NATIONAL BUREAU OF STANDARDS
MICROCOPY RESOLUTION TEST CHART
MERRIMACK RIVER BASIN
HARRISVILLE, NEW HAMPSHIRE

HARRISVILLE POND DAM
NH 00065
NHWRB 109.08

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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

MAY 1979

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<td>The dam is a dry rubble masonry and earth dam. The dam has a maximum height of 21 ft. and is about 75 ft. long. The dam is judged to be in fair condition. It is intermediate in size with a high hazard potential. Modification is necessary to improve the hydraulic and hydrological condition of the dam.</td>
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THIS DOCUMENT IS BEST QUALITY PRACTICABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.
Honorable Hugh J. Gallen
Governor of the State of New Hampshire
State House
Concord, New Hampshire 03301

Dear Governor Gallen:

Inclosed is a copy of the Harrisville Pond Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. The report is based upon a visual inspection, a review of past performance, and a preliminary hydrological analysis. A brief assessment is included at the beginning of the report.

The preliminary hydrologic analysis has indicated that the spillway capacity for the Harrisville Pond Dam would likely be exceeded by floods greater than 2.5 percent of the Probable Maximum Flood (PMF), the test flood for spillway adequacy. Our screening criteria specifies that a dam of this class which does not have sufficient spillway capacity to discharge fifty (50) percent of the PMF, should be adjudged as having a seriously inadequate spillway and the dam assessed as unsafe, non-emergency, until more detailed studies prove otherwise or corrective measures are completed.

The term "unsafe" applied to a dam because of an inadequate spillway does not indicate the same degree of emergency as that term would if applied because of structural deficiency. It does indicate, however, that a severe storm may cause overtopping and possible failure of the dam, with significant damage and potential loss of life downstream.

It is recommended that within twelve months from the date of this report the owner of the dam engage the services of a professional or consulting engineer to determine by more sophisticated methods and procedures the magnitude of the spillway deficiency. Based on this determination, appropriate remedial mitigating measures should be designed and completed within 24 months of this date of notification. In the interim a detailed emergency operation plan and warning system should be promptly developed. During periods of unusually heavy precipitation, round-the-clock surveillance should be provided.
NEDEDE-5
Honorable Hugh J. Gallen

I have approved the report and support the findings and recommendations described in Section 7, with qualifications as noted above. I request that you keep me informed of the actions taken to implement these recommendations since this follow-up is an important part of the non-Federal Dam Inspection Program.

A copy of this report has been forwarded to Water Resources Board, the cooperating agency for the State of New Hampshire. This report has also been furnished to the owner of the project, Mr. John J. Colony, Jr., c/o Harrisville Designs, Harrisville, New Hampshire 03450.

Copies of this report will be made available to the public, upon request to this office, under the Freedom of Information Act, thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Water Resources Board for the cooperation extended in carrying out this program.

Sincerely,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer
HARRISVILLE POND DAM

NH 00065

NHWRB 109.08

MERRIMACK RIVER BASIN
HARRISVILLE, NEW HAMPSHIRE

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
Identification No.: NH 00065
Name of Dam: Harrisville Pond Dam
Town: Harrisville
County and State: Cheshire, New Hampshire
Stream: Nubanusit Brook
Date of Inspection: May 22, 1978

Brief Assessment

Harrisville Pond Dam is a dry rubble masonry and earth dam which was constructed around 1886. The dam has a maximum height of 21 feet and is approximately 75 feet long. It is serving as the foundation of the north wall of a 2-story mill building. The spillway, located in the western end, is 3 feet 7 inches wide with a 2.5-foot high opening in the wall.

Based on the visual inspection, available records, and past operational performance, the dam is judged to be in fair condition. Water was observed seeping out of the downstream face of the dam and at the gate structure. Settlement was noted east of the gate structure. Continuance of this classification depends on proper operations and maintenance of the dam.

This dam falls under the category of high hazard potential, and it is intermediate in size. The test flood peak inflow is equal to the Probable Maximum Flood, 16,500 cfs, and the test flood peak outflow is 14,289 cfs. Hydraulic analysis indicates that the maximum surcharge pool elevation is 1329.4, approximately 11.4 feet above the spillway crest. The spillway in the body of the dam together with the waste sluice will pass approximately 2.5% of the test flood peak outflow without overtopping the country road above the bypass culvert. Therefore, the spillway capacity is inadequate. The test flood would overtop the county road by 8.9 feet.

As stated in Section 7, within 1 year after receipt of this Phase I report, the owner, Mr. John J. Colony, Jr., should retain the services of a competent engineer and implement the results of his evaluation of the following:

1. The modification necessary to improve the hydraulic and hydrologic condition of the dam.
2. The extent of submergence in Eastview and Harrisville in the event of failure of this dam.

The following operating and maintenance measures, as stated in Section 7.3, should also be implemented:

1. Leaks through the face of the dam should be monitored regularly until such time it can be repaired.

2. Reestablish the proper grade of the settled area east of the gate structure.

3. An operating and maintenance manual for the project should be prepared.

4. A program of technical annual periodic inspection of the project features should be prepared and initiated. This program should assure that all features of the foundation of the mill building within the discharge channel are continually maintained.

5. Surveillance and a warning system should be developed for periods of unusually heavy rains and runoff.

FAY, SPOFFORD & THORNDIKE, INC.

By

Jurgis Gimbutas, P.E.
Project Engineer

Richard W. Albrecht, P.E.
Vice President
This Phase I Inspection Report on Harrisville Pond Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

CHARLES G. TIERSCH
CHARLES G. TIERSCH, Chairman
Chief, Foundation and Materials Branch
Engineering Division

FRED J. RAVINS, Jr., Member
Chief, Design Branch
Engineering Division

SAUL COOPER, Member
Chief, Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division
This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonable possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.
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FARRISVILLE POND DAM

SECTION 1 - PROJECT INFORMATION

1.1 General

a. Authority

Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Fay, Spofford & Thorndike, Inc., Engineers, have been retained by the New England Division to inspect and report on selected dams in the State of New Hampshire. Authorization and notice to proceed was issued to Fay, Spofford & Thorndike, Inc., under a letter of May 3, 1978, from Mr. Ralph T. Garver, Colonel, Corps of Engineers. Contract No. DACW 33-78-C-0308 has been assigned by the Corps of Engineers for this work.

b. Purpose:

(1) Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) Encourage and prepare the States to initiate quickly effective dam safety programs for non-Federal dams.

(3) To update, verify, and complete the National Inventory of Dams.

1.2 Description of Project

a. Location

Harrisville Pond Dam, locally called the "Upper Pond Dam," is located near the southwest bay of Harrisville Pond, which is a natural pond. It is located in the southwestern part of New Hampshire in the center of the Town of Harrisville, near the Post Office, and about 10 miles east of Keene. Tolman Pond, Brick Yard Brook, and two conservation reservoirs, namely, Spoonwood Lake and Nubanusit Lake, drain into Harrisville Pond. Harrisville Pond drains into Skatutakee Lake,
which in turn drains into Nubanusit Brook, Contoocook River, and finally into the Merrimack River.

b. Description of Dam

The dam, built in 1886, is of stone masonry, 21 feet high, 75 feet long, and approximately 14 feet wide. The spillway, which is located in the western end, is 3 feet 7 inches wide and is approximately 2.5 feet below the top of the dam. Approximately in the center of the dam, there are four gates, 2 feet by 3 feet each, and all are operated by rack and pinion. Two gates open into a penstock, the other two open into a 6-foot high, 4-foot wide outlet conduit. The penstock pipe, 4 feet in diameter, is not in use (Photographs No. 7, 8, 9, and 10, Appendix C).

A two-story mill building was built adjacent to this dam with the dam serving as a foundation for the north wall. The abutments of this masonry dam are of earth, granite faced (Photographs No. 1 and 2, Appendix C).

The intake channel consists of two small ponds connected by two culverts under roads crossing parallel to the dam. The first bridge, which is near the dam, has a 14.5-foot by 10-foot opening, with a 4-foot freeboard. The second bridge, which is near Harrisville Pond, has an 11-foot by 7-foot opening with a 1.5-foot freeboard (Photographs No. 17 and 18, Appendix C).

