What is the percent increase in precipitation between TP-40 and NRCC precipitation estimates for the 100 year 24hr rainfall in Westchester County, NY?

   - ↗ 18% increase

WSP DAMS AND WATER RESOURCES GROUP

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