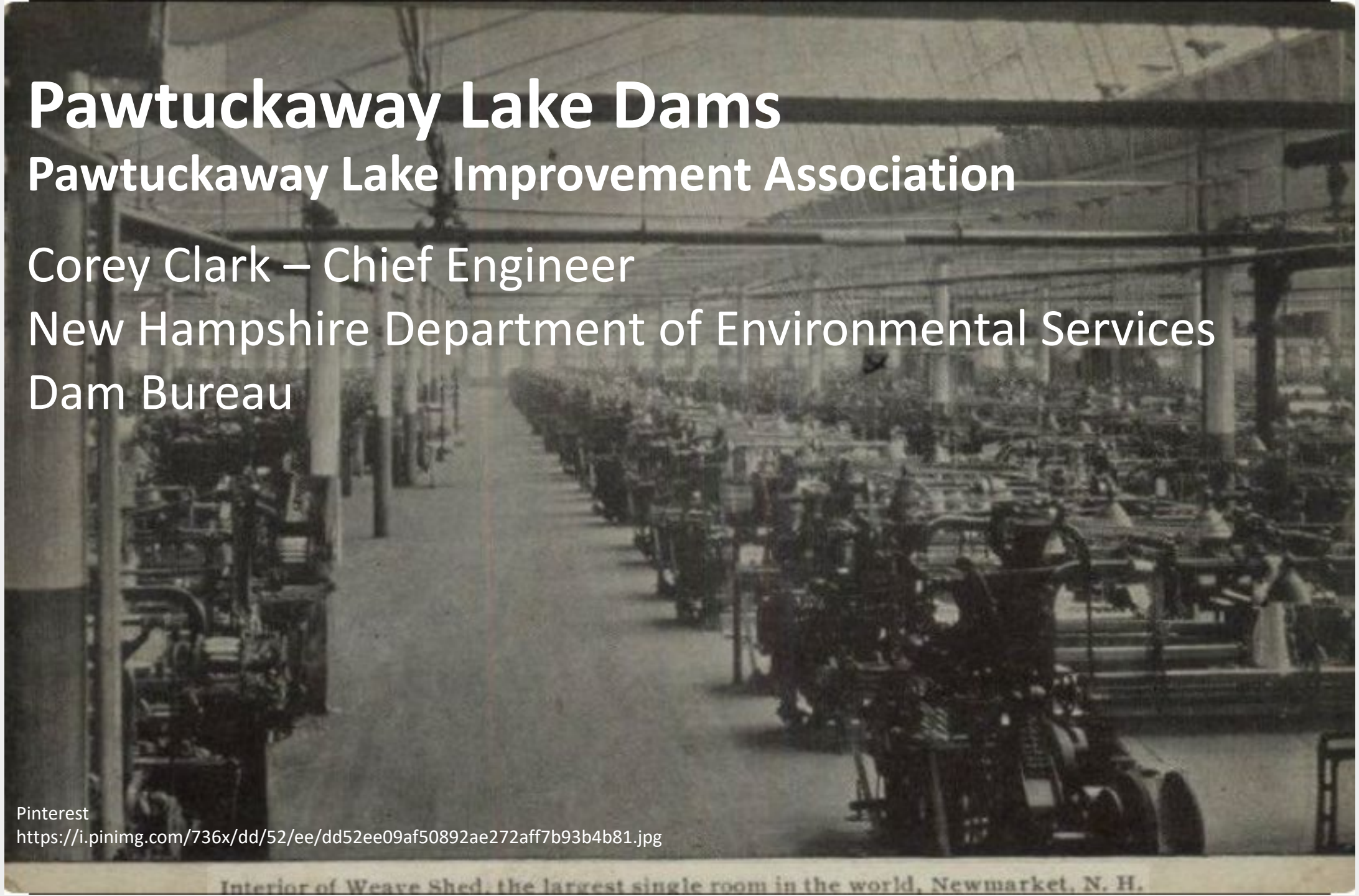
# Pawtuckaway Lake Dams

## Pawtuckaway Lake Improvement Association

Corey Clark – Chief Engineer
New Hampshire Department of Environmental Services
Dam Bureau




Pinterest
https://i.pinimg.com/736x/dd/52/ee/dd52ee09af50892ae272aff7b93b4b81.jpg

# Dam Bureau Overview

**Dam Safety and Inspection Section**

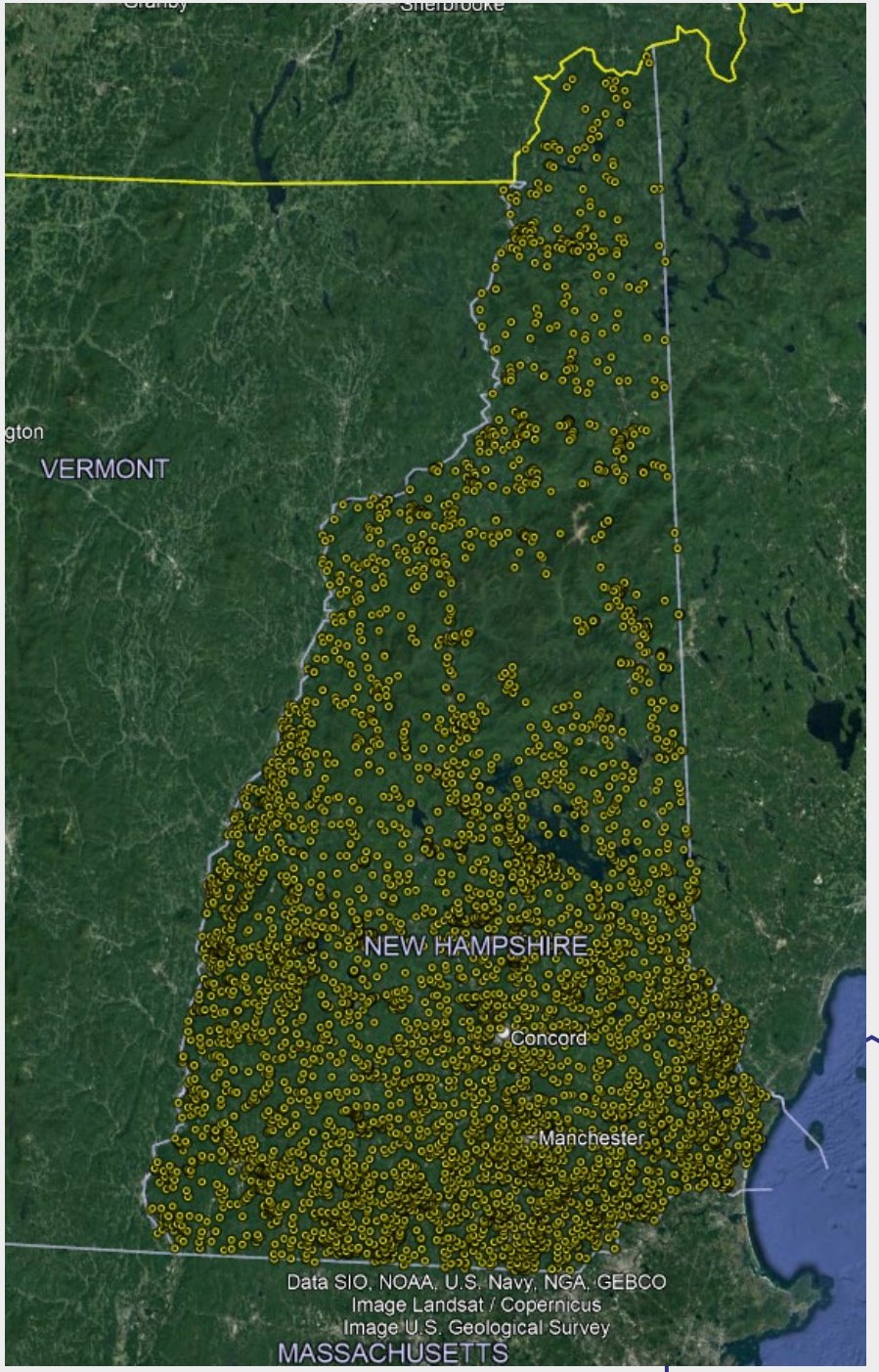

**Operations and Maintenance Section**


**Engineering and Construction Section**

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

# Dam Safety and Inspection Section

- Responsible for inspection of **over 2,600** privately and publicly owned dams. This includes routine inspections and construction inspections.
- Responsible for permitting of repairs on existing dams and permitting for new dam construction.




NEW HAMPSHIRE DEPARTMENT OF Environmental Services

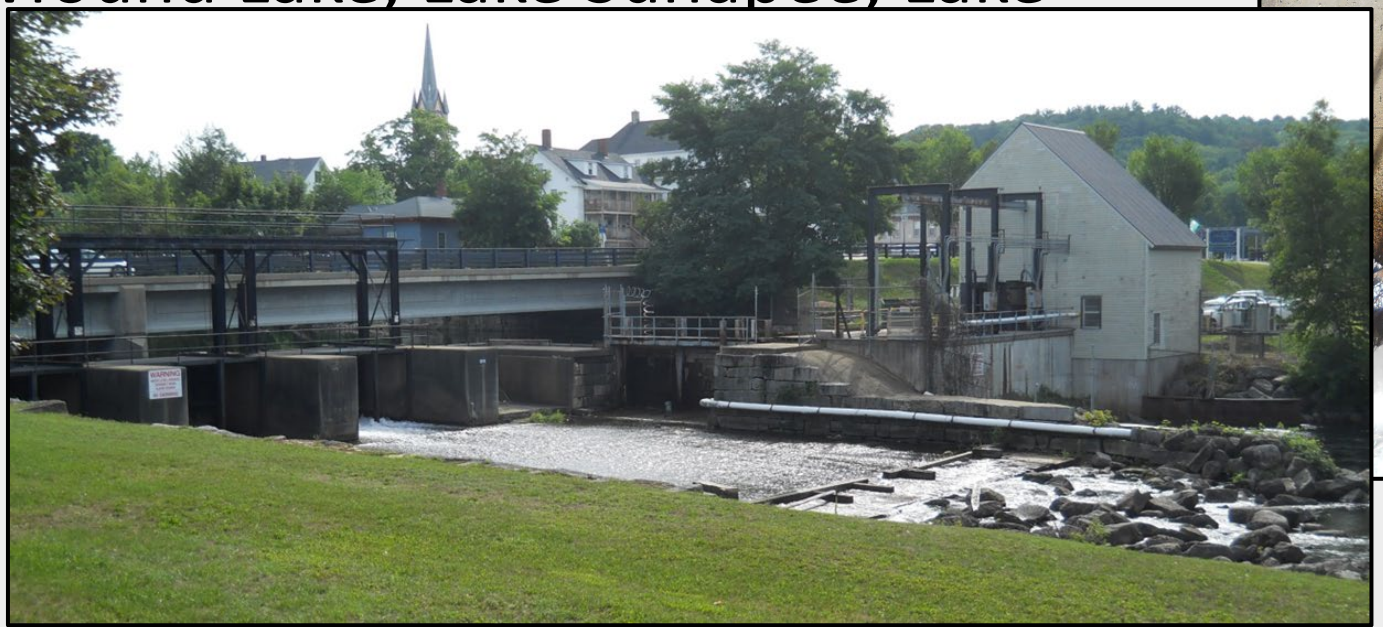
# Dam Safety and Inspection Section

- Works with dam owners to ensure dams are operated and maintained in proper working order and works with AG's office on enforcement actions
- Coordinates with Federal Energy Regulatory Commission (FERC) on inspections and permitting actions for hydropower projects

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

# Operations and Maintenance Section

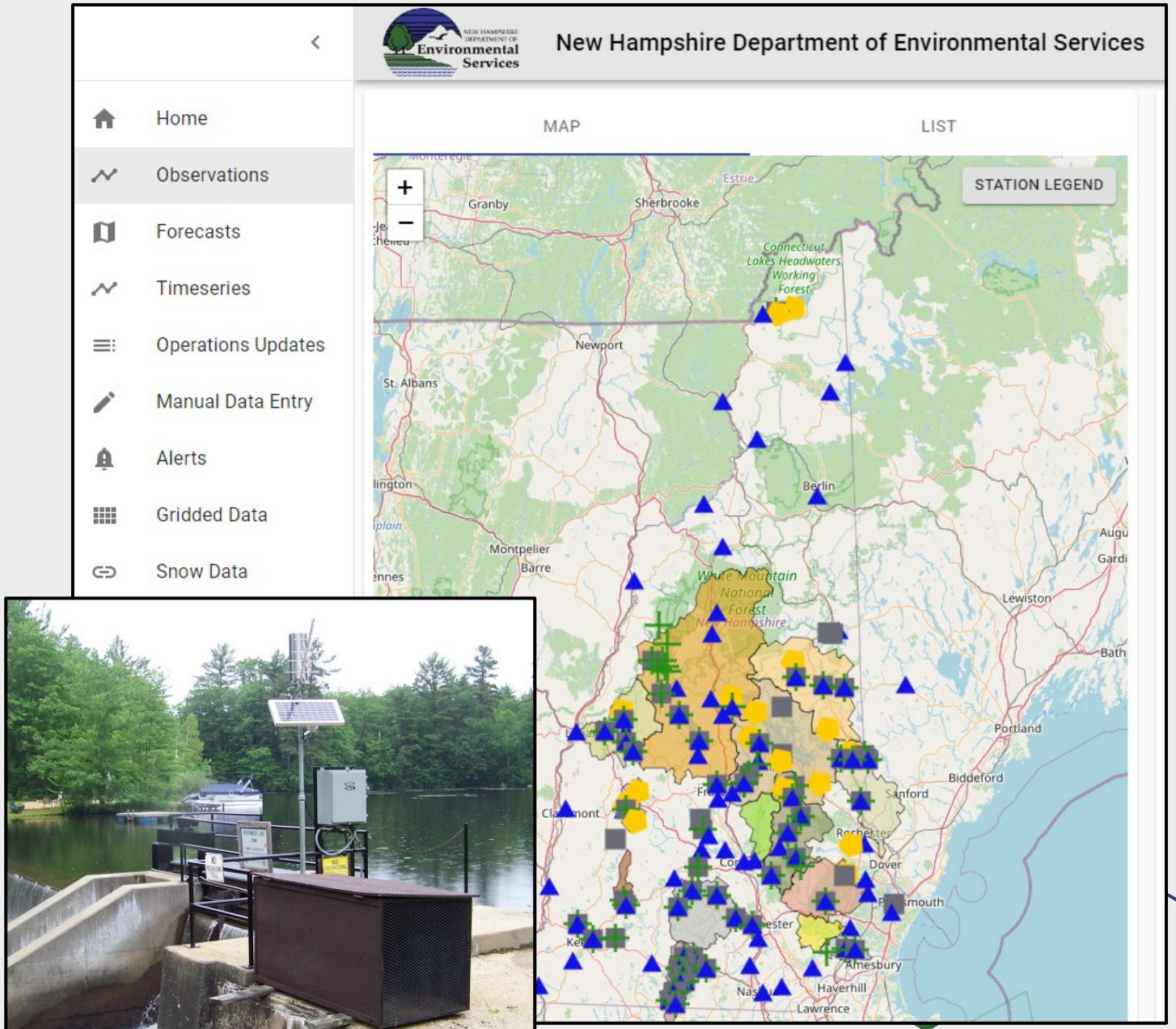
- Responsible for the operations and maintenance of **207 dams**.
- Responsible for maintaining dams and lake levels at the State's largest lakes (e.g., Lake Winnipesaukee, Lake Winnisquam, Squam Lake, Newfound Lake, Lake Sunapee, Lake Ossipee)



NEW HAMPSHIRE DEPARTMENT OF Environmental Services

# Operations and Maintenance Section

- Provides real time lake level, temperature, precipitation and discharge data at 31 lakes in NH through the https://nhdes.rtiamanzi.org/ web platform.
- Manages 8 leases and 26 water user agreements with hydropower operators