At the southeast bay of the Harrisville Pond, approximately 400 feet north of the intake channel, there is a rudimentary type weir and a culvert under a road. This weir is about 16 feet long, curved in plan, and has approximately a 1-foot drop. The discharge from the 4-foot culvert reenters the outlet channel below the toy shop (Photographs No. 19, 20, 21, and 22, Appendix C).

c. Size Classification

The storage capacity at the spillway crest is 2,000 acre-feet, which falls in the range \( \geq 1,000 \) and \( < 50,000 \) acre-feet. Therefore, the dam is classified as intermediate in size.

d. Hazard Classification

In the event of failure of this dam, the lower Skatutakee Dam might fail by domino effect and the village of Eastview, which is at a distance of about 2 1/2 miles downstream of Harrisville Pond Dam, will be in danger of being flooded. The mill building, toy shop, and the Filtrine Manufacturing Mills which are located downstream would be
damaged with eventual loss of the lives of the people in these structures. It is estimated that in the event of failure of this dam, loss of more than a few lives and excessive property damage could occur. Therefore, this dam falls in the category of high hazard potential.

e. Ownership

The oldest available inventory, dated 1925, gives the Cheshire Mills as the owner. The earliest available letter, signed by the present owner, Mr. John J. Colony, Jr., of the Cheshire Woolen Co. of Harrisville, New Hampshire, telephone 603-827-3402, was dated in 1942.

f. Operator

The owner: Mr. John J. Colony, Jr., (see Section 1.2.e.).

g. Purpose of the Dam

The pond behind the dam had been supplying water power for the Cheshire Woolens Co. mills until 1942, when electrically driven machinery was installed. However, the Filtrine Manufacturing Co. mills still depend on the water coming downstream. They need the water power to operate the hydro-electric turbine of the Northern Water Power Co. and to supply water for the fire protection system of the mill. The Northern Water Power Co. is a tenant of the Filtrine Manufacturing Co.

Currently, Harrisville Pond is being used primarily for recreational purposes.

h. Design and Construction History

There is no available data on the original design and construction of this dam. This dam was probably constructed around 1886, and no records of alterations are available. According to inspection reports and questionnaires, dated 1937, the dam was in good repair with the gates in operable condition, as they presently exist.

In 1974, some leaks were noticed near the penstock which was not and presently is not in use. In 1976, leakage through the stonework of the dam was observed on the downstream side. The water level was drawn down below the normal full pond level and the voids located and repaired. These voids occurred in the top few feet of the fill between the intake channel stonework and the dam stonework. Some settlement of backfill is visible in a small area on the east side of the intake structure.
In May, 1978, the old wooden planking over the intake structure was replaced by new flooring.

i. Normal Operation Procedures

The responsibility of operating the reservoir rests with the owner, Mr. John J. Colony, Jr. As the penstock was abandoned in 1942, and the spillway is ungated, the only control available is by two gates which are operable by rack and pinion. These gates open into the 6-foot high, 4-foot wide outlet conduit. During storms in the spring, both gates are kept open. If the water level in Harrisville Pond rises above a certain level, which level is not known from the project records, the water from the pond will pass over the rudimentary type weir at the southeast bay of Harrisville Pond.

1.3 Pertinent Data

a. Drainage Area

Harrisville Pond, as shown on the U.S.G.S. map, is located on Nubanusit Brook Watershed. This reservoir is a natural one and it has a drainage area of 10 square miles. The drainage area is best characterized as heavily wooded and its topography is undulated and rolling.

b. Discharge at Dam Site

(1) Outlet works (conduits) are permanently closed. The penstock is 4 feet in diameter and has an invert elevation of 1305.3 (estimated). The sluice opening is approximately 6 feet by 4 feet with an invert elevation of 1305.3 (estimated).

397.0 cfs through sluice at Elevation 1329.4.

(2) The maximum known flood at the dam site is the flood of September 21-24, 1938, magnitude not recorded.

(3) Ungated spillway capacity at the top of dam - not applicable.

(4) Ungated spillway capacity at test flood maximum pool.

123 cfs at Elevation 1329.4.
(5) Flow through 4-inch pipe culvert test flood maximum pool.

290.0 cfs at Elevation 1329.4.

c. Elevation (Feet above MSL)

(1) The top of the dam serves as a foundation of the north wall of a two-story mill building, which is adjacent to this dam.

(2) Test flood maximum pool elevation is 1329.40.

(3) The full flood control pool - unknown.

(4) The recreation pool (assumed from USGS data) is 1318.

(5) The spillway crest (assumed from USGS data) is 1318.

(6) The stream bed at the centerline of the dam is 1297 (estimated).

(7) The maximum tail water is 1304 (estimated).

d. Reservoir

(1) The length of the maximum pool is 7,500 feet (estimated).

(2) The length of recreation pool is 5,000 feet (estimated).

(3) The length of flood control pool is 6,000 feet (estimated).

e. Storage (Acre-Feet)

(1) Top of dam - not applicable.

(2) Test flood maximum pool elevation - 5,397 acre-feet.

(3) The flood control pool - unknown.

(4) The recreation pool - 2,000 acre-feet.

(5) Spillway crest - 2,000 acre-feet.
f. Reservoir Surface (Acres)

(1) The top of the dam - not applicable.
(2) Test flood maximum pool elevation - 358 acres.
(3) The flood control pool - unknown.
(4) The recreation pool - 119 acres.
(5) The spillway crest - 119 acres.

g. Dam

(1) Type
Dry rubble masonry and earth fill
(2) Length
75 feet
(3) Height
21 feet
(4) Top width
Approximately 14 feet
(5) Side slopes
(a) Upstream
Vertical
(b) Downstream
Vertical
(6) Zoning
Not applicable
(7) Impervious core
Not applicable
(8) Cutoff
None
(9) Grout curtain
None

h. Spillway

(1) Type
Ungated weir
(2) Length of weir
3 feet 7 inches
(3) Crest elevation
1318 (estimated)
(4) Gates
None
(5) U/S channel Pond

1. Regulating Outlets

The regulating outlet consists of an approximately 4-foot wide, 6-foot high waste sluice opening at the downstream face and a 4-foot diameter penstock. These are adjacent to each other. The flow through each outlet is controlled by two manually operated gates. Each gate is approximately 2 feet by 3 feet in dimension.

(1) Invert
   Elevation 1305.3

(2) Size
   48-inch diameter

(3) Description
   Steel penstock

(4) Control mechanism
   Two gates, manually operated

(5) Other
   (a) Invert
      1305 (estimated)
   (b) Size
      Width - approximately 4 feet
      Depth - approximately 6 feet
      Length - approximately 14 feet
   (c) Description
      Stone masonry waste sluice opening
   (d) Control mechanism
      Two gates, manually operated
SECTION 2 - ENGINEERING DATA

2.1 Design

No original design data was disclosed for Harrisville Pond Dam.

2.2 Construction

No engineering data are available on the construction of this dam.

2.3 Operation

No engineering operational data were disclosed.

For information pertaining to the history of previous failures or deficiencies, refer to Section 1. For operational procedures refer to Sections 1.2.i and 4.

2.4 Evaluation

a. Availability

Pertinent structural, geotechnical, hydrologic, and hydraulic data, which formed the basis of the design of the dam, are available on a very limited basis. The hydraulic and hydrologic determinations for design, as collected from project records, were obtained by rule of thumb techniques.

b. Adequacy

Sufficient engineering data are available for a Phase I inspection.

c. Validity

The available engineering data is considered valid on the basis of the results of the visual inspection.
SECTION 3 - VISUAL INSPECTION

3.1 Findings

The Phase I inspection of the Harrisville Pond Dam was performed on May 22, 1978. A copy of the inspection check list is included in Appendix A.

a. General

In general, the soil and rock features are in good condition. The only concrete observed was the topping placed on the apron walls.

b. Dam

No evidence of vertical or horizontal misalignment was observed. There is no indication of sloughing, bulging, or movement of the slopes, nor is there evidence of piping.

Water was observed seeping out of the downstream face of the dam on either side of the gates.

Within approximately 4 feet east of the gate structure adjacent to the mill building, the top portion of the dam has settled to a maximum depth of 4 feet. At the time of the inspection, water, minor in nature, was flowing in the vicinity of the gate structure into this depression. There is no apparent distress of the wall of the mill as a result of this settlement.

c. Appurtenant Structures

At the time of our inspection, all four sluice gates were closed. Water was observed flowing through the penstock, which indicates that the two gates opening into the penstock are leaking. The east gate, which controls the flow through the waste sluice opening, was leaking. The gates and their lifting mechanism are in operable condition. The approach to and the accessibility to the operating platform is well maintained.

The 48-inch steel penstock is in poor condition. A hole was observed in the top of the penstock near the dam. Leakage was also observed at the bottom of the penstock.

On the upstream side of the dam, the masonry is backfilled, except for the intake structure which is under water. Therefore, the
upstream face of the masonry could not be seen. Inside of the mill building, the exposed face of rubble masonry appears to be sound.

The rudimentary type weir at the southeast bay of Harrisville Pond, and the 4 foot diameter circular pipe under the country road, approximately 400 feet east of the dam, are in fair condition. Observation indicates that this weir is primitively constructed with miscellaneous materials such as loose stone and wood. The approach and discharge channel and side slopes were observed to be in good condition.

The superstructure of both concrete bridges over the intake channel appears to be in good condition. The concrete abutments have deteriorated at the water level, exposing the aggregates.

d. Reservoir Area

Harrisville Pond is located on the Nubanusit Brook watershed. The surface area of the pond is 119 acres. The reservoir area is accessible and its shoreline is heavily wooded.

e. Downstream Channel

The initial 45 feet of this channel was found to be the basement of the mill building, the next 60 feet, a stone-lined channel, and the next 20 feet, an opening in the foundation of the toy shop. Columns supporting the mill floor were observed in the channel. It appears that these columns were either repaired or replaced recently. Brick work in both the mill building and the toy shop appears to be in good condition. Debris was observed in the basement of the mill building. The quantity of debris will not impede the flow in the channel.

The downstream channel and side slopes were observed to be in good condition.

3.2 Evaluation

The observed condition of the dam is fair. The potential problems observed during the visual inspection are listed as follows:

(1) Leaks through the face of the dam and at the gate structure.

(2) Settlement east of the gate structure.

(3) Potential for overtopping of the country road at the bypass culvert.
(4) Potential for floods to rise against the wall of the building above the dam.
SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures

Mr. John J. Colony, Jr. has operated Harrisville Pond Dam since about 1942. The Pond level is maintained by a broad-crested spillway located at the western end of the dam. The flow is controlled by stop logs manually operated. The Pond can be lowered by the opening of two gates, which are operable by rack and pinion.

4.2 Maintenance of Dam

The maintenance of Harrisville Pond Dam is the responsibility of Mr. John J. Colony, Jr., of the Cheshire Woolen Co. of Harrisville.

4.3 Maintenance of Operating Facilities

No written maintenance procedures were disclosed for Harrisville Pond Dam. As the penstock is not used, the question of its operation does not arise. The possibility and/or permissibility of the gate operations controlling the flow through the sluice opening is not known. In view of the location of the foundation of the building, there is a possibility of the building being undermined if the gates are left open. The approach to and the accessibility to the operating platform is well maintained. Maintenance of the facilities for operating stop logs across the broad-crested spillway in the body of dam is satisfactory.

4.4 Description of any Warning System in Effect

A flood warning system is non-existent.

4.5 Evaluation

The current operation and maintenance procedure for Harrisville Pond Dam are inadequate to ensure that all problems can be remedied within a reasonable period of time.
SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design Data

(1) This dam falls under the category of high hazard potential and it is intermediate in size. Using the "Recommended Guidelines for Safety Inspection of Dams", the recommended spillway test flood peak inflow is equal to the Probable Maximum flood. The spillway test flood inflow hydrograph, estimated, is furnished in Appendix D. The spillway test flood peak inflow is 16,500 cfs.

(2) The estimated peak outflow corresponding to the spillway test flood inflow is about 14,289 cfs. Refer to Appendix D for further details.

(3) The pond storage capacity versus the elevation, an estimated capacity curve is furnished in Appendix D.

(4) The composite discharge rating curve for the spillway, waste sluice and the country roadway above the 4 foot diameter culvert pipe is included in Appendix D.

(5) The hydrologic map of the watershed above the dam site, including reservoir area, water course and principal stream flow, is included in Appendix D.

b. Experience Data

With the exception of sketchy information, past flood details are not available for Harrisville Pond Dam. Precipitation records for the area are available. It is noted that significant amounts of rainfall up to 12.43 inches, which was more than 3.5 times the monthly average rainfall, occurred in the month of September, 1938. The flood of September 21-24, 1938, is considered to be the maximum flood that has occurred. On the basis of regional frequency studies, the flood of 1938, corresponds to a 100-year flood.

All floods in the past were handled by opening the gates and using the culvert at the southeast bay of the lake.
c. Visual Observations

The valley cross section immediately below the dam is not sufficiently wide to convey the peak outflow from the reservoir. This cross section is approximately 8 feet by 8 feet.

Harrisville Pond Dam is provided with a rudimentary type weir, which leads into a 4-foot diameter circular pipe under a country road. The invert of the culvert pipe in relation to the crest elevation of the spillway in the body of the dam is not determinable without additional data.

d. Overtopping Potential

The dam is unusual since it forms part of the foundation of a mill building. The question of overtopping does not arise in the case of this dam. The length of the spillway is too small to handle the spillway test flood peak inflow that might result from 10 square miles of the drainage area of Harrisville Pond. Due to the unavailability of information, it is assumed that as soon as the water surface in the pond reaches Elevation 1320.5 there will be an overflow over the country road. To develop the composite discharge rating curve, flow through the waste sluice, spillway, and over the country road are only considered. It is also assumed that flow over the roadway would occur over an effective length of 200 feet. Based on these assumptions, an approximate composite rating curve for the spillway, the waste sluice, and the overflow over the roadway has been estimated and is furnished in Appendix D. The maximum pool elevation corresponding to the spillway test flood peak outflow is approximately 1329.4. The maximum surcharge height over the crest of the spillway is about 11.4 feet.
SECTION 6 - STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

The upstream slope could not be seen due to the fact that it was under water. The slopes do not show any erosion or weak areas. The visual inspection revealed the following evidence of possible stability problems:

(1) Leaks through the face of the dam and at the gate structure.

(2) Settlement east of the gate structure.

Visual inspection of the stone masonry did not reveal any evidence of instability.

b. Design and Construction Data

There are rough sketches in the inspection report dated 1937, but there are no structural computations. There are no other design and construction data available.

c. Operating Records

Except for memorandums and correspondence listed in Appendix B, other operating records are not available at the office of the New Hampshire Water Resources Board.

d. Post-Construction Changes

None recorded.

e. Seismic Stability

This dam is located in Seismic Zone 2 and in accordance with recommended Phase I guidelines does not warrant seismic analyses.
SECTION 7 - ASSESSMENT, RECOMMENDATIONS & REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition

Based on visual inspection, available records and past operational performance, the dam is judged to be in fair condition.

b. Adequacy of Information

An adequate assessment of the dam consistent with the scope of a Phase I investigation has been made based upon the visual inspection and available information.

c. Urgency

All recommendations and remedial measures enumerated below should be implemented within 1 year of receipt of this Phase I report by the owner.

d. Need for Additional Investigation

The information available from the visual inspection is adequate to identify the potential problem of overtopping. This problem will require the attention of a competent engineer who will have to make additional engineering studies to design or specify remedial measures to rectify the problem.

7.2 Recommendations

It is recommended that the owner retain the services of a competent engineer to do the following:

(1) In view of the inadequate spillway capacity, it is considered advisable to conduct detailed studies. These studies should evaluate the possible extent of damage in Harrisville and Eastview in the event of failure of this dam and the downstream Skatutakee Dam by domino effect.

(2) A study should be made to determine the modifications necessary to the rudimentary type weir and the culvert under the country road and its downstream channel to accommodate flood condition. Suggested modifications are lowering and increasing the size of the culvert, and enlarging the downstream channel to accommodate flood conditions. It should also include the feasibility of extending the discharge
channel of the overflow weir beyond the lower dam. During extreme flood events and spring runoff, this channel extension would be used and for the normal flow, the existing channel would be used.

7.3 Remedial Measures

It is considered important that the following operating and maintenance procedures be attended to as early as practical:

a. Leaks through the face of the dam should be monitored regularly until such time they can be repaired.

b. Proper grade of the settlement area east of the gate structure should be reestablished.

c. An operating and maintenance manual for the project should be prepared.

d. A program of technical annual periodic inspection of the project features should be prepared and initiated. This program should assure that all features of the foundation of the mill building within the discharge channel are continually maintained.

e. Because the dam is located upstream of a populated area, round-the-clock surveillance should be provided during periods of high precipitation.

f. The owner should develop a formal warning system. An operational procedure to follow in event of an emergency should also be adopted.

7.4 Alternatives

Until the hydraulic and hydrologic condition of this dam is improved, the pond should be operated at a lower level to provide more storage during extreme flood events and spring runoff.
APPENDIX A

VISUAL INSPECTION CHECK LISTS
## APPENDIX A

### VISUAL INSPECTION CHECK LIST

**PARTY ORGANIZATION**

**PROJECT** Harrisville Pond Dam  
**DATE** May 22, 1978  
**TIME** 9:30 - 14:00  
**WEATHER** Sunny  
**W.S. ELEV.** 1318.7 U.S.  
**DN.S.**

**PARTY:**

1. **Jurgis Gimbutas, P.E.**  
   Team Captain - Structural and Concrete

2. **Harvey H. Stoller, P.E.**  
   Soils, Geology and Foundations

3. **V. Rao Maddineni, P.E.**  
   Hydraulics and Hydrology

4. 

5. 