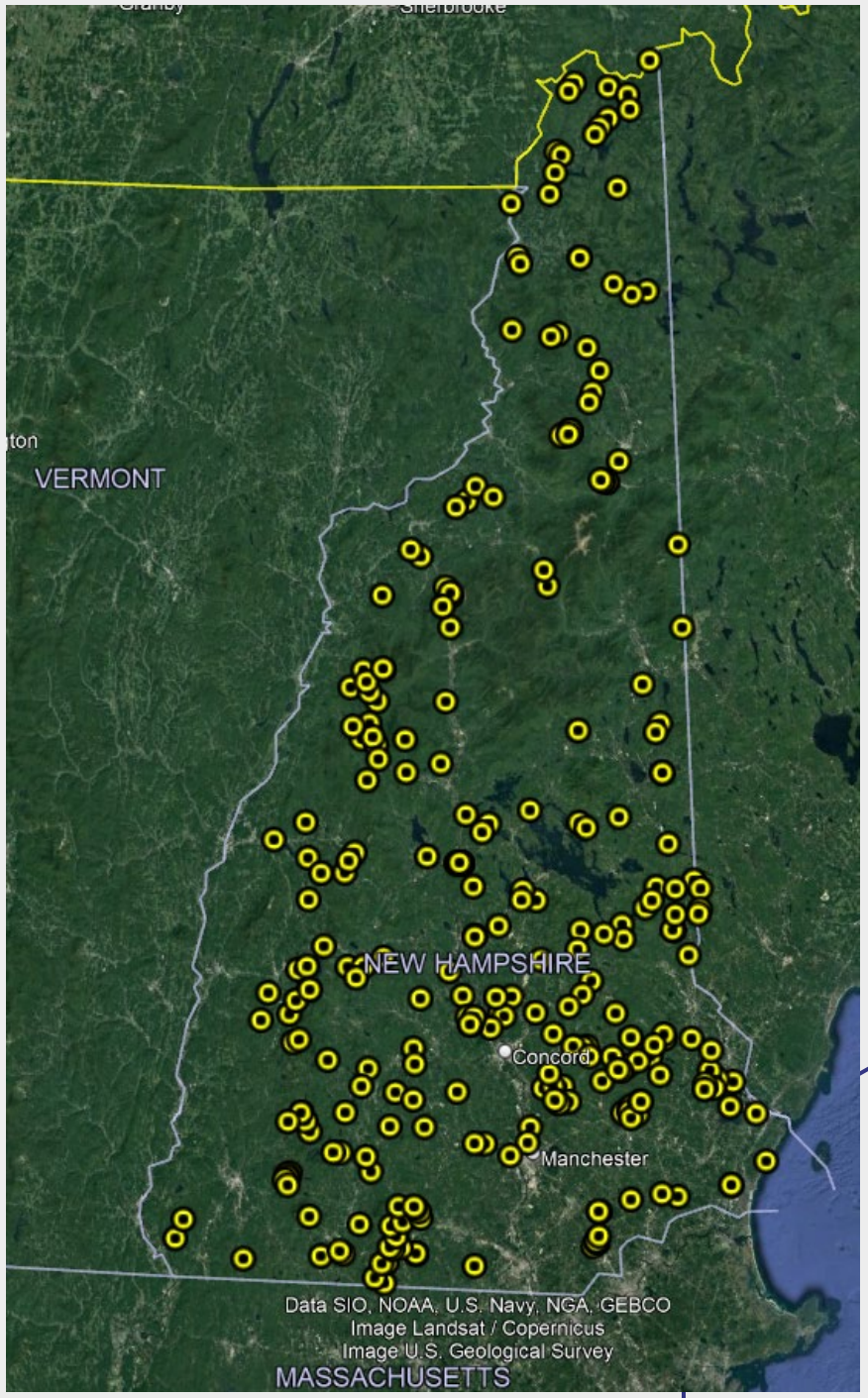





NEW HAMPSHIRE DEPARTMENT OF Environmental Services

# Engineering and Construction Section

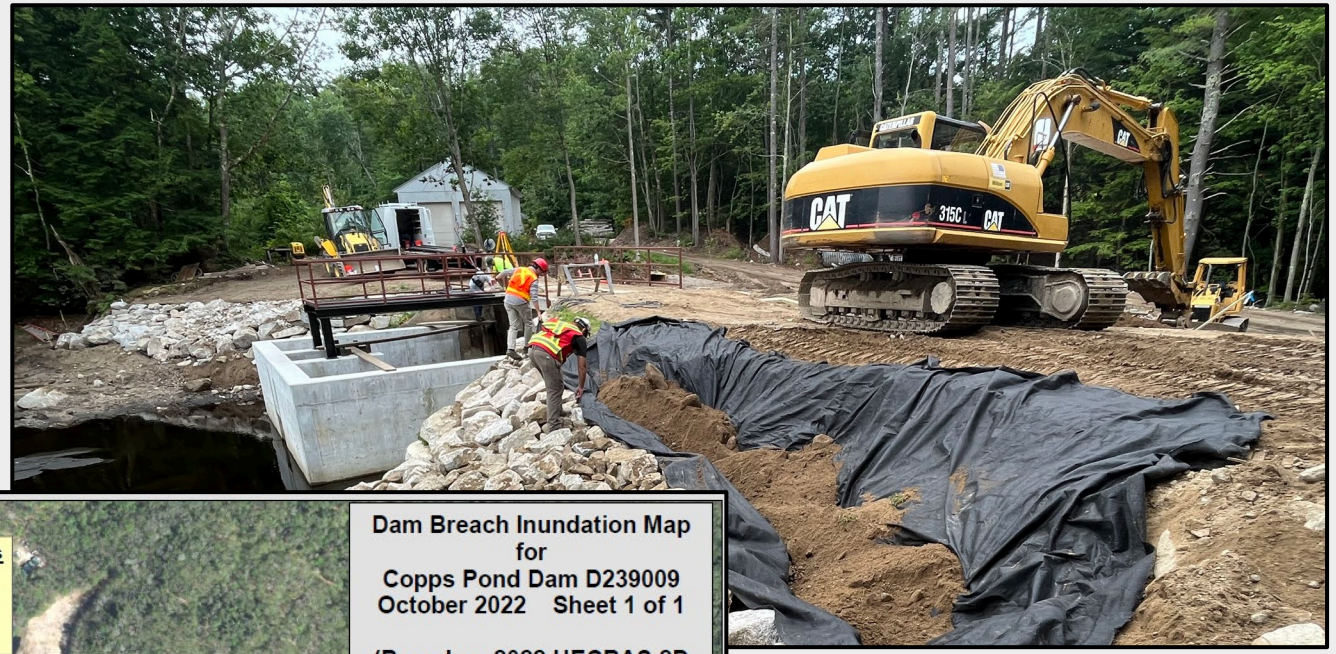
- Responsible for major repairs and reconstruction of **275 dams** on either a force account or contract basis.  This includes preparing and managing contracts, budget estimates and long-term schedules.
- Maintains ownership records and easements necessary for dam operations and repairs through the Land Management group.

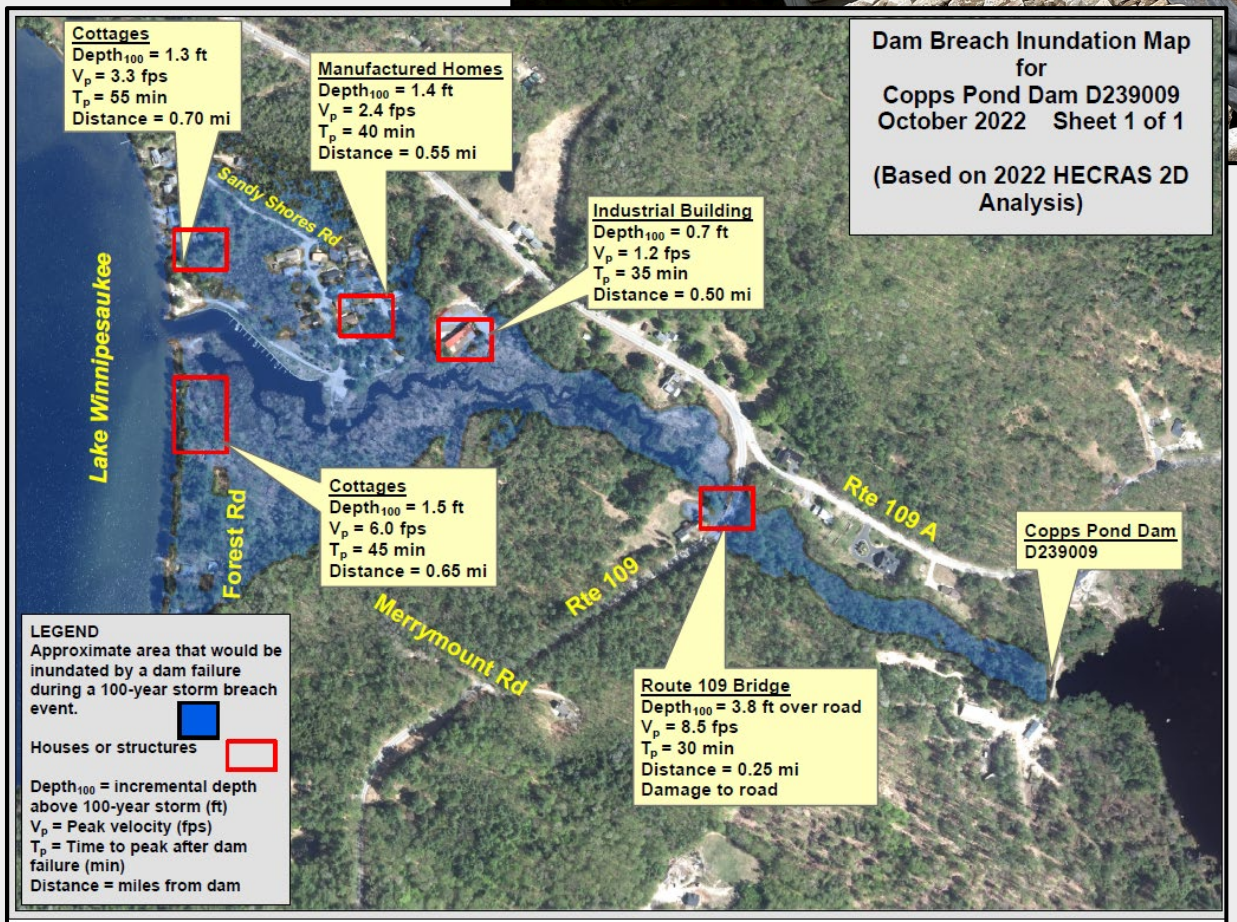



NEW HAMPSHIRE DEPARTMENT OF Environmental Services

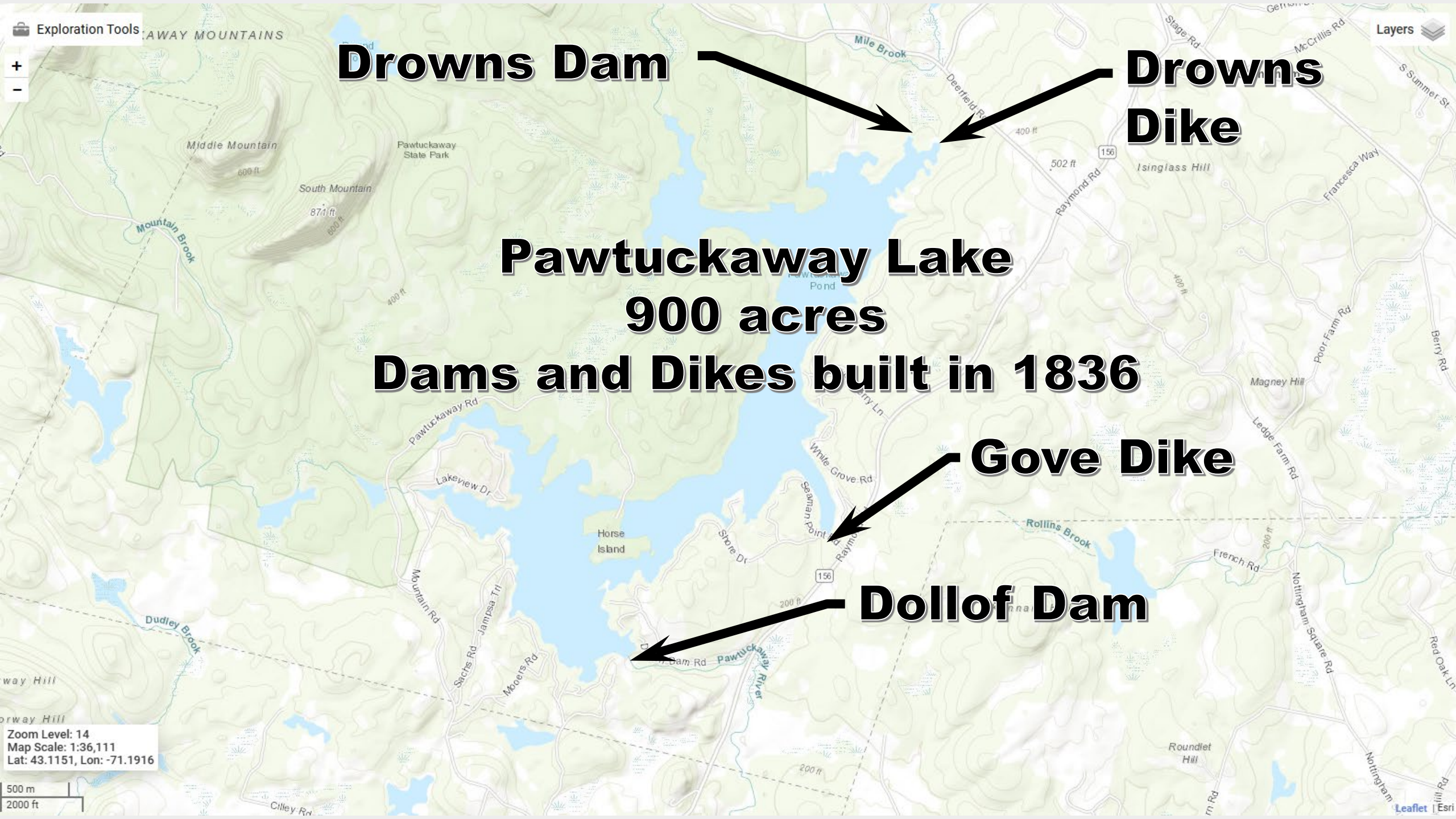
# Engineering and Construction Section

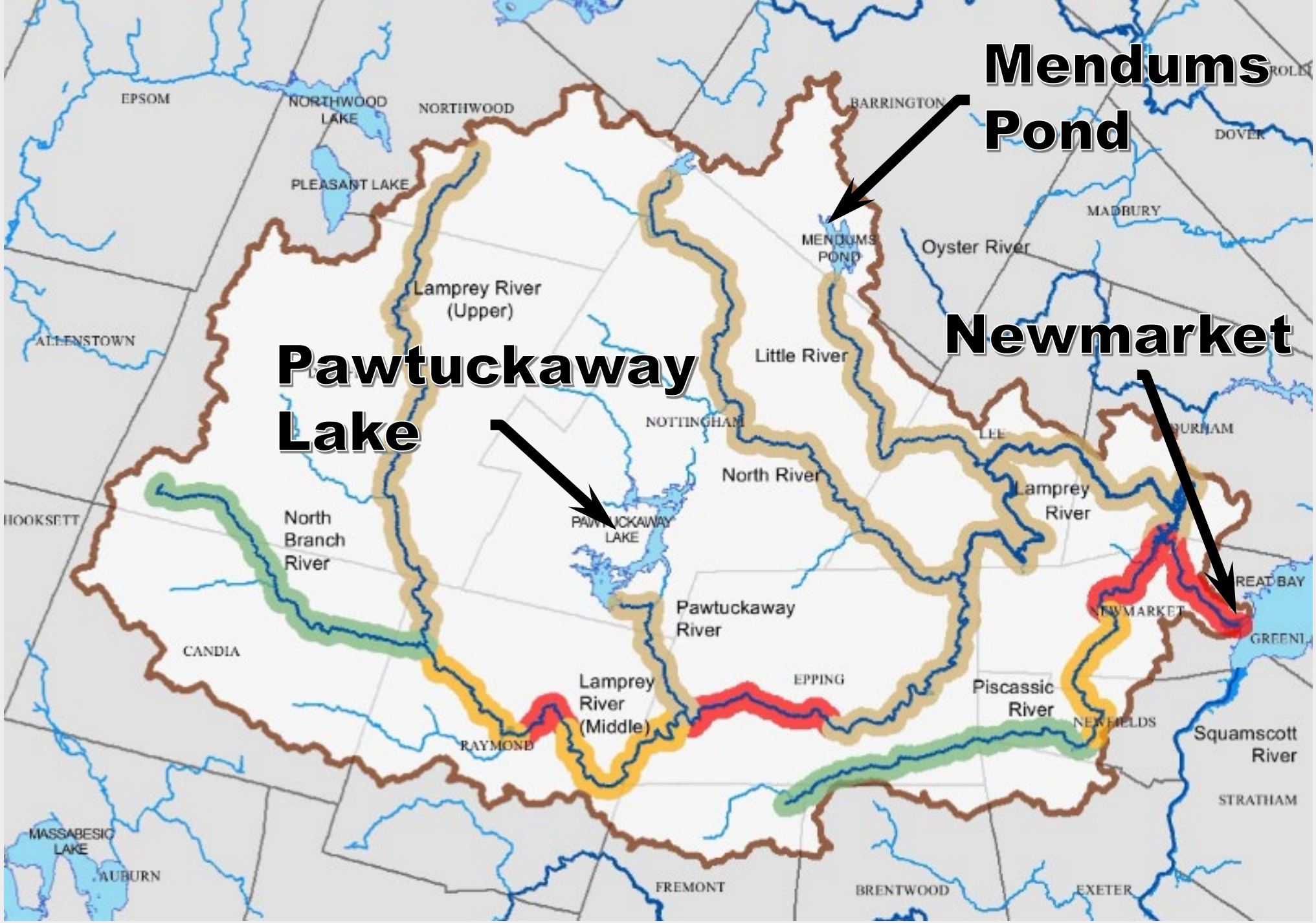
- Oversees an in-house construction crew and outside engineering and construction contracts
- Prepares Emergency Action Plans (EAP)s at 64 High and 34 Significant hazard dams.