### PROJECT FEATURE | INSPECTED BY | REMARKS

1. **Dam Embankments**  
   Outlet Works -  
   H. H. Stoller  
   Fair

2. **Penstock**  
   J. Gimbutas  
   Poor

3. **Outlet Works - Waste Sluice Opening**  
   J. Gimbutas  
   Fair

4. **Spillway Weir**  
   J. Gimbutas  
   Good

5. **Approach and Discharge Channels**  
   H. H. Stoller  
   Good

6. **Rudimentary Type Weir**  
   V. R. Maddineni  
   Fair

7. **Approach and Discharge Channels**  
   V. R. Maddineni  
   Good

8. **Pond and Downstream Channel**  
   V. R. Maddineni  
   Good
PERIODIC INSPECTION CHECK LIST

PROJECT Harrisville Pond Dam
DATE May 22, 1978

PROJECT FEATURE Dam Embankment
DISCIPLINE Soils & Foundation
NAME

PROJECT FEATURE
DISCIPLINE
NAME
DISCIPLINE
NAME

AREA EVALUATED CONDITION

**DAM EMBANKMENT**

<table>
<thead>
<tr>
<th>Area Evaluation</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crest Elevation</td>
<td>1320.5 (Estimated)</td>
</tr>
<tr>
<td>Current Pool Elevation</td>
<td>1318.7 (Estimated)</td>
</tr>
<tr>
<td>Maximum Impoundment to Date</td>
<td>Unknown</td>
</tr>
<tr>
<td>Surface Cracks</td>
<td>None observed</td>
</tr>
<tr>
<td>Pavement Condition</td>
<td>None</td>
</tr>
<tr>
<td>Movement or Settlement of Crest</td>
<td>East side of gate structure</td>
</tr>
<tr>
<td></td>
<td>(see narrative)</td>
</tr>
<tr>
<td>Lateral Movement</td>
<td>None observed</td>
</tr>
<tr>
<td>Vertical Alignment</td>
<td>No visual vertical misalignment observed</td>
</tr>
<tr>
<td>Horizontal Alignment</td>
<td>No visual horizontal misalignment observed</td>
</tr>
<tr>
<td>Condition at Abutment and at Concrete Structures</td>
<td>No concrete structures</td>
</tr>
</tbody>
</table>
### PERIODIC INSPECTION CHECK LIST

**PROJECT** Harrisville Pond Dam  
**DATE** May 22, 1978  

**PROJECT FEATURE** Dam Embankment  
**DISCIPLINE** Soils & Foundation  
**NAME** 

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<tr>
<th>AREA EVALUATED</th>
<th>CONDITION</th>
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<tr>
<td>Indications of Movement of Structural Items on Slopes</td>
<td>None observed</td>
</tr>
<tr>
<td>Trespassing on Slopes</td>
<td>None observed</td>
</tr>
<tr>
<td>Sloughing or Erosion of Slopes or Abutments</td>
<td>None observed</td>
</tr>
<tr>
<td>Rock Slope Protection - Riprap Failures</td>
<td>None</td>
</tr>
<tr>
<td>Unusual Movement or Cracking at or Near Toes</td>
<td>None</td>
</tr>
<tr>
<td>Unusual Embankment or Downstream Seepage</td>
<td>See narrative</td>
</tr>
<tr>
<td>Piping or Boils</td>
<td>None observed</td>
</tr>
<tr>
<td>Foundation Drainage Features</td>
<td>None</td>
</tr>
<tr>
<td>Toe Drains</td>
<td>None</td>
</tr>
<tr>
<td>Instrumentation System</td>
<td>None</td>
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A-3
PERIODIC INSPECTION CHECK LIST

<table>
<thead>
<tr>
<th>PROJECT FEATURE</th>
<th>Outlet Works</th>
<th>DISCIPLINE</th>
<th>Structures</th>
<th>NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATE</td>
<td>May 22, 1978</td>
<td>PROJECT FEATURE</td>
<td>Outlet Works</td>
<td>DISCIPLINE</td>
</tr>
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<td></td>
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<td>PROJECT FEATURE</td>
<td>Outlet Works</td>
<td>DISCIPLINE</td>
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<tr>
<td></td>
<td></td>
<td>PROJECT FEATURE</td>
<td>Outlet Works</td>
<td>DISCIPLINE</td>
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<table>
<thead>
<tr>
<th>AREA EVALUATED</th>
<th>CONDITION</th>
</tr>
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<tbody>
<tr>
<td>OUTLET WORKS - WASTE SLUICE OPENING</td>
<td></td>
</tr>
<tr>
<td>General Condition of Stonework</td>
<td>Fair</td>
</tr>
<tr>
<td>Erosion or Cavitation</td>
<td>None observed</td>
</tr>
<tr>
<td>Condition at Joints</td>
<td>Good</td>
</tr>
<tr>
<td>Gates</td>
<td>Two, manually operated</td>
</tr>
<tr>
<td>OUTLET WORKS - PENSTOCK</td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>48-inch steel pipe</td>
</tr>
<tr>
<td>General Condition</td>
<td>Poor, has a hole near the dam</td>
</tr>
<tr>
<td>Gates</td>
<td>Two, manually operated</td>
</tr>
</tbody>
</table>
PERIODIC INSPECTION CHECK LIST

PROJECT  Harrisville Pond Dam  DATE  May 22, 1978

PROJECT FEATURE  Spillway Weir
DISCIPLINE  Structures

PROJECT FEATURE  Approach Channel
DISCIPLINE  Soils & Foundation
DISCIPLINE  Hydraulics & Hydrology

NAME

AREA EVALUATED  CONDITION

OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS

a. Approach Channel

General Condition  Good
Loose Rock Overhanging Channel  None observed
Trees Overhanging Channel  None observed
Floor of Approach Channel  With water above crest elevation, floor not visible

b. Weir and Training Walls

General Condition of Stonework  Good
PERIODIC INSPECTION CHECK LIST

PROJECT_ Harrisville Pond Dam_ DATE_ May 22, 1978_

PROJECT FEATURE_ Discharge Channel_
DISCIPLINE_ Soils & Foundation_ NAME_ Henry E. Stull_
DISCIPLINE_ Hydraulics & Hydrology_ NAME_ L. O. Mc;redie_

AREA EVALUATED CONDITION

c. Discharge Channel

<table>
<thead>
<tr>
<th>General Condition</th>
<th>Good</th>
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<tbody>
<tr>
<td>Loose Rock</td>
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</tr>
<tr>
<td>Overhanging Channel</td>
<td>None observed</td>
</tr>
<tr>
<td>Trees Overhanging Channel</td>
<td>None observed</td>
</tr>
<tr>
<td>Floor of Channel</td>
<td>Good condition</td>
</tr>
<tr>
<td>Other Obstructions</td>
<td>None observed</td>
</tr>
</tbody>
</table>
PERIODIC INSPECTION CHECK LIST

PROJECT Harrisville Pond Dam
DATE May 22, 1978

PROJECT FEATURE

DISCIPLINE Rudimentary Type Weir
NAME

PROJECT FEATURE Channels

DISCIPLINE Soils & Foundation
NAME

DISCIPLINE Hydraulics & Hydrology
NAME

AREA EVALUATED

OUTLET WORKS - RUDIMENTARY TYPE WEIR, APPROACH AND DISCHARGE CHANNELS

a. Approach Channel

General Condition Good
Loose Rock None observed
Overhanging Channel
Trees Overhanging Channel None observed
Floor of Approach Channel Could not be seen

b. Weir

General Condition Fair condition, constructed with miscellaneous materials

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N
PERIODIC INSPECTION CHECK LIST

PROJECT Harrisville Pond Dam                DATE May 22, 1978

PROJECT FEATURE

DISCIPLINE Rudimentary Type Weir
NAME

PROJECT FEATURE Channels

DISCIPLINE Soils & Foundation
NAME

DISCIPLINE Hydraulics & Hydrology
NAME

<table>
<thead>
<tr>
<th>AREA EVALUATED</th>
<th>CONDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loose Rock</td>
<td>None observed</td>
</tr>
<tr>
<td>Overhanging Channel</td>
<td>None observed</td>
</tr>
<tr>
<td>Trees Overhanging</td>
<td>None observed</td>
</tr>
<tr>
<td>Channel</td>
<td></td>
</tr>
<tr>
<td>Floor of Channel</td>
<td>Good condition</td>
</tr>
<tr>
<td>Other Obstructions</td>
<td>None observed</td>
</tr>
</tbody>
</table>
APPENDIX B

EXISTING AVAILABLE INFORMATION
APPENDIX B

1. Listing of Records and their Location

New Hampshire Water Resources Board in Concord, New Hampshire, 37 Pleasant Street, have a file of records and correspondence from 1937-1977, filed under Town/Dam No. 109.08.

The documents of importance to design and maintenance are the following:

(1) December 12, 1938. Two pages of data on Reservoirs and Water Developments in New Hampshire. By the New Hampshire Water Control Commission. Tabulated by AAN & RLT.


(3) January 28, 1948. Questionaire (similar to above).

(4) March 18, 1977. Letter from Filtrine Manufacturing Co., Mr. John P. Hansel, president, to Mr. Vern Knowlton, New Hampshire Water Resources Board, regarding application for the right to operate the dams on Nubanusit Brook.

2. Copies of Past Inspection Records

Included with this report are the following past inspection reports:

(1) October 8, 1937 - By the New Hampshire Water Resources Board, including sketches, some dimensions, two pages.

(2) December 12, 1938 - By the New Hampshire Water Control Commission, tabulated by AAN & RLT, one page.

(3) October 18, 1974 - By the New Hampshire Water Resources Board, one page.

(4) December 12, 1975 - By the New Hampshire Water Resources Board, signed by Mr. S. Burritt. Includes a key plan with dimensions of openings, four pages.
NEW HAMPSHIRE WATER RESOURCES BOARD

INVENTORY OF DAMS AND WATER POWER DEVELOPMENTS

**DAM**

<table>
<thead>
<tr>
<th>BAY</th>
<th>Hours</th>
<th>No.</th>
<th>109.08</th>
</tr>
</thead>
<tbody>
<tr>
<td>RIVER</td>
<td>萩山</td>
<td>MILES FROM SOUTH</td>
<td>B.A.S. M.</td>
</tr>
<tr>
<td>TOWN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOCAL NAME OF DAM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BUILT</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**FLOOD AREA-ACRES** | 113.05 | DRAMNOH FT. | |
**FLOOD CAPACITY-ACRE FT.** | |
**HEIGHT-TOP TO END OF STREAM-FT.** | 192 | 100 |
**MAX.** | |
**OVERALL LENGTH OF DAM-FT.** | 147 | 147 |
**MAX. FLOOD HEIGHT ABOVE CREST-FT.** | 132 | 132 |
**PERMANENT CREST ELEV. U.S.G.S.** | 115 | |
**LOCAL GAGE** | |
**TALL WATER ELEV. U.S.G.S.** | |
**LOCAL GAGE** | |
**SPIELWAY LENGTHS-FT.** | 100 | 100 |
**FREEBOARD-FT.** | |
**FLASHBOARDS-TYPE, HEIGHT ABOVE CREST** | |
**WATER GATES-10, WIDTH MAX. OPENING DEPTH STILL BELLOW CREST** | |
**REMARKS** | Condition fine. Condition under old building such as to undermine foundation if gates wide open. |
**POWER DEVELOPMENT** | |

<table>
<thead>
<tr>
<th>UNIT NO.</th>
<th>RATED HP</th>
<th>HEAD FEET</th>
<th>C.F.S.</th>
<th>FULL GAGE</th>
<th>KW</th>
<th>MAKE</th>
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</thead>
<tbody>
<tr>
<td>10</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td></td>
<td></td>
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<tr>
<td>12</td>
<td>120</td>
<td>120</td>
<td>120</td>
<td>120</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>140</td>
<td>140</td>
<td>140</td>
<td>140</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**USE** | Water power for wooden mill |

**REMARKS** | Primary P.o. c. Lyric 29.3 |
| | |

10/22/36 A.C. | 1975 |

*Dated* | **Signed** |

*******
DATA ON DAMS IN NEW HAMPSHIRE

LOCATION

Town: Harrisville
County: Cheshire
Stream: Harrisville Pond
Basin-Primary: Merrimack R.
Basin-Secondary: Hubert sit Brook

Local Name

Coordinates—Lat. 42°55'10" N.; Long. 72°05'10" W.

GENERAL DATA

Drainage area: Controlled: Sq. Mi.: Uncontrolled: Sq. Mi.: Total Sq. Mi.

Overall length of dam: 75 ft.; Date of Construction: 1863

Height: Stream bed to highest elev.: 21 ft.; Max. Structure: ft.

Cost—Dam: Reservoir

DESCRIPTION

Masonry—Stone Earth & Concrete

Waste Gates

Type

Number: 1

Size: 6 ft. high x 8 ft. wide

Elevation Invert: 15

Total Area: 35 72 sq. ft.

Hoist

Waste Gates Conduit

Number

Size: ft.

Length: ft.

Area: sq. ft.

Embankment

Type

Height—Max: ft.

Min: ft.

Top—Width: Elev.: ft.

Slopes—Upstream: on

Downstream: on

Length—Right of Spillway

Left of Spillway

Spillway

Materials of Construction: (none)

Length—Total: ft.

Net: ft.

Height of permanent section—Max: ft.

Min: ft.

Flashboards—Type

Height: ft.

Elevation—Permanent Crest: Top of Flashboard

Flood Capacity: cfs:

Abutments

Materials:

Freeboard: Max: ft.

Min: ft.

Headwork to Power Devel. (See "Data on Power Development")

OWNER

Cheshire Milla

REMARKS

Power — Woolen Mill

Tabulation By: A.M. & P.L.T.

Date: December 13, 1933.

B-4
**DAM SAFETY INSPECTION REPORT FORM**

**Town:** Henniker  
**Dam Number:** 109.03

**Inspected by:**  
**Date:** 18 Oct 1974

**Local name of dam or water body:**  
**Owner:**  
**Address:**  
**Owner was/was not interviewed during inspection:**

**Drainage Area:**  
**Stream:**  
**Pond Area:**  
**Storage Ac-Ft.**  
**Max. Head Ft.**

**Foundation:** Type  
Seepage present at toe - Yes/No,  
**Spillway:** Type  
Freeboard over perm. crest:  
Width  
Flashboard height  
Max. Capacity c.f.s.

**Embankment:** Type  
Cover Width  
Upstream slope to 1; Downstream slope to 1

**Abutments:** Type  
Condition: Good, Fair, Poor

**Gates or Pond Drain:** Size  
Capacity  
Type

**Lifting apparatus**  
Operational condition

**Changes since construction or last inspection:**

**Downstream development:**

**This dam would not be a menace if it failed.**  
**Suggested reinspection date:**

**Remarks:** Saw leaks 4' Pinstock N/T 10/4/74
# Site Evaluation Data

**Owner:** John Colby Jr  
**Telephone No.:**

**Mailing Address:** Harrisville

**Site Location (Town or City):** Harrisville

**Name of Stream or Waterbody:** Harrisville

**Quadrangle:**  
**Location:**

**Height of (Proposed, Existing) Dam:** 21  
**Length:** 75

**Type of (Proposed, Existing) Structure:**

**Drainage Area:** 10.95 m²  
**Pond Area:** 119 A

**Available Artificial Storage:**  
- Permanent:  
- Temporary:  
- Total: 2000

**Existing Development Downstream of (Proposed, Existing) Structure:**  
- Mill  
- Other Dam

**Potential Development Downstream of (Proposed, Existing) Structure:** Limited

**Potential Damage Downstream of Structure:** (Explain in detail and include any potential loss of life estimate.)  
- Washout of Toyshop and damage to mill  
- Possible loss of life from people in mill

**Other Comments:**

**Class of Structure:** Non-Menace  
**Menace:**

**DAM # 109.08**

**Date of Inspection:** 12 Dec 75

**Signed:**

**Date:**
NEW HAMPSHIRE WATER RESOURCES BOARD

INSPECTION REPORT

Town: Harrisville Dam Number: 109.03

Name of Dam, Stream and/or Water Body: Harrisville Lake

Owner: John Cilley Jr. Telephone Number:

Mailing Address: Harrisville

Max. Height of Dam: 21' Pond Area: 119.34 Length of Dam: 75'

FOUNDATION:

OUTLET WORKS:

Spillway 3'7" wide 2'5' Freeboard

Overflow 2" higher than spillway go under road with 4' Dia Culvert. Water from over flow goes in below mill.

4 Gates 2'x3' all work 250 to 2700 ft

Pinstock

ABUTMENTS:

Granite Face with Earth Behind. Good Shear

ENRANEMENT:

Note: Give Sizing Condition and detailed description for each item, if applicable.
SPILLWAY: Length: 3' 7" Freeboard: 2' 6"

SEEPAGE: Location, estimated quantity, etc.
Seepage through left side over ground settled on embankment above.

Changes Since Construction or Last Inspection:

Tail Water Conditions:
Tail water has about 3 x 8 ft. lets through bank.