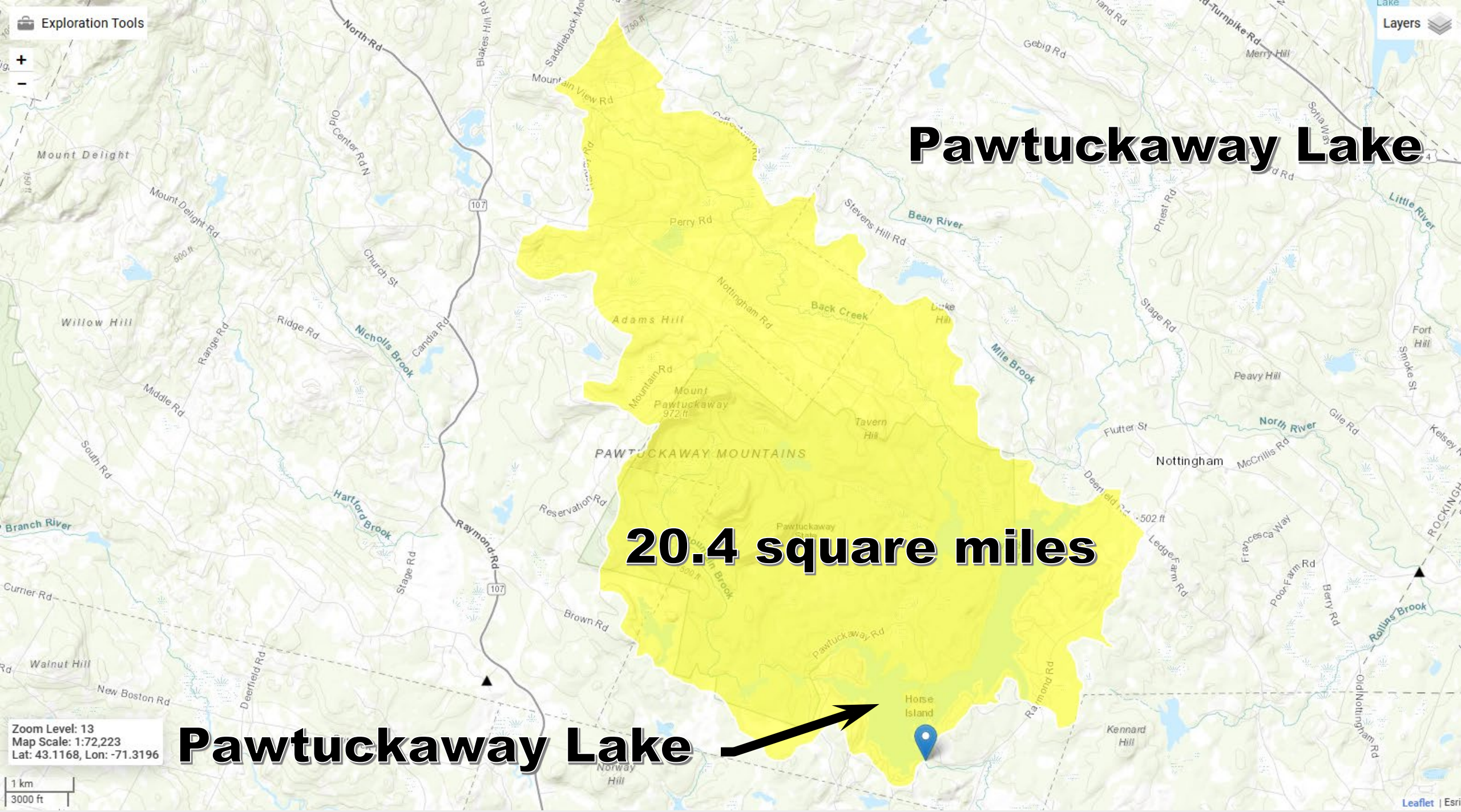


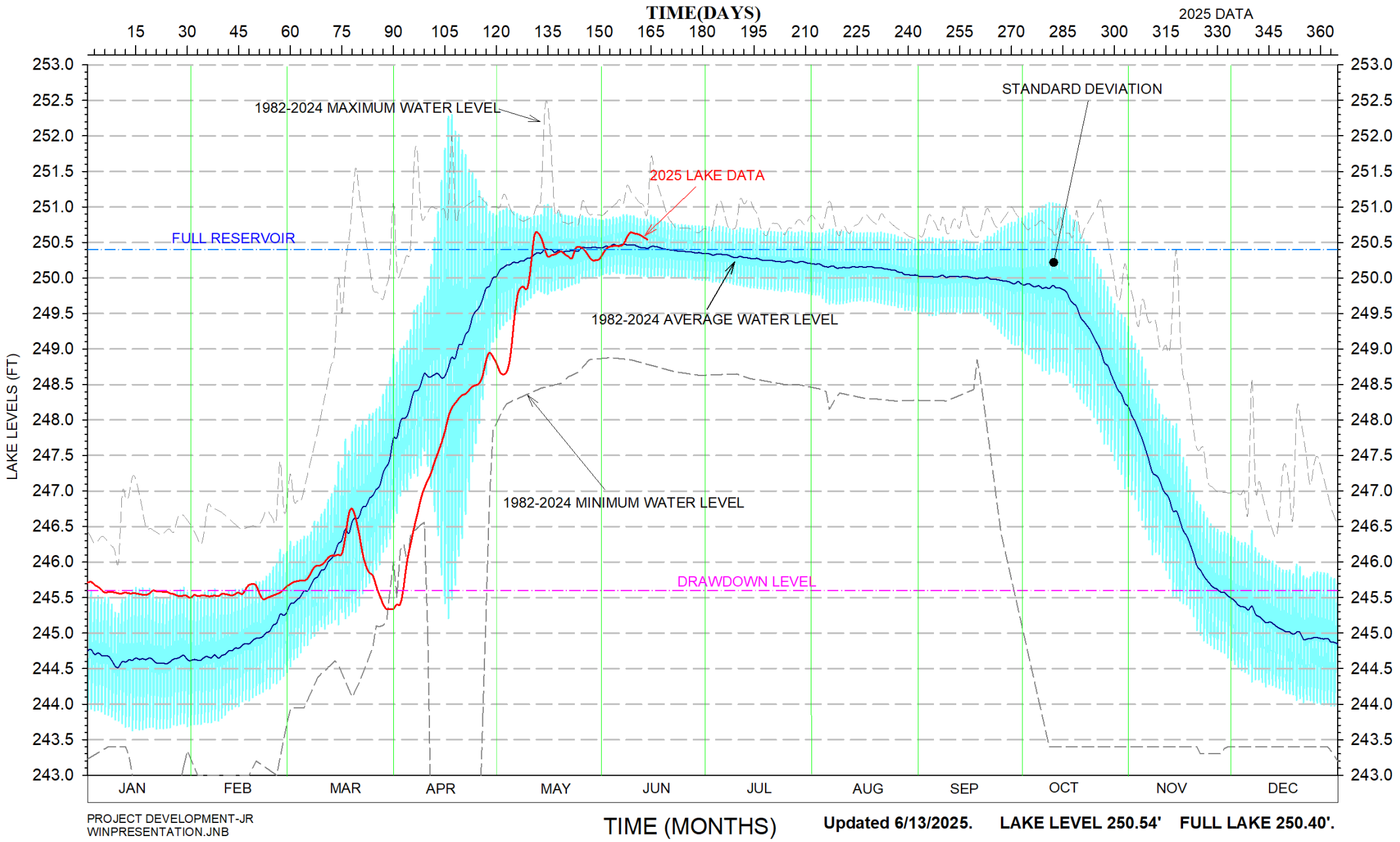

NEW HAMPSHIRE DEPARTMENT OF Environmental Services


Drowns Dam
Drowns Dike
Pawtuckaway Lake
900 acres
Dams and Dikes built in 1836
Gove Dike
Dollof Dam
Exploration Tools
Layers
Middle Mountain
Pawtuckaway State Park
South Mountain
871 ft
Mountain Brook
Mile Brook
Deerfield Rd
Stage Rd
McCrillis Rd
S Summer St
Raymond Rd
Isinglass Hill
Francesca Way
Poor Farm Rd
Berry Rd
Magney Hill
Ledge Farm Rd
Pawtuckaway Rd
Lakeview Dr
White Grove Rd
Seaman Point Rd
Shore Dr
Horse Island
Rollins Brook
French Rd
Nottingham Square Rd
Red Oak Ln
Mountain Rd
Sachs Rd
Jampsa Trl
Moores Rd
Dudley Brook
Pawtuckaway River
Roundlet Hill
Cilley Rd
Zoom Level: 14
Map Scale: 1:36,111
Lat: 43.1151, Lon: -71.1916
500 m
2000 ft
Leaflet | Esri


Mendums Pond
Newmarket
Pawtuckaway Lake
EPSOM
NORTHWOOD LAKE
NORTHWOOD
BARRINGTON
DOVER
PLEASANT LAKE
MADBURY
MENDUMS POND
Oyster River
Lamprey River (Upper)
ALLENSTOWN
Little River
NOTTINGHAM
LEE
North River
Lamprey River
HOOKSETT
North Branch River
PAWTUCKAWAY LAKE
GREAT BAY
NEWMARKET
Pawtuckaway River
CANDIA
GREENL
EPPING
Lamprey River (Middle)
Piscassic River
NEWFIELDS
Squamscott River
RAYMOND
STRATHAM
MASSABESIC LAKE
AUBURN
FREMONT
BRENTWOOD
EXETER


Exploration Tools
Layers
Pawtuckaway Lake
20.4 square miles
Pawtuckaway Lake
PAWTUCKAWAY MOUNTAINS
Mount Pawtuckaway 972 ft
Adams Hill
Tavern Hill
Horse Island
Nottingham
Mount Delight
Willow Hill
Walnut Hill
Norway Hill
Kennard Hill
Peavy Hill
Fort Hill
Perry Rd
Nottingham Rd
Back Creek
Bean River
Mile Brook
Stevens Hill Rd
Stage Rd
Flutter St
North River
Gile Rd
McCrillis Rd
Pawtuckaway Rd
Reservation Rd
Brown Rd
Currier Rd
New Boston Rd
Deerfield Rd
Raymond Rd
Hartford Brook
Nichols Brook
Ridge Rd
Range Rd
Middle Rd
South Rd
Church St
Candia Rd
Old Center Rd N
North Rd
Blakes Hill Rd
Mountain View Rd
Saddleback Mountain
Gebig Rd
Merry Hill
Priest Rd
Little River
Smoke St
Francesca Way
Poor Farm Rd
Berry Rd
Rollins Brook
Old Nottingham Rd
Ledge Farm Rd
Deerfield Rd
Zoom Level: 13
Map Scale: 1:72,223
Lat: 43.1168, Lon: -71.3196
1 km
3000 ft
Leaflet | Esri