Overall Condition of Dam: Fair
Contact With Owner: Yes
Date of Inspection: 12 Dec 75 Suggested Reinspection Date 1977
Class of Dam: Menace C

Signature: J. Burnett
Date

COMMENTS: Rocks below overflow exist at r. end. They should be removed to improve flow.
APPENDIX C

PHOTOGRAPHS
## LOCATION PLAN

Plan 1 - Location of Photographs Taken May 22, 1978

## PHOTOGRAPHS

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Negative No.</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Intake Channel and the Dam Intake Structure, Looking Northeast.</td>
<td>1-17</td>
<td>C-4</td>
</tr>
<tr>
<td>2.</td>
<td>Intake Structure, Right - Intake Conduit to Spillway Mill Building Built on Top of Dam.</td>
<td>1-13</td>
<td>C-4</td>
</tr>
<tr>
<td>3.</td>
<td>Rack-and-Pinion Gate Operators Over the Intake Structure.</td>
<td>1-16</td>
<td>C-5</td>
</tr>
<tr>
<td>4.</td>
<td>Detail of Rack-and-Pinion Gate Operators.</td>
<td>1-20</td>
<td>C-5</td>
</tr>
<tr>
<td>5.</td>
<td>Settlement of Backfill Near the Intake Structure, Looking Downstream into the Basement Window.</td>
<td>3-18A</td>
<td>C-6</td>
</tr>
<tr>
<td>6.</td>
<td>Columns Supporting the Mill Floor Over the Basement Which is Part of the Downstream Channel.</td>
<td>3-12A</td>
<td>C-6</td>
</tr>
<tr>
<td>7.</td>
<td>Dam Looking Upstream from the Basement of the Mill; Left - Spillway; Right - Abandoned Penstock; Center - Sluice Opening.</td>
<td>1-12</td>
<td>C-7</td>
</tr>
<tr>
<td>8.</td>
<td>Spillway and Sluice Opening, Looking Upstream, Inside of the Basement.</td>
<td>3-15A</td>
<td>C-7</td>
</tr>
<tr>
<td>9.</td>
<td>Penstock, Upper End, With a Hole On Top Near the Intake Structure.</td>
<td>3-14A</td>
<td>C-8</td>
</tr>
<tr>
<td>No.</td>
<td>Description</td>
<td>Negative No.</td>
<td>Page</td>
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<td>-----</td>
<td>------------------------------------------------------------------------------</td>
<td>--------------</td>
<td>------</td>
</tr>
<tr>
<td>10.</td>
<td>Dam Masonry Looking Upstream from the Basement of the Mill, Abandoned Penstock to the Left.</td>
<td>3-17A</td>
<td>C-8</td>
</tr>
<tr>
<td>11.</td>
<td>Penstock (Abandoned), Lower End and the Downstream Channel, Looking from the Basement of Mill Building.</td>
<td>3-13A</td>
<td>C-9</td>
</tr>
<tr>
<td>12.</td>
<td>Penstock Coming Out of the Basement of Mill Building.</td>
<td>2-8</td>
<td>C-9</td>
</tr>
<tr>
<td>13.</td>
<td>Upper Mill (Over the Dam) and the Toy Shop (Right), Downstream Channel Below these Buildings.</td>
<td>1-18</td>
<td>C-10</td>
</tr>
<tr>
<td>14.</td>
<td>Downstream Channel Looking Up, Toy Shop Straddles this Channel, the Upper Mill is in Background, with the Dam Under it.</td>
<td>1-9</td>
<td>C-10</td>
</tr>
<tr>
<td>15.</td>
<td>Downstream Channel, Looking from the Toy Shop.</td>
<td>2-6</td>
<td>C-11</td>
</tr>
<tr>
<td>16.</td>
<td>Lower Mill and Pond, Looking from the Road below the Toy Shop.</td>
<td>2-11</td>
<td>C-11</td>
</tr>
<tr>
<td>17.</td>
<td>Bridge Over Channel from Harrisville Pond to the Inner Pond.</td>
<td>3-20A</td>
<td>C-12</td>
</tr>
<tr>
<td>18.</td>
<td>Bridge Over Intake Channel from the Inner Pond to the Dam, Looking Upstream.</td>
<td>3-22A</td>
<td>C-12</td>
</tr>
<tr>
<td>19.</td>
<td>Harrisville Pond Looking West, with Overflow Weir in Front.</td>
<td>1-4</td>
<td>C-13</td>
</tr>
<tr>
<td>20.</td>
<td>Four-Foot Diameter Culvert Looking West, Upstream.</td>
<td>1-3</td>
<td>C-13</td>
</tr>
<tr>
<td>21.</td>
<td>Four-Foot Diameter Culvert Looking East, Downstream.</td>
<td>1-2</td>
<td>C-14</td>
</tr>
<tr>
<td>22.</td>
<td>Discharge of Four-Foot Diameter Culvert to the Pond Below the Toy Shop.</td>
<td>1-11</td>
<td>C-14</td>
</tr>
</tbody>
</table>
1. Intake Tunnel and the Dam Intake Structure, Looking Northwest.

2. Intake Structure. Sheet - Intake Tunnel; Shaft, Mill. A Minor Point on Top of Dam.

4. Detail of Rack-and-Pinion Gate Operators.
5. Settlement of Backfill Near the Intake Structure, Looking Downstream into the Basement Window

6. Columns Supporting the Mill Floor Over the Basement Which is Part of the Downstream Channel.
7. Dam Looking Upstream from the Paseament of the Mill.
Left - Spillway; Right - Abandoned Penstock;
Center - Sluice Opening.


10. Dam Masonry Looking Upstream from the Basement of the Mill. Abandoned Penstock to the Left.
11. Penstock (Abandoned), Lower End and the Downstream Channel, Looking from the Basement of the Mill Building.

13. Upper Mill (Over the Dam) and the Toy Shop (Right). Downstream Channel Below These Buildings.

14. Downstream Channel Looking Up. Toy Shop Straddles this Channel, the Upper Mill is in Background With the Dam Under it.
15. Downstream Channel, Looking from the Toy Shop.

16. Lower Mill and Pond, Looking from the Road Below the Toy Shop.
17. Bridge over Channel from Barricades toward Inner Port.
11. Four-Foot Diameter Culvert Looking East, Downstream.

16. Discharge of Four-Foot Diameter Culvert to the Pond below the Troy Ship.
APPENDIX D

HYDROLOGIC & HYDRAULIC COMPUTATIONS
The drainage area of Harricville Pond at dam

\[ = 10.6 \text{ square miles} \]

The drainage area of Harricville Pond, is
characterized by rolling topography. Hence, from guide curves furnished by the Corps of Engineers, it is found that

Probable maximum flood peak in feet

\[ = 1650 \times 10 \text{ cfs} \]
\[ = 16,500 \text{ cfs} \]

According to size classification, Harricville Pond dam is intermediate in size.

According to hazard classification Harricville dam falls under the category of high hazard dam.

Therefore, the adopted spillway test flood peak inflow \( (Q_p) = 16,500 \text{ cfs} \).
Max. length of travel = 31,700 ft.

Diff. in Elevation = 46 ft.

\[ T = \frac{(31,700)^{1.15}}{7700 \times (46)^{0.68}} \text{ hrs} \]

\[ = \frac{15.0044}{7700 \times 10.327} \]

\[ = 1.886 \text{ hrs} \]

\[ = 2.0 \text{ hrs} \]

Spillway test flood peak inflow = 16,500 cfs.
**SPILLWAY TEST FLOOD INFLOW HYDROGRAPH**

(BASED ON SCS DIMENSIONLESS HYDROGRAPH)

\[ T_c = 2.0 \text{ hrs.} \]
\[ Q_p = 16,500 \text{ hrs.} \]

<table>
<thead>
<tr>
<th>7 (hrs)</th>
<th>( T/T_c )</th>
<th>( Q/Q_p )</th>
<th>Q (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.50</td>
<td>0.25</td>
<td>0.05</td>
<td>825</td>
</tr>
<tr>
<td>1.00</td>
<td>0.50</td>
<td>0.18</td>
<td>2970</td>
</tr>
<tr>
<td>1.50</td>
<td>0.75</td>
<td>0.73</td>
<td>12045</td>
</tr>
<tr>
<td>2.00</td>
<td>1.00</td>
<td>1.00</td>
<td>16500</td>
</tr>
<tr>
<td>2.50</td>
<td>1.25</td>
<td>0.80</td>
<td>13200</td>
</tr>
<tr>
<td>3.00</td>
<td>1.50</td>
<td>0.40</td>
<td>6600</td>
</tr>
<tr>
<td>3.50</td>
<td>1.75</td>
<td>0.25</td>
<td>4125</td>
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<tr>
<td>4.00</td>
<td>2.00</td>
<td>0.17</td>
<td>2805</td>
</tr>
<tr>
<td>4.50</td>
<td>2.25</td>
<td>0.06</td>
<td>990</td>
</tr>
<tr>
<td>5.00</td>
<td>2.50</td>
<td>0.02</td>
<td>330</td>
</tr>
<tr>
<td>5.50</td>
<td>2.75</td>
<td>0.01</td>
<td>165</td>
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</table>
It is assumed that the stability must be at ELE. 1318.0
Surface area of lake at ELE. 1318 = 114.0 acres