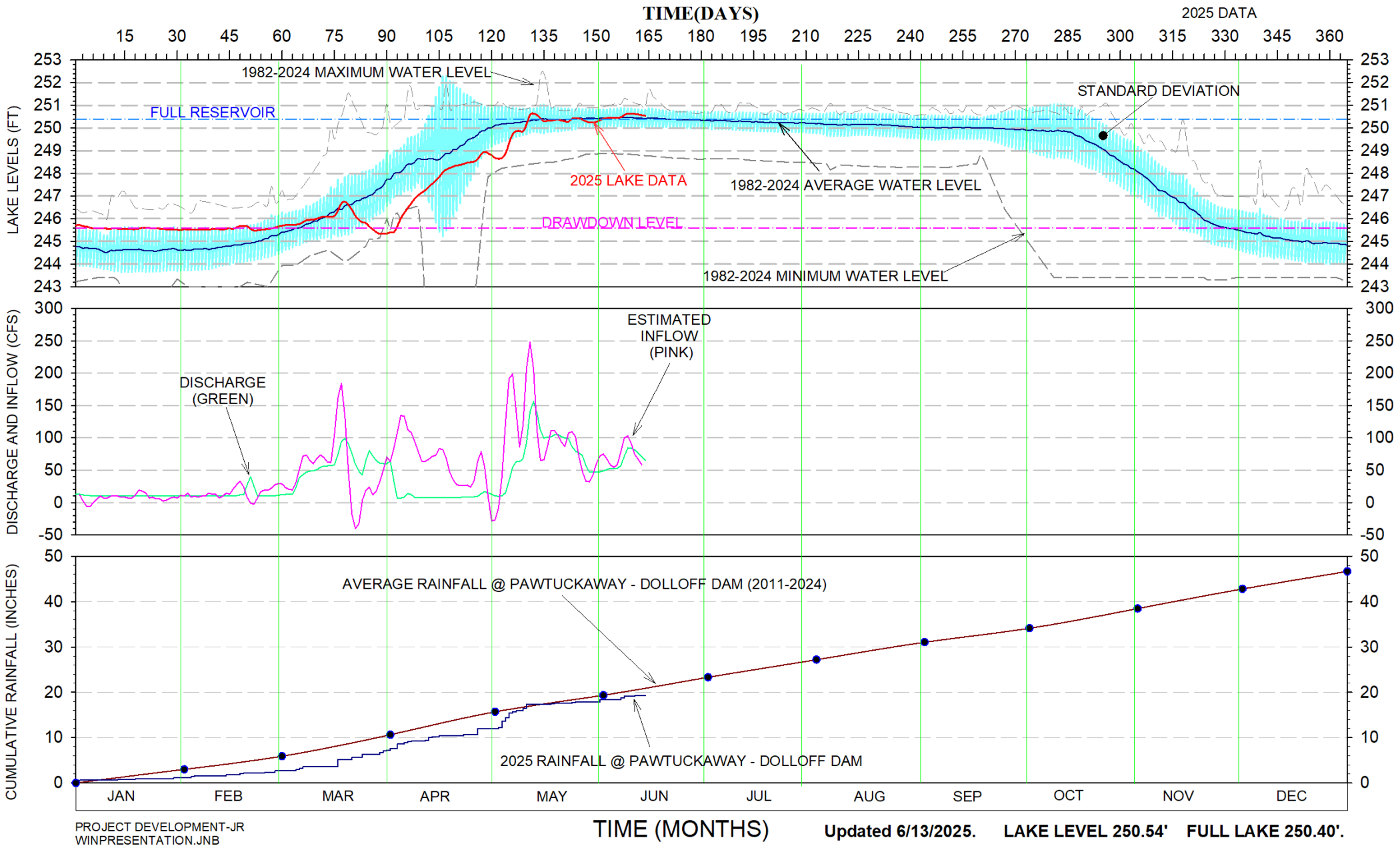
# PAWTUCKAWAY LAKE LEVEL DATA




PROJECT DEVELOPMENT-JR
WINPRESENTATION.JNB

**Updated 6/13/2025. LAKE LEVEL 250.54' FULL LAKE 250.40'.**

# PAWTUCKAWAY LAKE LEVEL DATA

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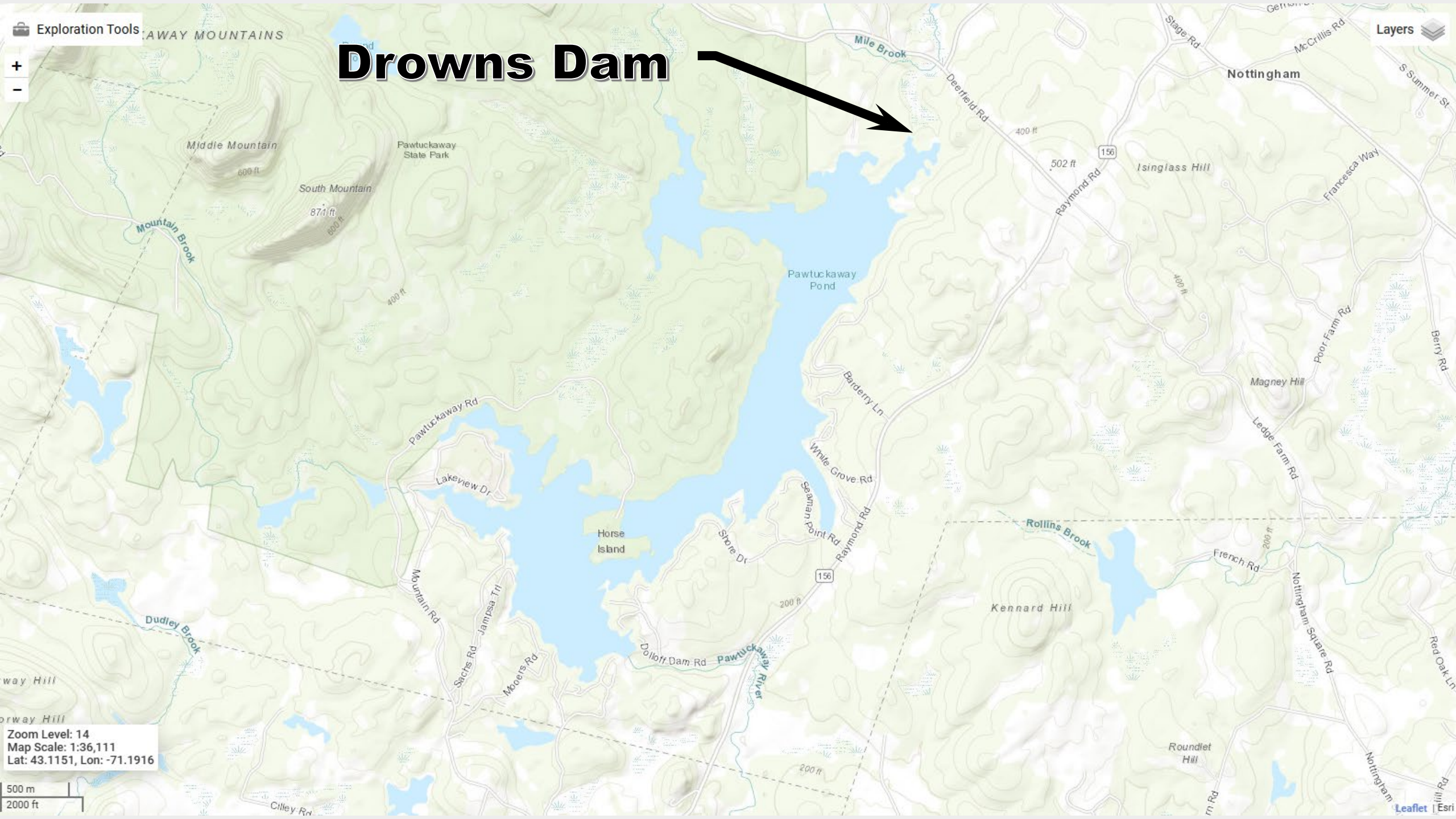
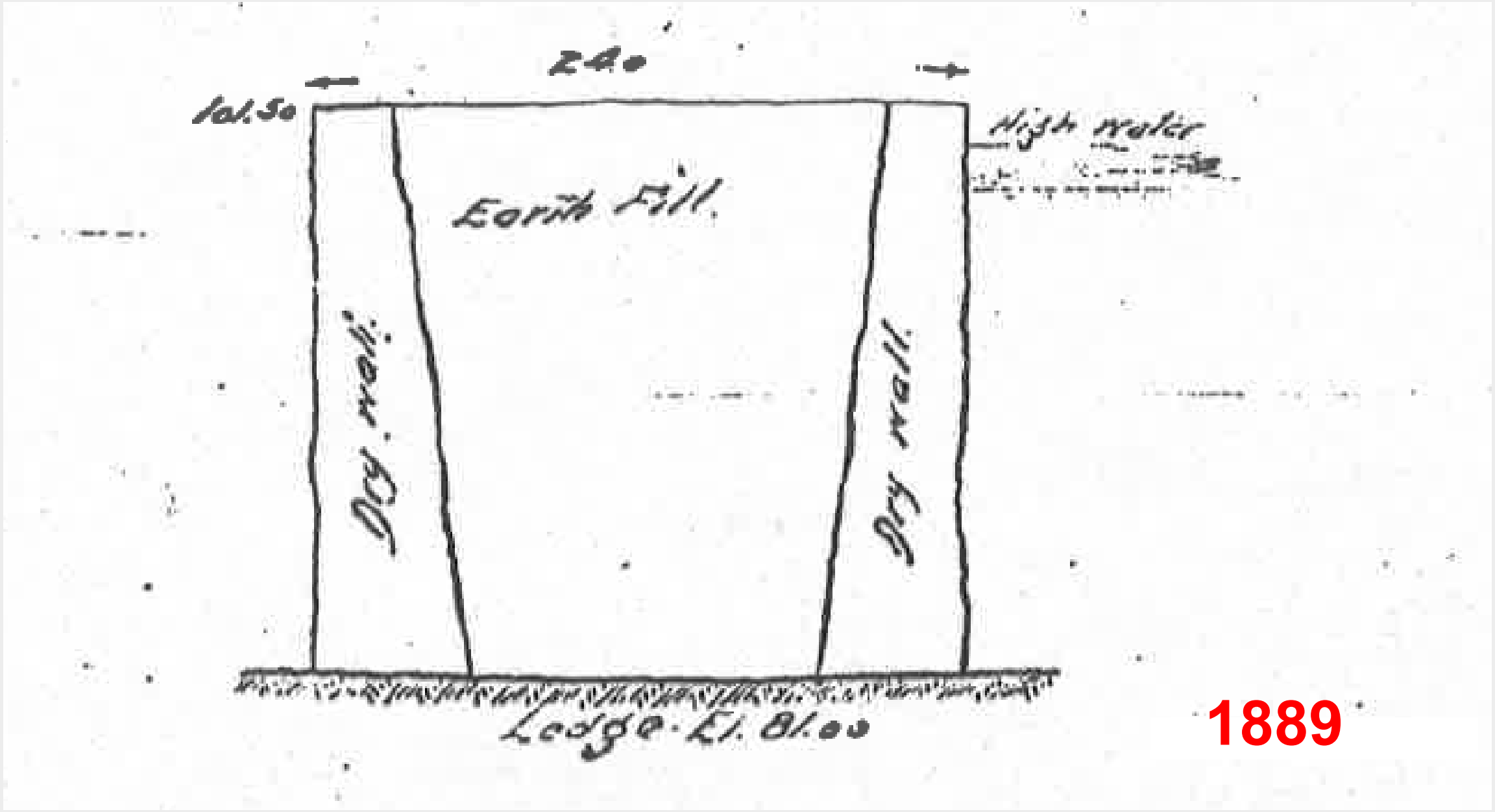
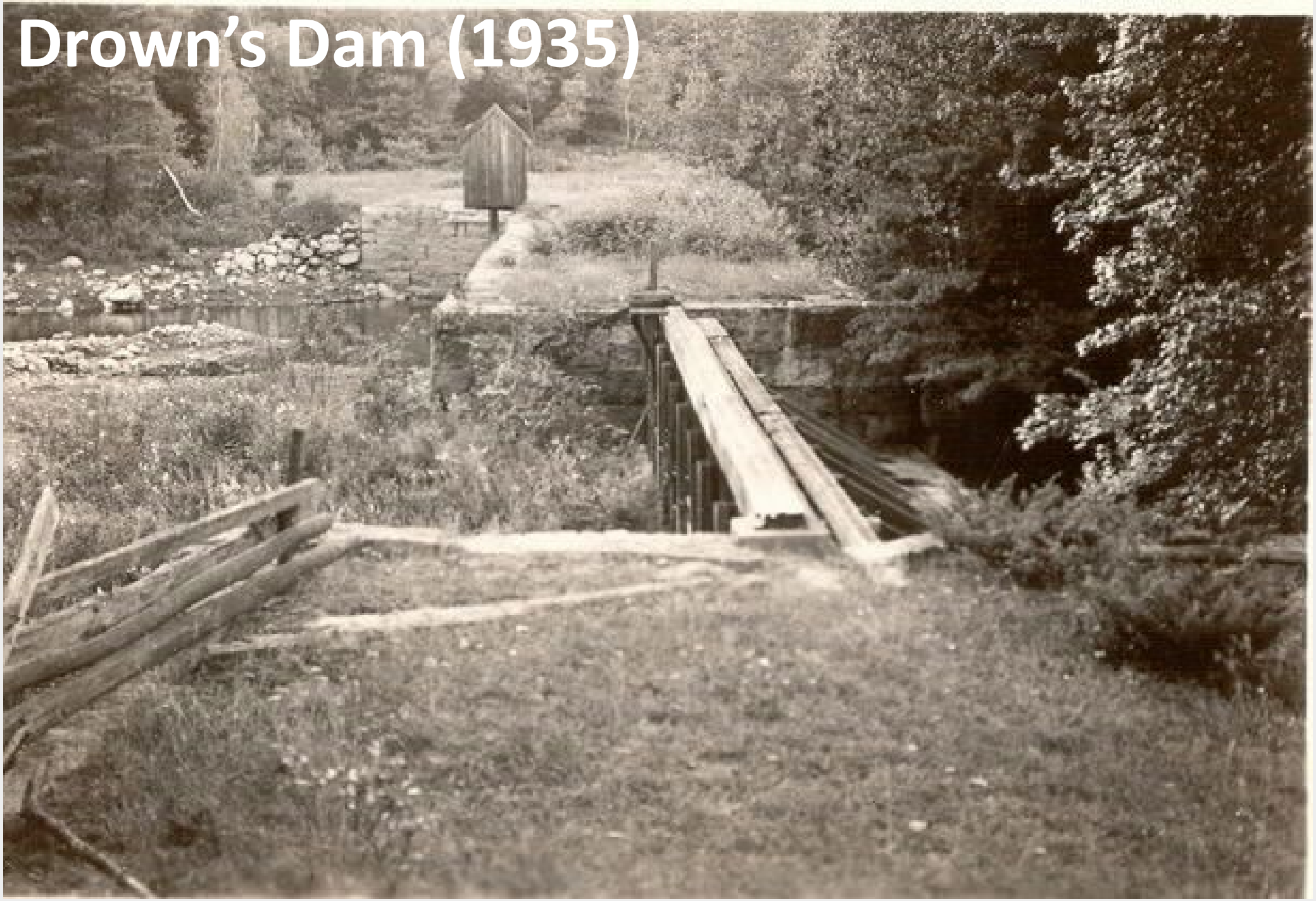
**Updated 6/13/2025. LAKE LEVEL 250.54' FULL LAKE 250.40'.**


Drowns Dam
Exploration Tools
Layers
Middle Mountain
600 ft
Pawtuckaway State Park
South Mountain
871 ft
Mountain Brook
400 ft
Pawtuckaway Pond
Mile Brook
Deerfield Rd
Stage Rd
McCrillis Rd
Nottingham
S Summer St
400 ft
502 ft
156
Raymond Rd
Isinglass Hill
Francesca Way
Poor Farm Rd
Berry Rd
Magney Hill
Ledge Farm Rd
Barberry Ln
White Grove Rd
Seaman Point Rd
Shore Dr
Horse Island
Pawtuckaway Rd
Lakeview Dr
Mountain Rd
Sachs Rd
Jampsa Trl
Moers Rd
Dudley Brook
Dolloff Dam Rd
Pawtuckaway River
200 ft
Rollins Brook
French Rd
Kennard Hill
Nottingham Square Rd
Red Oak Ln
Roundlet Hill
Cilley Rd
Zoom Level: 14
Map Scale: 1:36,111
Lat: 43.1151, Lon: -71.1916
500 m
2000 ft
Leaflet | Esri

# Drowns Dam – 18 feet tall – 235 feet long



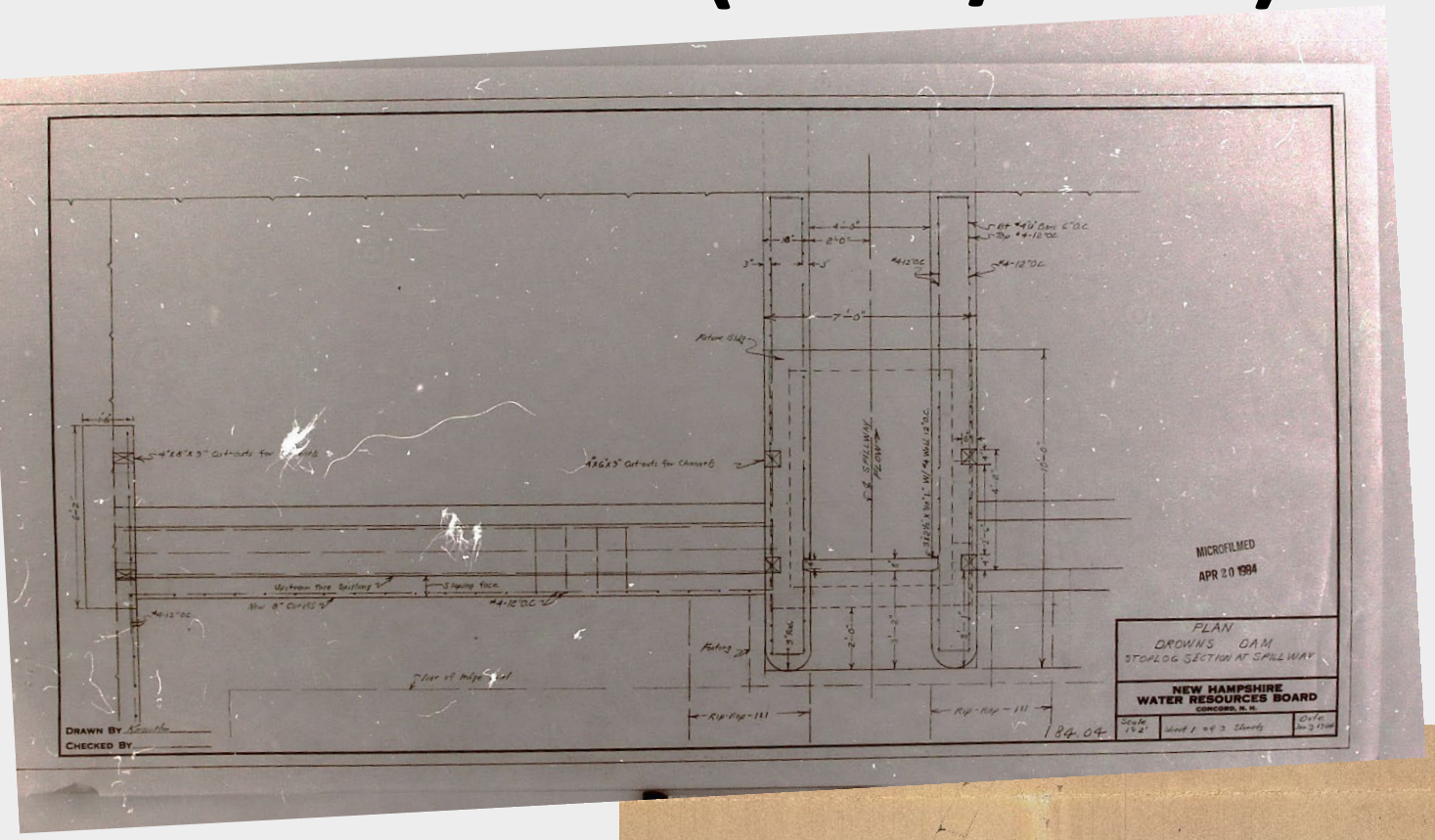
# Drown’s Dam (1935)