<table>
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<tr>
<th>ELEVATION</th>
<th>STORAGE (Acres·feet)</th>
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<tr>
<td>1318.0</td>
<td>2000</td>
</tr>
<tr>
<td>1318.5</td>
<td>2060</td>
</tr>
<tr>
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<td>2119</td>
</tr>
<tr>
<td>1320.0</td>
<td>2239</td>
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<td>2358</td>
</tr>
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<td>1322.0</td>
<td>2478</td>
</tr>
<tr>
<td>1325.0</td>
<td>2835</td>
</tr>
<tr>
<td>1330.0</td>
<td>3432</td>
</tr>
<tr>
<td>1335.0</td>
<td>4029</td>
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</table>
**FAME: SPOAOG 6 TNOA. OfKL W~C**

**FILE NUMBER BN-914**

**SHEET NUMBER 5 F P**

**DATE 7-28-1972**

**CHECKED BY**

---

**SUBJECT: HARRISVILLE POND**

**DISCHARGE RATING TABLE FOR THE WASTE SLUICE**

- Invert Elevation of Waste Sluice = 1305.3
- Elevation of the Center of Sluice = 1308.3
- Area of Waste Sluice = 4 x 0.4 = 2.87 ft
- Assume
  - C_d = 0.45 (ENESCO p. 53 for influent discharge)

**Discharge Calculation**

\[
Q = C_d \cdot A \cdot \sqrt{2gY} = 0.45 \cdot 2.87 \cdot \sqrt{5} = 86.4 \text{ ft}^3/\text{s}
\]

<table>
<thead>
<tr>
<th>ELEV.</th>
<th>Y</th>
<th>Q W.S.</th>
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<tbody>
<tr>
<td>1318</td>
<td>9.70</td>
<td>264.0</td>
</tr>
<tr>
<td>1318.5</td>
<td>10.20</td>
<td>276.0</td>
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<tr>
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<td>10.70</td>
<td>283.0</td>
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<td>11.20</td>
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<td>296.0</td>
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<tr>
<td>1320.5</td>
<td>12.20</td>
<td>302.0</td>
</tr>
<tr>
<td>1321.0</td>
<td>12.70</td>
<td>314.0</td>
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<td>443.0</td>
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<td>461.0</td>
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</table>
FAT SPOPOD A
C

FAT SPOPOD A
C

PROJECT EN-204 (D)
FILE NUMBER EN-206
SHEET NUMBER 6 OF 6
DATE 11-6-1978
COMPUTED BY VAM
CHECKED BY

HARRISVILLE POND DAM
DISCHARGE RATING TABLE FOR
SPILLWAY

ASSUME THAT THE SPILLWAY CRUST ELEV = 1318.0

SPILLWAY LENGTH = 3 FEET 7 INCHES
= 3.58 FEET

The height of opening in the wall above the spillway crust = 2.5 FEET

It is assumed here that the elevation of the country road above 4 feet diameter road culvert
PEL CE = 1320.5

It means that as long as the water surface elevation in the pond rises above 1320.5 during
flooding, there will be overflowing over the roadway.
It is also assumed that the effective length of the roadway = 200 FEET

DISCHARGE OVER SPILLWAY

HEAD ELE.

\( H_1 = 0.5 \) 1318.5 \( Q_s = 2.8 \times 3.58 \times (0.5)^{0.5} = 3.5 \text{ cfs} \)

\( H_1 = 1.0 \) 1319.0 \( Q_s = 2.8 \times 3.58 \times 1 = 10.0 \text{ cfs} \)

\( H_1 = 1.5 \) 1319.5 \( Q_s = 2.8 \times 3.58 \times (1.5)^{0.5} = 18.4 \text{ cfs} \)

\( H_1 = 2.0 \) 1320.0 \( Q_s = 2.8 \times 3.58 \times (2)^{0.5} = 28.35 \text{ cfs} \)

\( H_1 = 2.5 \) 1320.5 \( Q_s = 2.8 \times 3.58 \times (2.5)^{0.5} = 39.59 \text{ cfs} \)

For \( H_1 > 2.5 \), the opening functions as a rectangular orifice.

\( Q = C \cdot A \cdot \sqrt{2gh} \)

Let \( C = 0.54 \).
SPILLWAY.

\[ h = 3.56 \times 2.5 = 8.95 \text{ ft} \]

\[ C_h = 0.54 \times 8.95 \times 8.02 = 36.76 \]

\[ Q = 36.76 \sqrt{h} \]

\[ h_1 = 3.5 \quad 1321.5 \quad Q_1 = 36.76 \sqrt{12.25} = 58.0 \text{ cfs} \]

\[ h_1 = 4.5 \quad 1322.5 \quad Q_2 = 36.76 \sqrt{13.25} = 70.0 \text{ cfs} \]

\[ h_1 = 5.5 \quad 1323.5 \quad Q_3 = 36.76 \sqrt{14.25} = 80.0 \text{ cfs} \]

\[ h_1 = 6.6 \quad 1324.5 \quad Q_4 = 36.76 \sqrt{15.25} = 89.0 \text{ cfs} \]

\[ h_1 = 7.5 \quad 1325.5 \quad Q_5 = 36.76 \sqrt{16.25} = 97.0 \text{ cfs} \]

\[ h_1 = 8.5 \quad 1326.5 \quad Q_6 = 36.76 \sqrt{17.25} = 104.0 \text{ cfs} \]

\[ h_1 = 10.5 \quad 1328.5 \quad Q_7 = 36.76 \sqrt{19.25} = 118.0 \text{ cfs} \]

\[ h_1 = 12.5 \quad 1330.5 \quad Q_8 = 36.76 \sqrt{21.25} = 130.0 \text{ cfs} \]

\[ h_1 = 14.5 \quad 1332.5 \quad Q_9 = 36.76 \sqrt{23.25} = 141.0 \text{ cfs} \]

\[ Q_5 = 36.76 \sqrt{10.15} = 123.0 \text{ cfs} \]
### Gates Table for Roadway

\[ Q = \frac{2.6 \times 200 \times H^{3/2}}{520 \times H^{3/2}} \]

<table>
<thead>
<tr>
<th>( H )</th>
<th>Elevation</th>
<th>( Q = 520H^{3/2} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>1321.5</td>
<td>520.0</td>
</tr>
<tr>
<td>2.0</td>
<td>1322.5</td>
<td>1471.0</td>
</tr>
<tr>
<td>3.0</td>
<td>1323.5</td>
<td>2702.0</td>
</tr>
<tr>
<td>4.0</td>
<td>1324.5</td>
<td>4160.0</td>
</tr>
<tr>
<td>5.0</td>
<td>1325.5</td>
<td>5814.0</td>
</tr>
<tr>
<td>6.0</td>
<td>1326.5</td>
<td>7642.0</td>
</tr>
<tr>
<td>8.0</td>
<td>1328.5</td>
<td>11766.0</td>
</tr>
<tr>
<td>10.0</td>
<td>1330.5</td>
<td>16444.0</td>
</tr>
<tr>
<td>12.0</td>
<td>1332.5</td>
<td>21615.0</td>
</tr>
</tbody>
</table>

Discharge through the 4 feet diameter pipe culvert under the roadway is ignored as the contribution is negligibly small. It is also assumed that the invert elevation of the pipe culvert is about 7 feet below the top of roadway. That is, invert elevation of pipe culvert = 1313.5 feet.
**Composite Discharge Rating**

<table>
<thead>
<tr>
<th>ELEV.</th>
<th>DISCHARGE Q_s</th>
<th>WASTE SLUICE Q_w,s</th>
<th>FLOWOVER ROADWAY Q_Rw</th>
<th>TOTAL Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>1318.0</td>
<td>0.0</td>
<td>269</td>
<td></td>
<td>269.0</td>
</tr>
<tr>
<td>1318.5</td>
<td>3.5</td>
<td>276</td>
<td></td>
<td>280.0</td>
</tr>
<tr>
<td>1319.0</td>
<td>10.0</td>
<td>283</td>
<td></td>
<td>293.0</td>
</tr>
<tr>
<td>1319.5</td>
<td>18.4</td>
<td>289</td>
<td></td>
<td>307.8</td>
</tr>
<tr>
<td>1320.0</td>
<td>28.35</td>
<td>296</td>
<td></td>
<td>324.0</td>
</tr>
<tr>
<td>1320.5</td>
<td>39.59</td>
<td>302</td>
<td>0.0</td>
<td>342.0</td>
</tr>
<tr>
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<td>314</td>
<td>52.1</td>
<td>843.0</td>
</tr>
<tr>
<td>1322.5</td>
<td>70.10</td>
<td>326</td>
<td>1471.0</td>
<td>1867.0</td>
</tr>
<tr>
<td>1323.5</td>
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<tr>
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<td>16951.0</td>
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<td>141.00</td>
<td>425</td>
<td>21615.0</td>
<td>22181.0</td>
</tr>
</tbody>
</table>

**Discharge Through Pipe Culvert at ELEV 1239.40**

Assume Type 5 Flow i.e. the culvert entrance is submerged, and the tailwater is below the crown at the outlet.

\[
\frac{h_z - z}{D} = \frac{15.9}{4} = 4.0
\]

\[
Q = C A_o \sqrt{2gh_z} = 0.72 \times \frac{\pi}{4} \times 4^2 \times \sqrt{2 \times 4.4 \times 15.9} (\text{Assume } z = 0)
\]

\[
= 9.048 \times 32.0
\]

\[
= 290.0 \text{ cfs}
\]
HARRISVILLE POND DAM
TO DETERMINE PEAK CUTOFF

SPILLWAY TEST FLOOD PEAK INFLOW ($Q_p$)

$Q_p = 16,500$ cfs

TRIAL #1:

ASSUME inflow volume = 19" of runoff from P.A.