# Drown's Dam (1935)

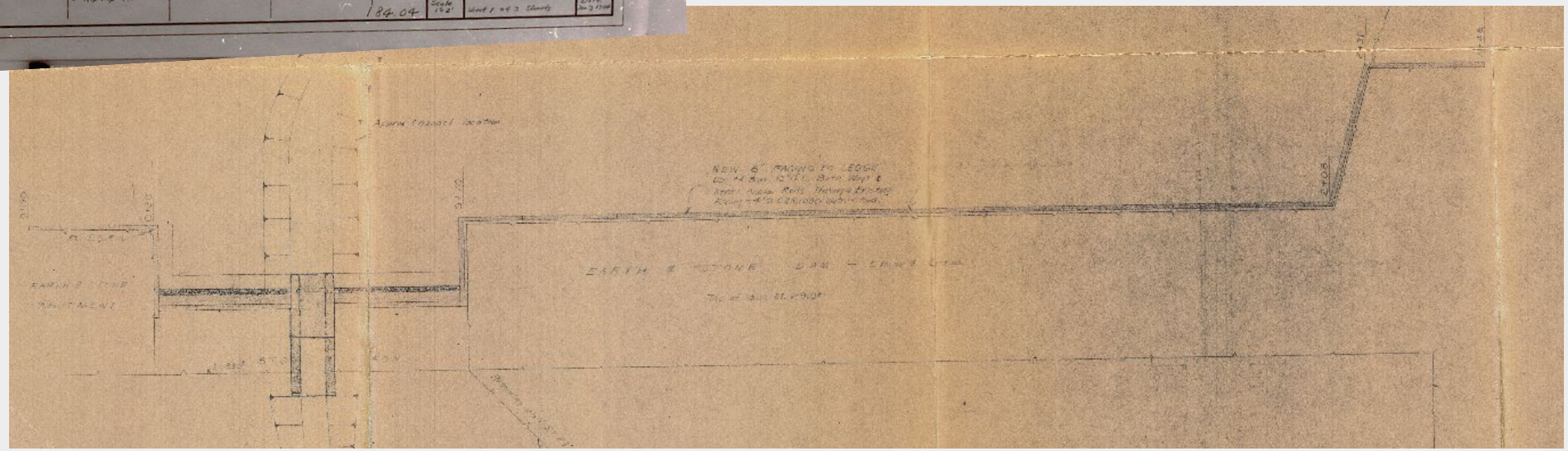
REPLACED OCT. 1939 WITH CONCRETE SECTION

# Drowns Dam (1963/1964)



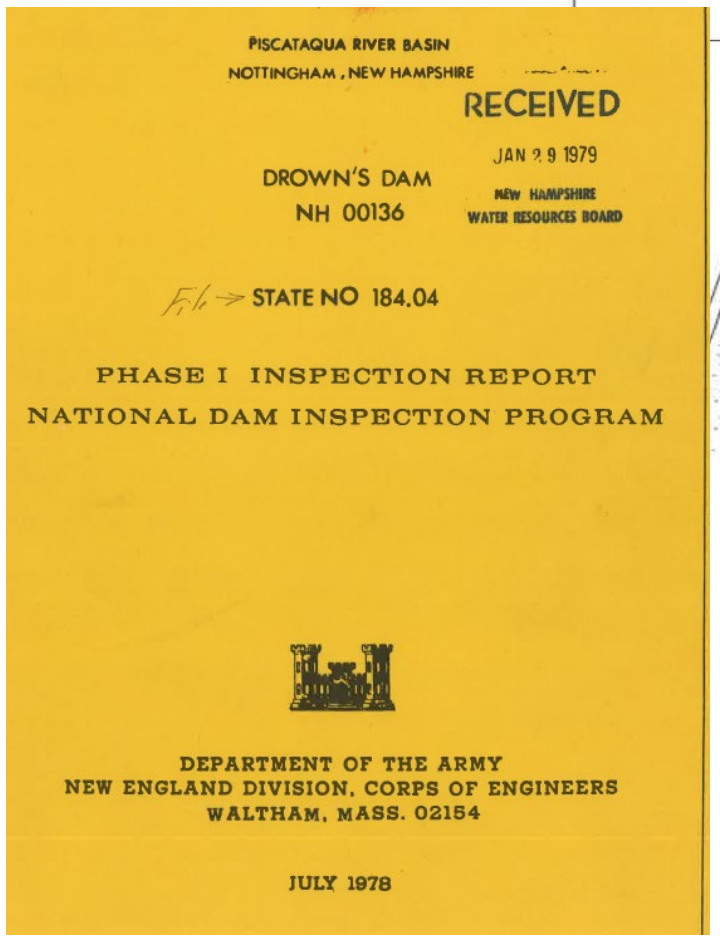

1963 – new concrete facing

1964 – new concrete spillway and stoplog bay



**Seepage through the old penstock opening.

**Seepage through and/or under the dam.


PISCATAQUA RIVER BASIN
NOTTINGHAM, NEW HAMPSHIRE

RECEIVED
JAN 29 1979
NEW HAMPSHIRE
WATER RESOURCES BOARD

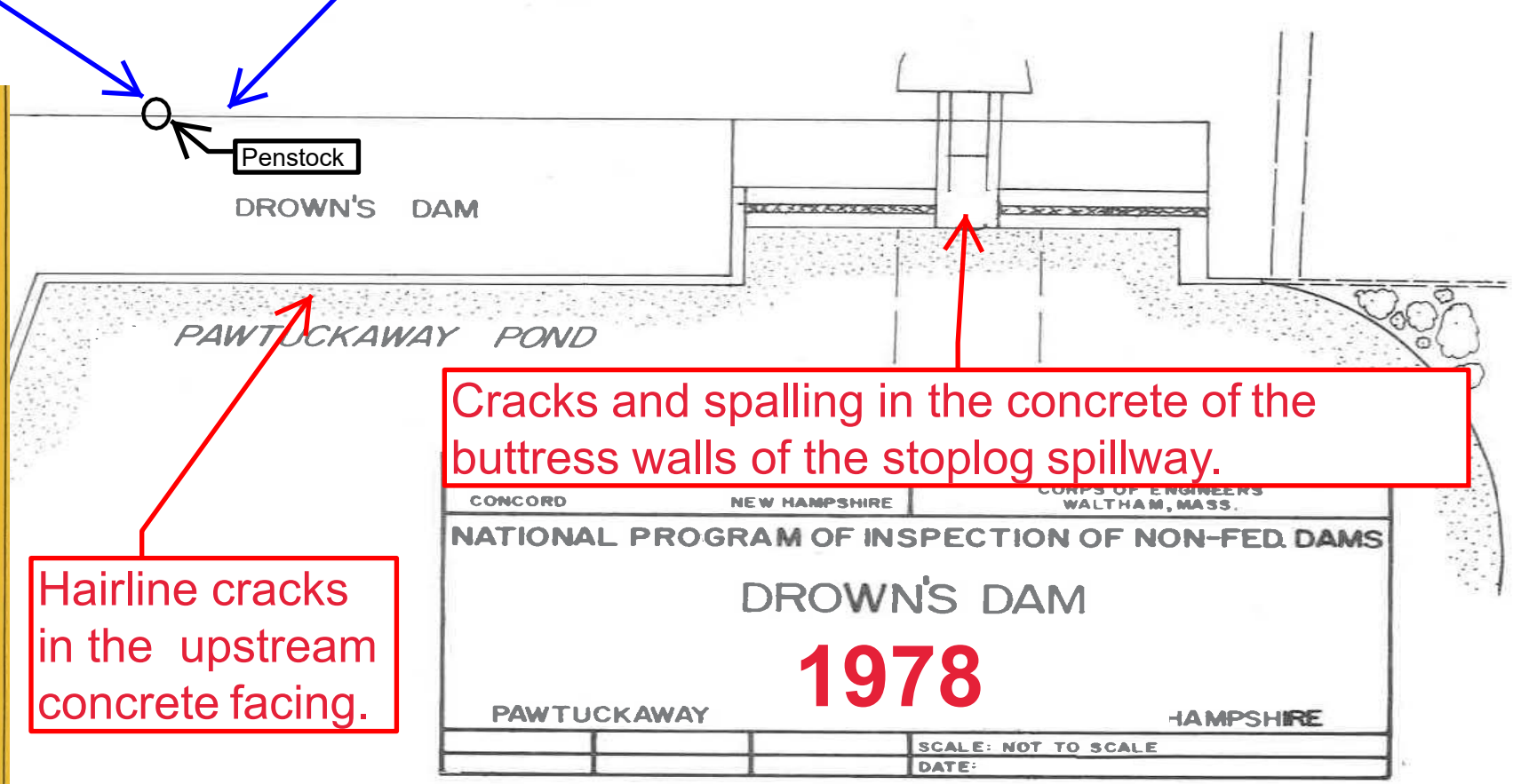
DROWN'S DAM
NH 00136

STATE NO 184.04

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

JULY 1978




Cracks and spalling in the concrete of the buttress walls of the stoplog spillway.

Hairline cracks in the upstream concrete facing.

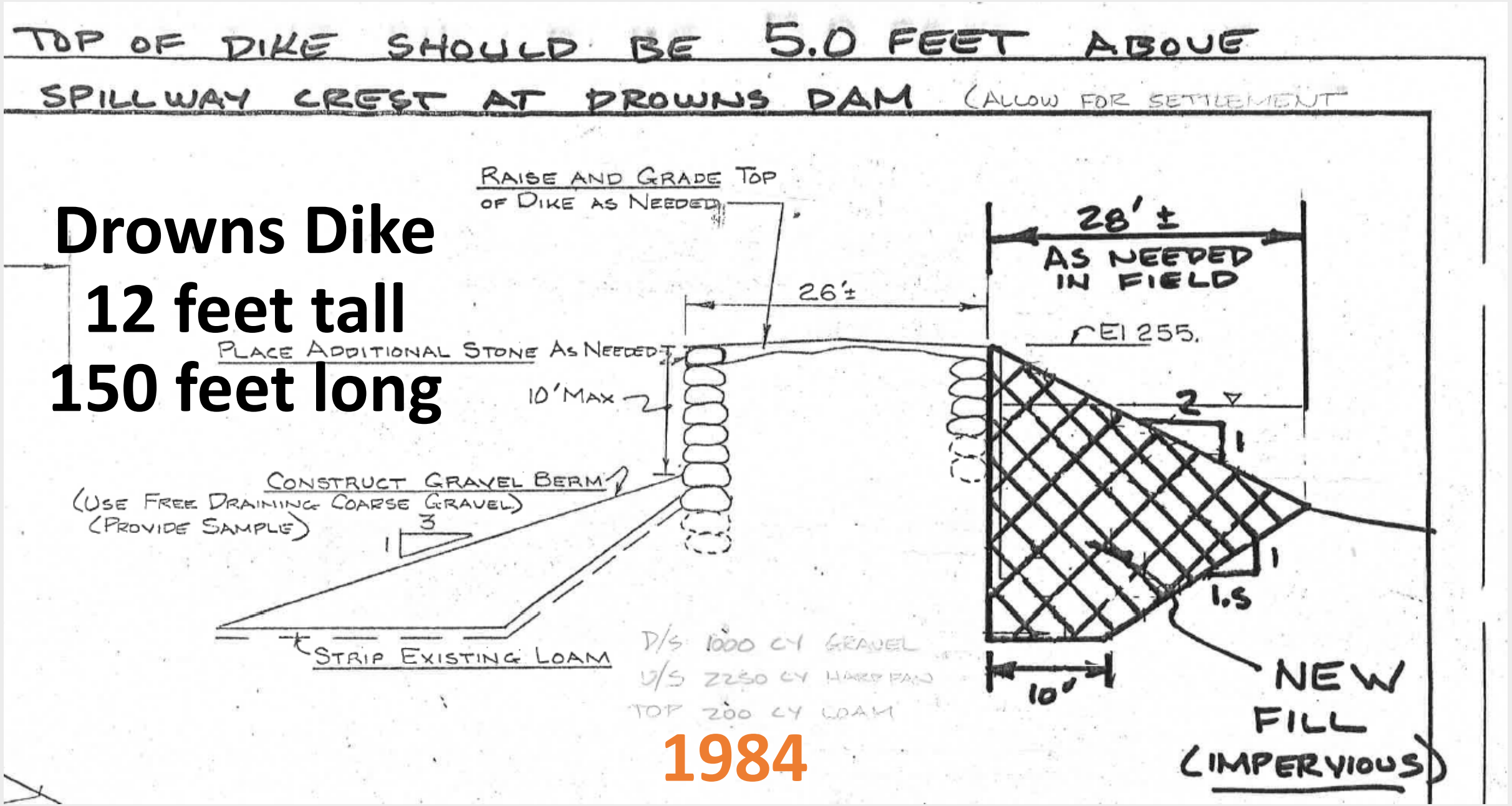

1985
https://pawtuckawaylake.com/photos/1985-lake-drawdown/#bwg4/439

# Drowns Dam (2011)


Photograph 5 – Concrete pumper truck used for wall pour.

# Drowns Dam (2020)


Drowns Dike
Exploration Tools
Layers
Round Pond
Middle Mountain
600 ft
Pawtuckaway State Park
South Mountain
871 ft
Mountain Brook
400 ft
Mile Brook
Deerfield Rd
Stage Rd
McCrillis Rd
S Summer St
400 ft
502 ft
156
Raymond Rd
Isinglass Hill
Francesca Way
Pawtuckaway Pond
Barberry Ln
Poor Farm Rd
Berry Rd
Magney Hill
Ledge Farm Rd
Pawtuckaway Rd
Lakeview Dr
White Grove Rd
Seaman Point Rd
Horse Island
Shore Dr
Rollins Brook
French Rd
200 ft
Nottingham Square Rd
Red Oak Ln
Mountain Rd
Sachs Rd
Jampsa Trl
Moers Rd
Dudley Brook
Dolloff Dam Rd
Pawtuckaway River
Kennard Hill
Roundlet Hill
Nottingham
Cilley Rd
Zoom Level: 14
Map Scale: 1:36,111
Lat: 43.1151, Lon: -71.1916
500 m
2000 ft
Leaflet | Esri

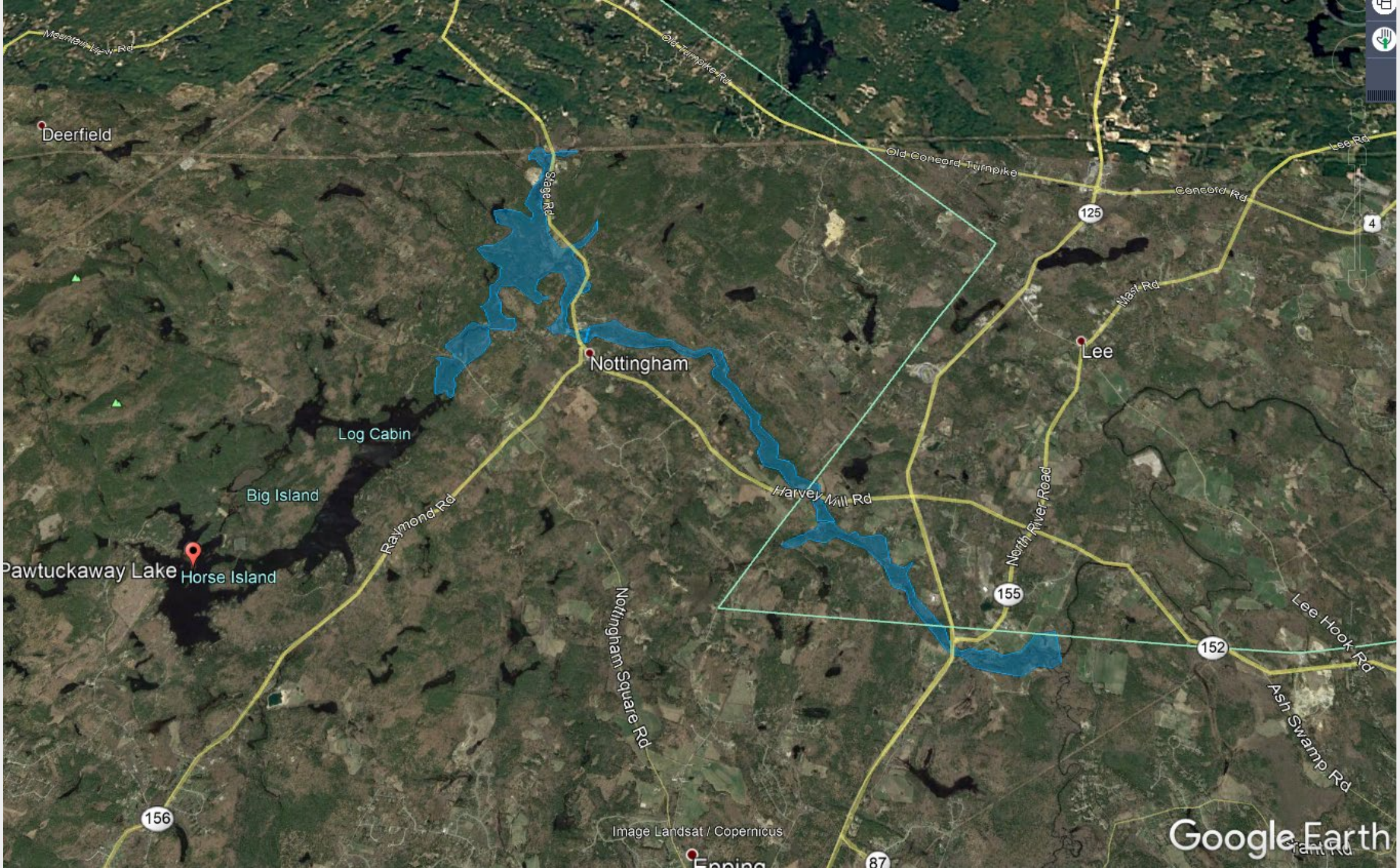



**Drowns Dike**
**12 feet tall**
**150 feet long**

1984

# Drowns Dike Reconstruction (1985)

# Drowns Dike


Deerfield
Old Concord Turnpike
Concord Rd
Lee Rd
Stage Rd
Nottingham
Lee
Mast Rd
125
4
Log Cabin
Big Island
Raymond Rd
Harvey Mill Rd
North River Road
Pawtuckaway Lake
Horse Island
155
Lee Hook Rd
152
Nottingham Square Rd
Ash Swamp Rd
156
Image Landsat / Copernicus
Google Earth


Exploration Tools
Layers
Gove Dike
Pawtuckaway Pond
Horse Island
Middle Mountain
South Mountain
871 ft
Pawtuckaway State Park
Round Pond
Mountain Brook
Dudley Brook
Pawtuckaway Rd
Lakeview Dr
Mountain Rd
Sachs Rd
Jampsa Trl
Moers Rd
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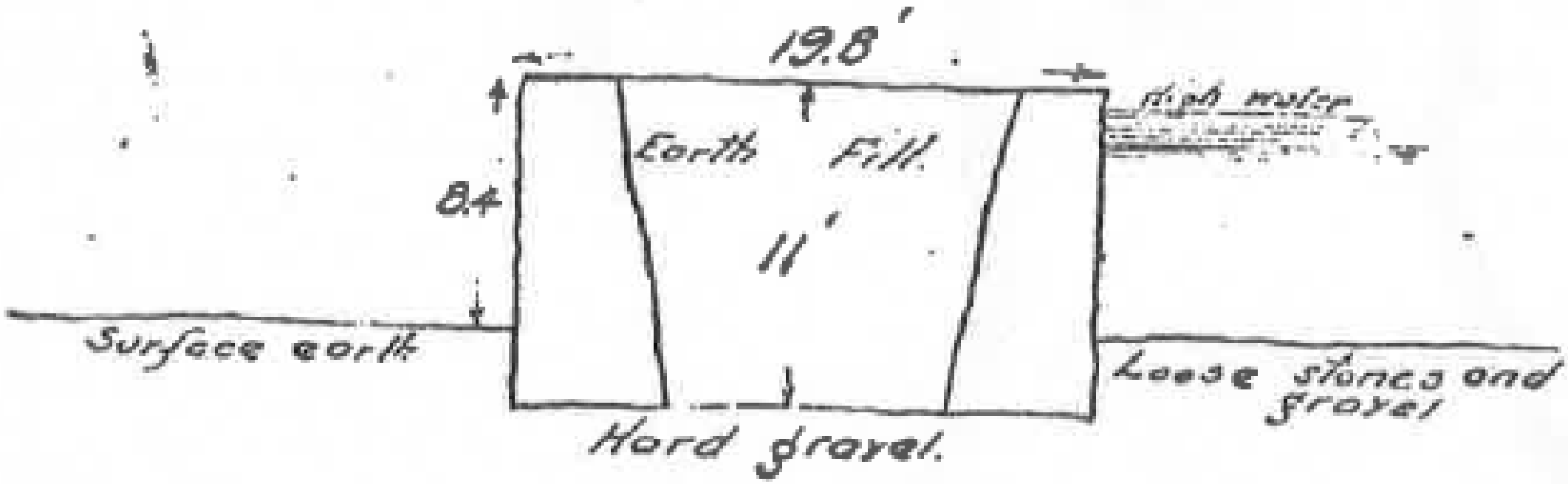
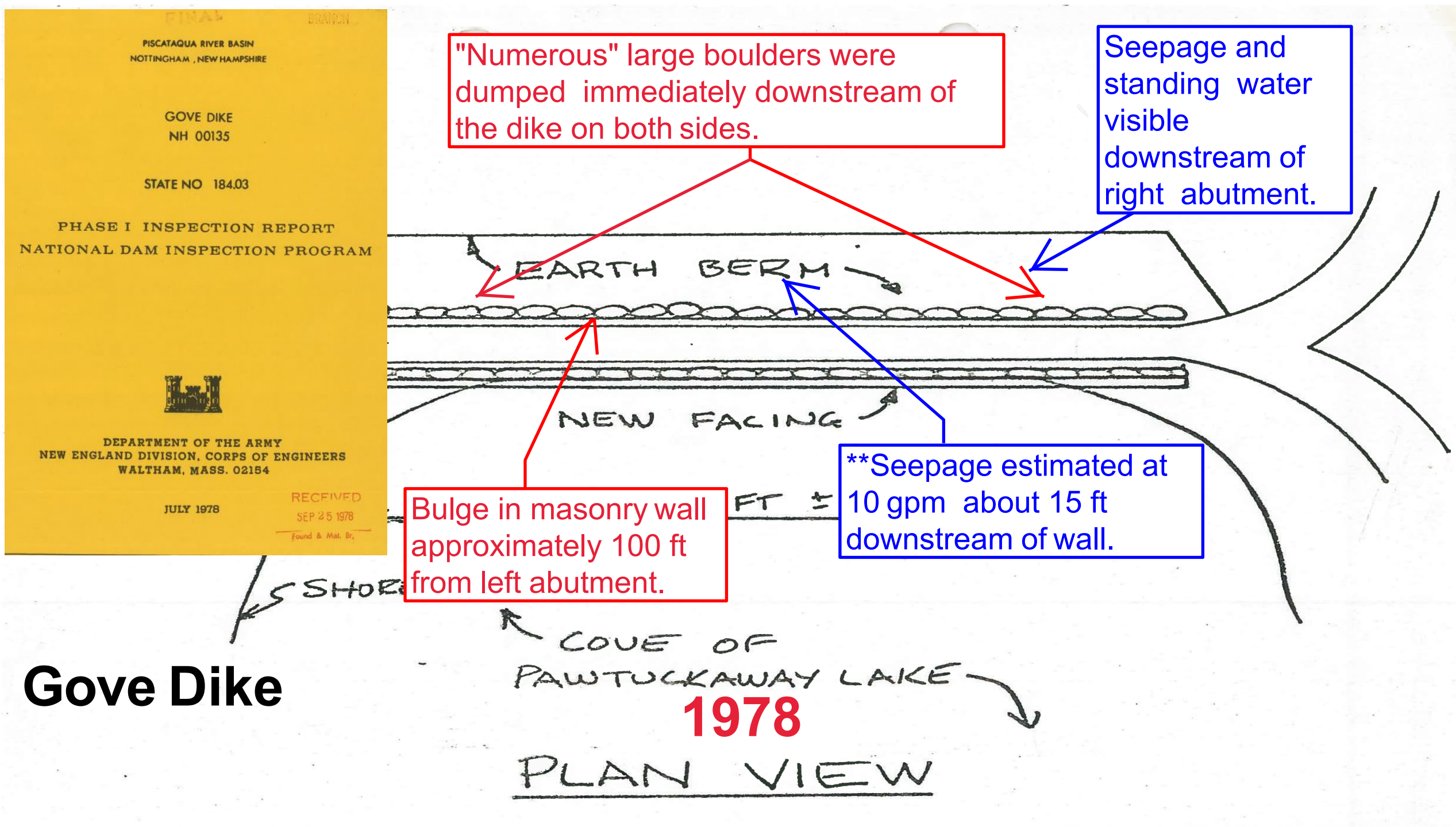
Raymond Rd
Nottingham
Stage Rd
McCrillis Rd
S Summer St
Isinglass Hill
Francesca Way
Poor Farm Rd
Berry Rd
Magney Hill
Ledge Farm Rd
Rollins Brook
French Rd
Nottingham Square Rd
Red Oak Ln
Kennard Hill
Roundlet Hill
Cilley Rd
156
400 ft
200 ft
600 ft
502 ft
Zoom Level: 14
Map Scale: 1:36,111
Lat: 43.1151, Lon: -71.1916
500 m
2000 ft
Leaflet | Esri

# Gove Dike - 9 feet tall - 330 feet long



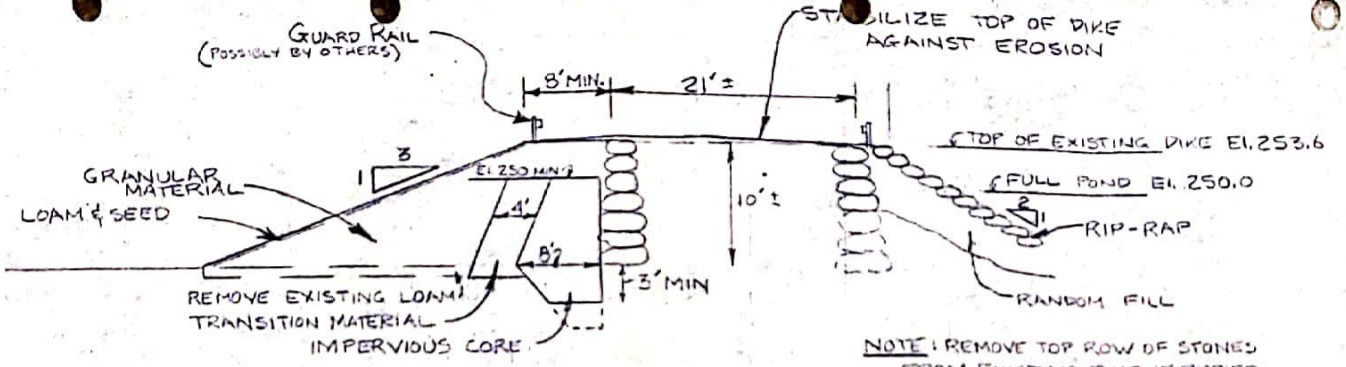

1889

1940


PISCATAQUA RIVER BASIN
NOTTINGHAM , NEW HAMPSHIRE
GOVE DIKE
NH 00135
STATE NO 184.03
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154
JULY 1978
RECEIVED
SEP 25 1978
"Numerous" large boulders were dumped immediately downstream of the dike on both sides.
Seepage and standing water visible downstream of right abutment.
EARTH BERM
NEW FACING
**Seepage estimated at 10 gpm about 15 ft downstream of wall.
Bulge in masonry wall approximately 100 ft from left abutment.
FT ±
SHORE
COVE OF
PAWTUCKAWAY LAKE
1978
PLAN VIEW

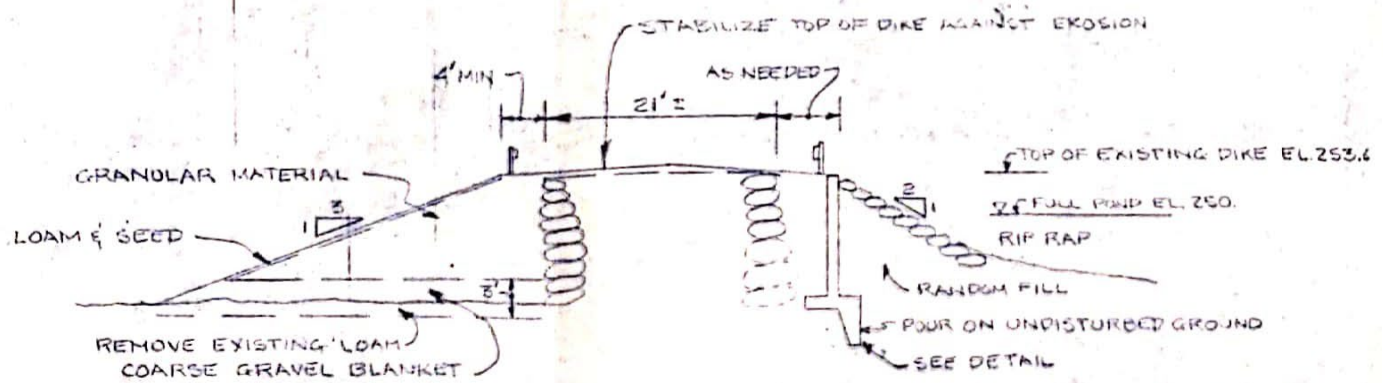
# Gove Dike

# 1983



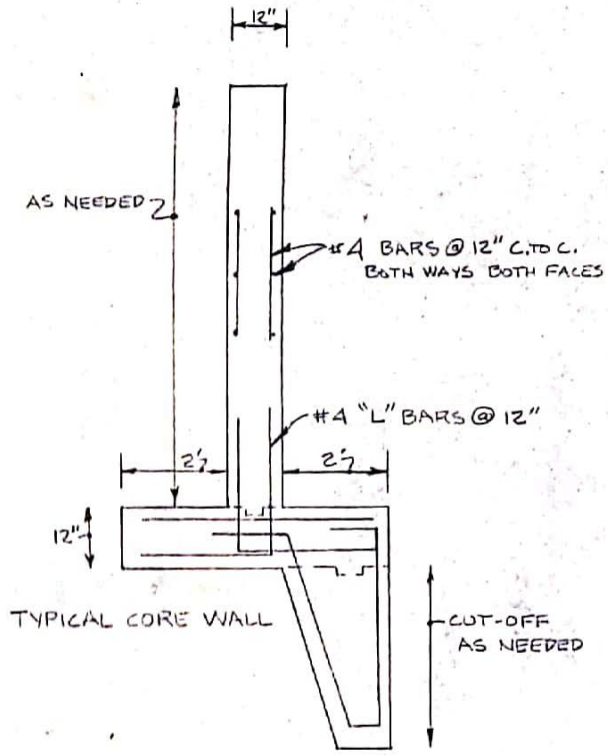

NOTE: REMOVE TOP ROW OF STONES FROM EXISTING DIKE IF BURIED.