Available discharge storage up to top of

receding abate emergency spillway outlet

Penelec 7 feet above spillway crest.

$$\text{Pond discharge storage} = \frac{1.56}{19} \times 12$$

$$= 1.56 \text{ inches of runoff from P.A.}$$

$$\frac{\text{Pond discharge storage}}{\text{Inflow runoff in ft}} = 0.082$$

Referring to Figure 17-11 in Sec NEH, Section 4

$\frac{\text{Outflow peak rate}}{\text{Inflow peak rate}} = 0.94$

$\text{Outflow peak rate} = 0.94 \times 16,500$

$= 15,510$ cfs.
From the composite rating curve, the above outflow peak rate corresponds to ELEV. 1329.90

\[ \text{i.e. Surchage height above the spillway crest} = 11.90 \text{ feet} \]

\[ \text{Vol. of Surchage storage (STOR)} = \frac{119 \times 11.90}{10 \times 640} \times 12 \]

\[ = 2.655 \text{ inches of runoff from D.A.} \]

\[ \text{Peak outflow } Q_p = Q_m \left(1 - \frac{\text{STOR}}{19}\right) \]

\[ = 16500 \left(1 - \frac{2.655}{19}\right) \]

\[ = 16500 \left(1 - 0.140\right) \]

\[ = 14190 \text{ cfs.} \]
TRIAL #3:

From the composite discharge rating curve the above outflow peak rate corresponds to ELEV. 1329.35

i.e. surcharge h. above the spillway crest

= 11.35 ft.

Vol. of surcharge storage (GTOA)

\[ V = \frac{119 \times 11.35}{10 \times 640} \times 12 \]

= 0.211 inches of runoff from GTOA

Peak outflow \( Q_p \) = 16,500 \( (1 - \frac{0.211}{19}) \)

= 16,500 \( (1 - 0.011) \)

= 15,685 cfs.
TRIAL # 4:

From the composite discharge rating curve the above outflow Peak Rate comes to: 16,500 cfs to ELEV. 1324.5

drainage area above the spillway crest

= 11.5 feet

Volume of discharge change (570 cu.ft)

= \frac{119 \times 11.5}{10 \times 640} \times 12

= 2.566 inches of runoff from dam.

Peak outflow \( Q_2 \) = 16,500 \( (1 - \frac{2.566}{19}) \)

= 16,500 \( (1 - 0.135) \)

= 14,272.0 cfs.
TRIAL #5:

From the composite discharge rating curve, the above outflow peak rate corresponds to ELEV. 1329.35

i.e. surcharge h. above the spillway crest = 11.35 f.6-

VOL. OF SURCHARGE STORAGE (STOR2)

\[
\text{VOL. OF SURCHARGE STORAGE (STOR2)} = \frac{119 \times 11.35}{10 \times 640} \times 12
\]

\[= 2.53 \text{ inches of runoff from } \text{D.A.}\]

Average of \text{STOR1 and STOR2}

\[
\text{Average of } \text{STOR1 and STOR2} = \frac{2.56 + 2.55}{2}
\]

\[= 2.549 \text{ inches of runoff from } \text{D.A.}\]

PEAK OUTFLOW = 16,500 \left(1 - \frac{2.548}{19}\right)

\[= 16,500 \left(1 - 0.134\right)
\]

\[= 14,289 \text{ cfs.}\]
The corresponding maximum ptc
elution = 1329.40.

Maximum breach height = 11.40 feet.

At the maximum ptc elution, the spillway can
pass 123.0 cfs.

Here, the question of overtopping the dam does
not arise as the dam forms the foundation of
the northern half of a two-story mill building.

Roadway over the culvert pipe would be
overtopped by 8.9 feet.

Without overtopping the roadway, (i.e. at elev.
1320.5), the spillway and the waste device
together can pass only about 342 cfs.

That is about 2.5% of the test flotation
peak outflow.
WATER IN THE VICINITY OF DAMAGE IMPACT AREA DUE TO BREACH IN THE DAM AT RESERVOIR FULL CONDITION.

As explained in section 1.2.6, it is not possible to generate downstream dam failure hydrograph in the vicinity of damage impact area using USGS topo map on which the contours are at 20-foot intervals.

Besides, no other topographic map is available for the area.

From the knowledge of the damage impact area, in the vicinity of Eastview Village which is a distance of 1 1/2 miles downstream of Harrisville Pond Dam, a flood parade estimate has been made as follows:

Depth of water above the streambed at F.E.L

\[ \text{Depth} = 1318 - 1297 = 21 \text{ feet} \]

Height of flood surge at damage impact area is estimated to be about 14 feet. Width of water spread at damage impact area is approximately indicated on the USGS map included in APPENDIX D.
STORAGE CAPACITY - ELEVATION CURVE

FAY, SPOFFORD & THORNDIKE, INC.
ENGINEERS
BOSTON, MASS.

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

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

HARRISVILLE POND DAM

NEW HAMPSHIRE

SCALE AS SHOWN

DATE AUGUST, 1978
APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS
## INVENTORY OF DAMS IN THE UNITED STATES

<table>
<thead>
<tr>
<th>STATE</th>
<th>COUNTY</th>
<th>POST</th>
<th>NAME</th>
<th>LATITUDE (NORTH)</th>
<th>LONGITUDE (WEST)</th>
<th>REPORT DATE</th>
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<tr>
<td>NH</td>
<td>005</td>
<td>02</td>
<td>HARRISVILLE POND DAM</td>
<td>72°46.7'</td>
<td>76°05.9'</td>
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<table>
<thead>
<tr>
<th>POPULAR NAME</th>
<th>NAME OF IMPOUNDMENT</th>
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<tr>
<td>UPPER POND DAM</td>
<td>HARRISVILLE POND</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>REGION</th>
<th>BASIN</th>
<th>RIVER OR STREAM</th>
<th>NEAREST DOWNSTREAM CITY-TOWN-VILLAGE</th>
<th>DIST FROM DAM</th>
<th>POPULATION</th>
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<tbody>
<tr>
<td>01.08</td>
<td>NUBANSIT HOUK</td>
<td>HARRISVILLE</td>
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<td>650</td>
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<tr>
<th>TYPE OF DAM</th>
<th>YEAR COMPLETED</th>
<th>PURPOSES</th>
<th>STAGE HEIGHT</th>
<th>HYDRAULIC</th>
<th>IMPOUNDING CAPACITIES</th>
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<td>RO</td>
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<td>21</td>
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<table>
<thead>
<tr>
<th>DIST OWN</th>
<th>FED</th>
<th>PRV/FED</th>
<th>SCS</th>
<th>A</th>
<th>VER/DATE</th>
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<tr>
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<td>N</td>
<td>N</td>
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<td>N</td>
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### REMARKS

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<thead>
<tr>
<th>D/S HAS</th>
<th>SPILLWAY</th>
<th>MAXIMUM DISCHARGE</th>
<th>VOLUME OF DAM</th>
<th>POWER CAPACITY</th>
<th>NAVIGATION LOCKS</th>
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<tbody>
<tr>
<td>1</td>
<td>75</td>
<td>N</td>
<td>4</td>
<td>175</td>
<td>800</td>
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<table>
<thead>
<tr>
<th>OWNER</th>
<th>ENGINEERING BY</th>
<th>CONSTRUCTION BY</th>
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<tbody>
<tr>
<td>JOHN COLUNY, JR.</td>
<td></td>
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<table>
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<tr>
<th>REGULATORY AGENCY</th>
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<table>
<thead>
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<th>INSPECTION DATE</th>
<th>AUTHORITY FOR INSPECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAY SPOFFORD &amp; THORNDIKE, INC</td>
<td>22 MAY 78</td>
<td>PL92-367</td>
</tr>
</tbody>
</table>

### REMARKS
END

FILMED

8-85

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