## TYPICAL SECTION
### ALT 1




NOTE: REMOVE TOP ROW OF STONES FROM EXISTING DIKE IF BURIED

## TYPICAL SECTION
### ALT 2




DRAWN BY KEN STORN

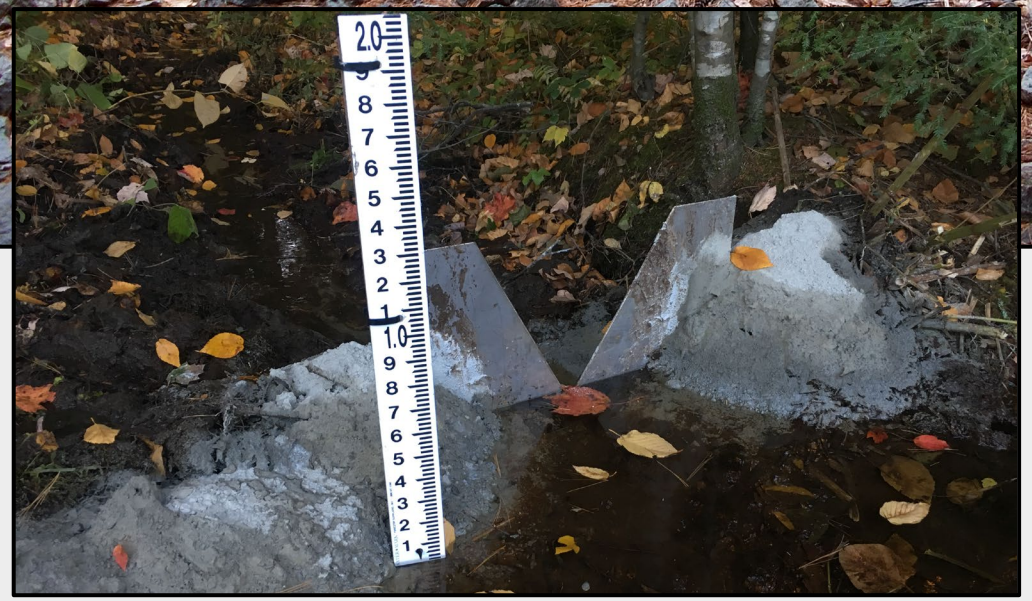
CHECKED BY

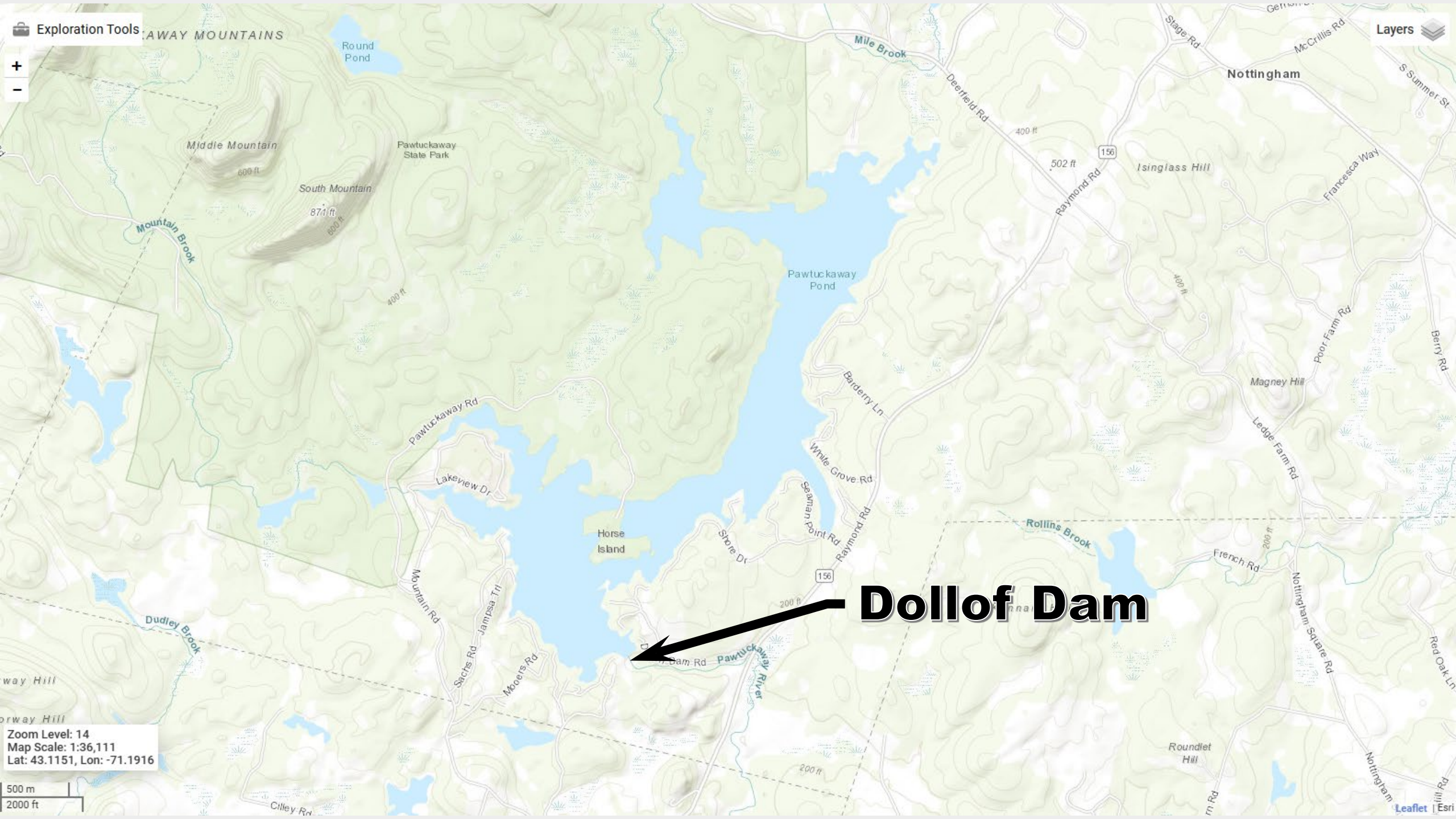
GOVE DIKE REPAIRS

NEW HAMPSHIRE WATER RESOURCES BOARD
CONCORD, N. H.

| 184.03 | NOTTINGHAM | 12/83 |
|---|---|---|

# Gove Dike





Exploration Tools
Layers
Dollof Dam
Pawtuckaway Pond
Horse Island
Pawtuckaway State Park
Round Pond
Middle Mountain
South Mountain
871 ft
Mountain Brook
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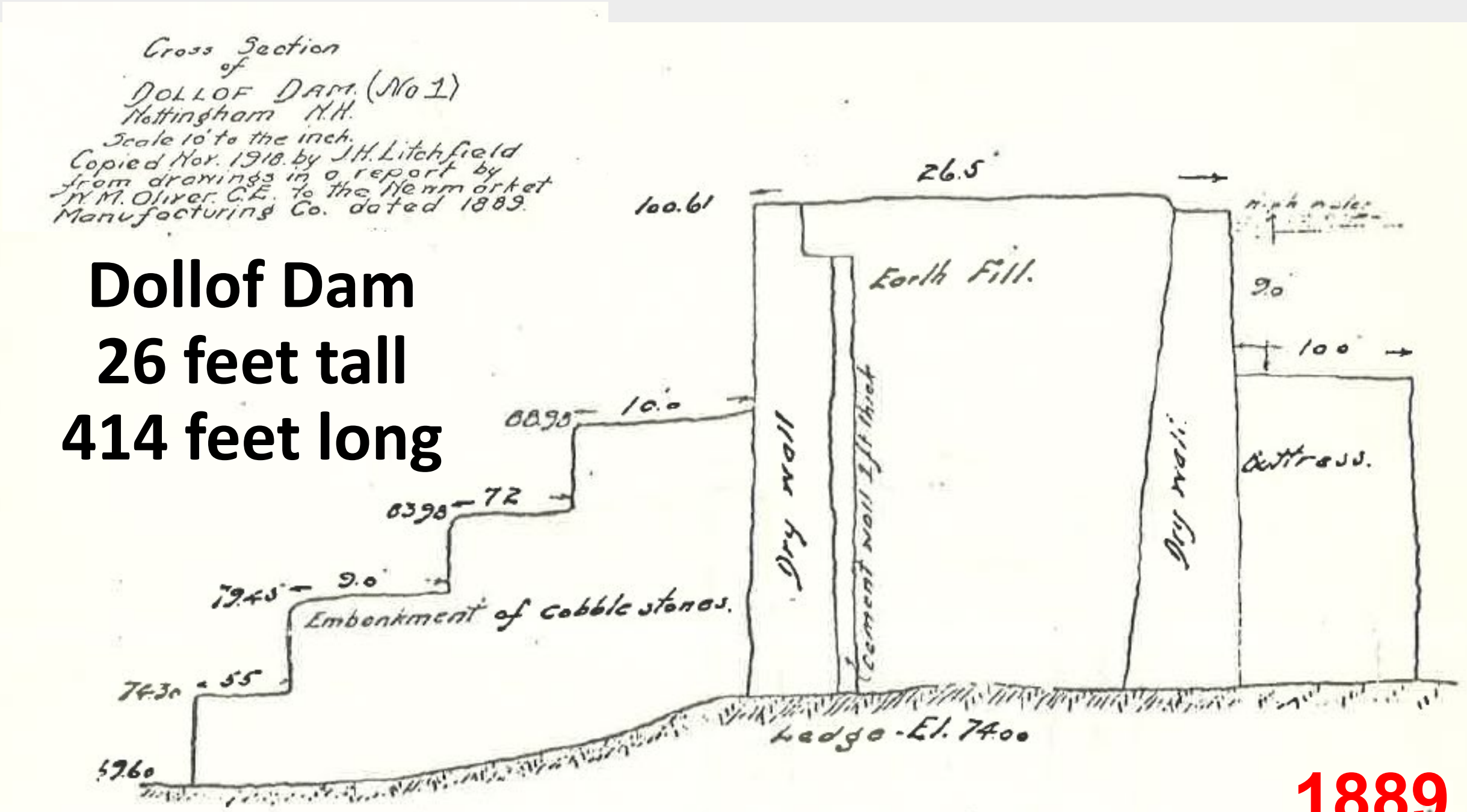
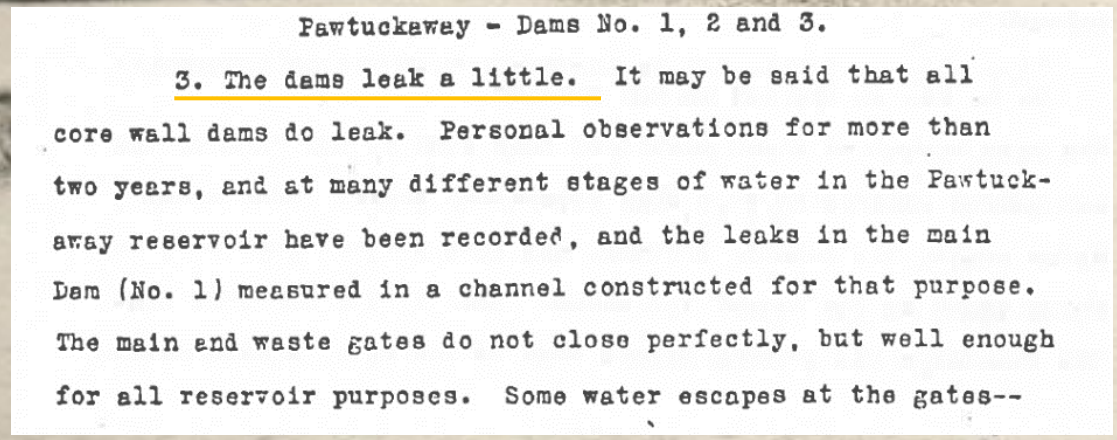



**Dollof Dam**
**26 feet tall**
**414 feet long**

**1889**

# Dolloff Dam (1918)

# Dolloff Dam (1918)



Pawtuckaway - Dams No. 1, 2 and 3.

3. The dams leak a little. It may be said that all core wall dams do leak. Personal observations for more than two years, and at many different stages of water in the Pawtuckaway reservoir have been recorded, and the leaks in the main Dam (No. 1) measured in a channel constructed for that purpose. The main and waste gates do not close perfectly, but well enough for all reservoir purposes. Some water escapes at the gates--

Report from H.F. Dunham, December 1918

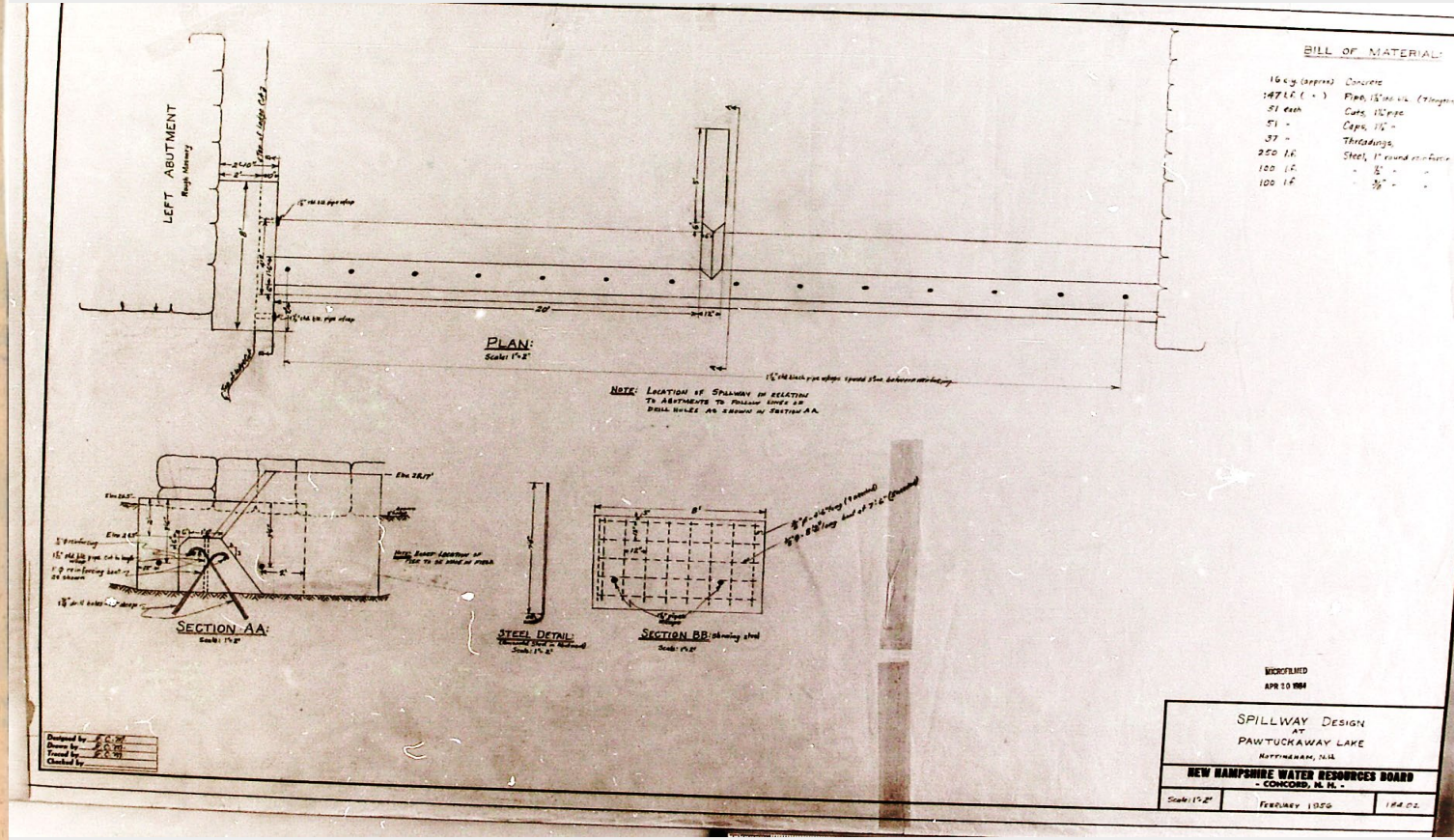
## In 1918:

- 20”x50” main gate at original level of stream
- (2) 3’x3’ waste gates

# Dolloff Dam Spillway Reconstruction (1956)

MPSHIRE SUNDAY NEWS, NOVEMBER 12, 1950

**PAWTUCKWAY POND** (above) looks like barren wasteland this weekend but, electric company officials say, this is the last time it will appear in such condition. After repairs to the dam, the firm has agreed to maintain a 10-foot winter and 18-foot summer water level. Hans Brustle, local resident, is working with his wheelbarrow where he would ordinarily be fishing from his row boat.




154 cubic yards of ledge blasted from spillway to increase capacity

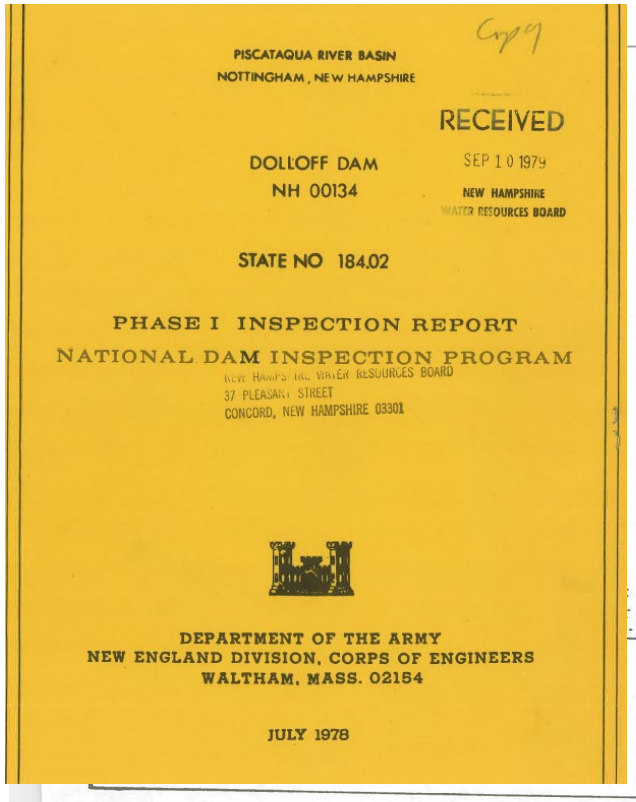

Completed
Spillway
(1978 photo)


1974

1974

Original stoplog spillway section built in 1956 (1974 photo)

Post-1974 reconstruction (1978 photo)




**"Substantial leakage" observed around the wooden gate and numerous large leaks were flowing from cracks in the sidewalls.

Water flowing from the base of the lowest rock berm at the toe of the dam.

Bulging and tilt was observed in the top part of the vertical dry masonry wall.

Seepage observed along the bottom of the sidewalls.

GATE SECTION

STOPLOG SPILLWAY

OVERFLOW SPI

Anderson-Nichols & Co., Inc.
CONCORD NEW HAMPSHIRE

U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

DOLLOFF DAM

1978

PAWTUCKAWAY POND NEW HAMPSHIRE

SCALE: NOT TO SCALE

Nov. 1985

**1985**

https://pawtuckawaylake.com/wp-content/uploads/photo gallery/imported_from_media_libray/1985-Goves-Dike-maybe scaled.jpg?bwg=1601487007


1985
https://pawtuckawaylake.com/photos/1985-lake-drawdown/#bwg4/431

# 1985

https://pawtuckawaylake.com/photos/1985-lake-drawdown/#bwg4/426


1985
https://pawtuckawaylake.com/photos/1985-lake-drawdown/#bwg4/424


Gate Repair - Dec. 1985


April 1986

# Dolloff Dam (1986)

Seepage weir

Wooden weir installed to monitor leakage from gate structure

Subsurface exploration and installation of monitoring wells (wells also installed in 1997)


1988

Seepage in gate house shaft

← upper

lower ↓

1988

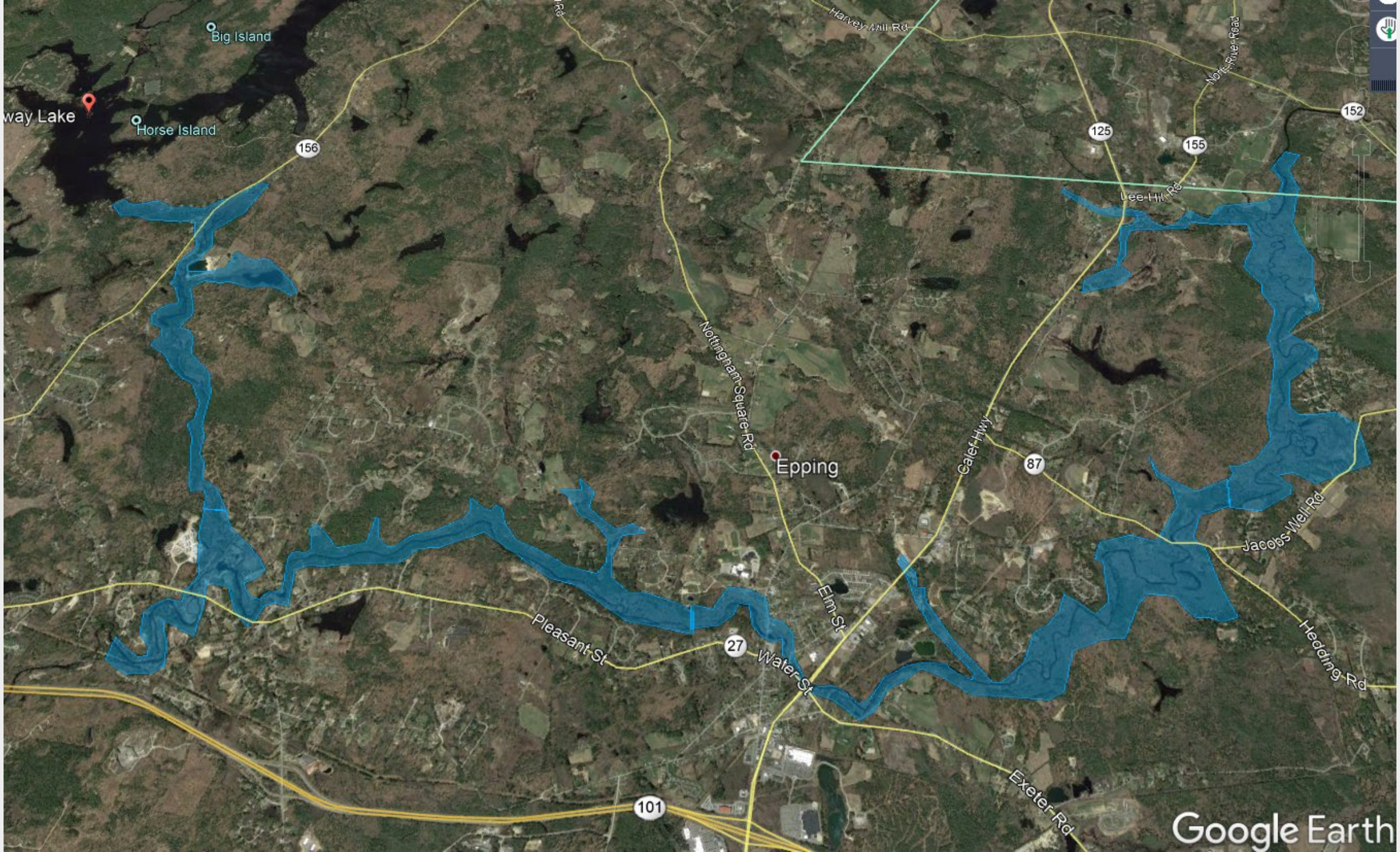
# Dolloff Dam 2019
# Gate Leakage

# Dolloff Dam 2020 Monitoring Weirs

# Dolloff Dam 2025 Sink Hole

# Dolloff Dam 2025 Repairs/Dive Inspection


**“Multiple locations of seepage through a horizontal crack, spalling, isolated poor consolidation, and open joints in the vertical shaft”**


Big Island
Horse Island
156
Harvey Mill Rd
North River Road
152
125
155
Lee Hill Rd
Nottingham Square Rd
Epping
Calef Hwy
87
Jacobs Well Rd
Pleasant St
27
Water St
Elm St
Hedding Rd
Exeter Rd
101
Google Earth

# Dolloff Dam
## Potential Failure Modes Analysis (2020)

**Failure Likelihood**

***Very High*** - has initiated and/or is likely to occur in near future; flood or earthquake more frequent than 1 in 1,000/yr. to cause failure;

***High*** - Conditions exist; key evidence is weighted more heavily toward likely than unlikely; flood or earthquake between 1/1,000/yr. and 1/10,000/yr. to cause failure;

***Moderate*** - Conditions exist; key evidence is weighted more heavily toward unlikely than likely; flood or earthquake between 1 in 10,000/yr. and 1in 100,000/yr. to cause failure;

***Low*** - Cannot be ruled out, but no compelling evidence; flood or earthquake more remote than 1 in 100,000/yr. to cause failure;

***Remote*** – Several unlikely events needed for failure. Negligible likelihood or non-credible.

**Magnitude of Consequences**

***Level 0*** - No significant impacts to downstream population other than temporary minor flooding of roads or land;

***Level 1*** - Limited property/environmental damage. Although life-threatening flows are released and people are at risk, life loss is unlikely;

***Level 2*** – Moderate property/environmental damage. Some life loss is expected (1 to 10);

***Level 3*** - Significant property/environmental damage. Large life loss is expected (10 to 100);

***Level 4*** - Significant property/environmental damage. Large life loss is expected (>100).

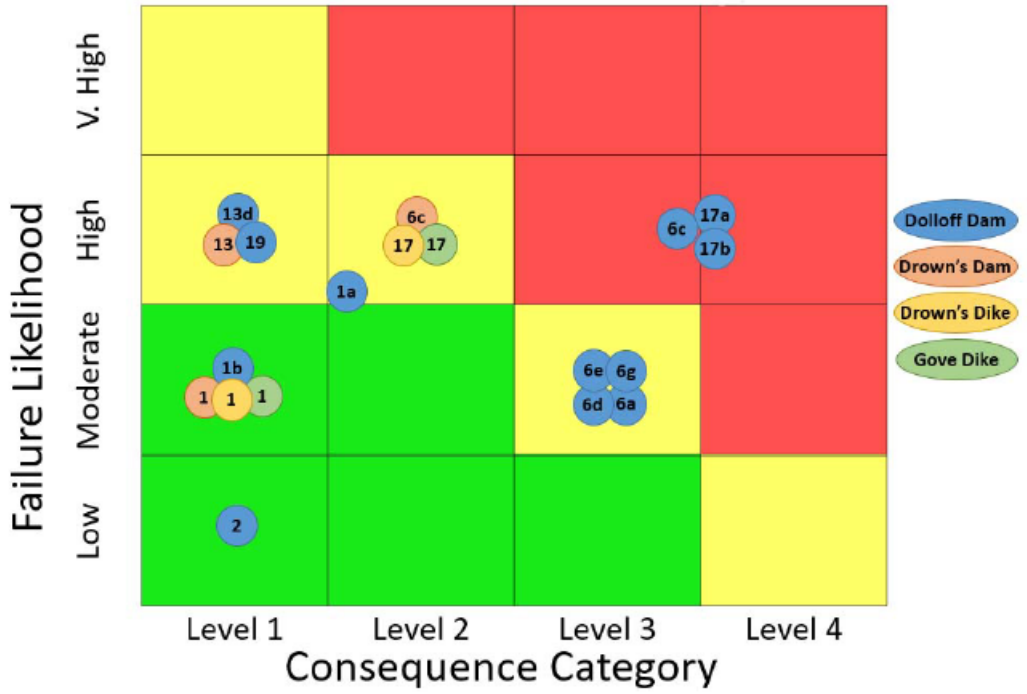



**Figure 9 - PFMA Binning Chart**

The PFMs on the binning chart are described in detail in Appendix B, and are summarized as follows:

- **PFM 1**: Erosion of Abutment(s) during Overtopping Flood Causing Uncontrolled Release and Loss of Access
  - PFM 1a involves erosion of the left abutment at Dolloff Dam.
  - PFM 1b involves erosion of the right abutment at Dolloff Dam.
- **PFM 2**: Failure of Spillway Bridge Causing Loss of Bridge and Access
- **PFM 6**: Saturated or Partly-Saturated Earth Fill Destabilizes Downstream Masonry Wall Causing Uncontrolled Release
  - PFMs 6c and 6d occur during an overtopping flood, which would saturate the embankment fill leading to destabilization.
  - PFMs 6a, 6e, and 6g occur during a non-overtopping flood, which would elevate the phreatic surface in the fill between the masonry walls leading to destabilization.
- **PFM 13**: Vandals Remove Stoplogs/Open Gate Causing Uncontrolled Release
- **PFM 17**: During Overtopping Flood, Saturated Embankment Fill and Erosion of Buttress at Toe of Dam Destabilizes Downstream Masonry Wall Leading to Uncontrolled Release

# Dolloff Dam

## Potential Failure Modes Analysis (2020)

***PFM 17:*** **During Overtopping Flood, Saturated Embankment Fill and Erosion of Buttress at Toe of Dam Destabilizes Downstream Masonry Wall Leading to Uncontrolled Release**

***High*** - Conditions exist; key evidence is weighted more heavily toward likely than unlikely; flood or earthquake between 1/1,000/yr. and 1/10,000/yr. to cause failure;

***Level 4 -*** Significant property/environmental damage. Large life loss is expected (>100).

# Pawtuckaway Lake
## Hydraulic Analysis (2024)

| Location | 100-year event | 1000-year event |
|---|---|---|
| Dollof Dam | 0.1 ft overtopping depth | 2.2 ft overtopping depth |
| Gove Dike | -0.1 ft overtopping depth | 2.0 ft overtopping depth |
| Drowns Dam | -1.1 ft overtopping depth | 1.0 ft overtopping depth |
| Drowns Dike | 0.7 ft overtopping depth | 2.8 ft overtopping depth |

*2006 flood event – 1.6ft of freeboard*

*1000-year event (design event) – 5.8 feet above normal*

# Pawtuckaway Lake
## Global Stability Analysis (2024)

| Location | Normal | No Freeboard | Seismic |
|---|---|---|---|
| Required Factor of Safety | 1.5 | 1.4 | 1.0 |
| Dollof Dam | 1.8 | 1.8 | 0.6 |
| Gove Dike | 1.5 | 1.6 | 0.9 |
| Drowns Dam | 2.0 | 1.9 | 0.3 |
| Drowns Dike | 1.6 | 1.6 | 1.1 |

# Pawtuckaway Lake
## Structural Stability Analysis (2024)

| Location | Normal | 100yr event | 1000yr event | Seismic |
|---|---|---|---|---|
| Required Factor of Safety | 1.5 | 1.3 | 1.3 | 1.1 |
| Dollof Dam | 1.0 | 0.6 | 1.5 | 0.6 |
| Gove Dike | N/A | N/A | N/A | N/A |
| Drowns Dam | 1.2 | 0.6 | 0.5 | 0.9 |
| Drowns Dike | 2.2 | 0.8 | 0.6 | 2.0 |

# Pawtuckaway Lake – Future Plans

***Address lack of discharge capacity and stability of all four structures.***

Develop concepts for increasing discharge capacity and/or increasing height of dams **– ongoing**

Develop designs for selected concepts **– ongoing**

Address sinkhole development at Dollof **– ongoing**

Secure funding for construction **– 2026 – 2027 budget process**

Project out to bid **– late 2027 – early 2028***

Construct project **– 2028 – 2029***

*** Contingent on securing funding and project management resources**

# Pawtuckaway Lake – Cost

***Compare to Mendums Pond in Nottingham***

In house upstream repair = $2.25 million

Design of downstream repair = $0.73 million

Construction of downstream repair = $5.43 million

**Total Cost = $8.41 million**

**Cost to repair all 4 Pawtuckaway Dam - Unknown**

# Mendums Construction

# Mendums Construction (2025)

# Mendums Construction (2025)

# Mendums Construction (2025)

# Thank you

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603-271-1961

**Burnhams Marsh**
**2017 before removal**
**2025 after removal**