CONNECTICUT RIVER BASIN
WHATELY, MASSACHUSETTS

NORTHAMPTON RESERVOIR
(UPPER DAM)
MA 00521

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

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**NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS**

**Northampton Reservoir**
(Upper Dam)  

**Performing Organization Name and Address**
U.S. Army Corps of Engineers  
New England Division  
DEPT. OF THE ARMY, CORPS OF ENGINEERS  
NEW ENGLAND DIVISION, NEDED  
424 TRAPELO ROAD, WALTHAM, MA. 02254  

**Monitoring Agency Name and Address**

**Report Date**
August 1978

**Number of Pages**
63

**Security Classification of This Report**
UNCLASSIFIED

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**Supplementary Notes**
Cover program reads: Phase I inspection report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

**Key Words**
Dams, Inspection, Dam Safety, Connecticut River Basin, West Brook, Whately, Massachusetts

**Abstract**
The dam is a 940 ft. long earth embankment dam with a concrete spillway. The visual inspection did not disclose any findings that indicate an immediate unsafe condition. It is recommended that the areas of erosion both on the upstream and downstream faces where the abutments and embankment interface be repaired. Surface water in these areas should be redirected to prevent further erosion.
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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 Michael S. Dukakis
Governor of the Commonwealth of Massachusetts
State House
Boston, Massachusetts 02133

Dear Governor Dukakis:

I am forwarding to you a copy of the Northampton Reservoir (Upper Dam) Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Quality Engineering, the cooperating agency for the Commonwealth of Massachusetts. In addition, a copy of the report has also been furnished the owner, the City of Northampton, c/o Board of Public Works - Water Division, 237 Prospect Street, Northampton, Massachusetts 01060.

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

I wish to take this opportunity to thank you and the Department of Environmental Quality Engineering for your cooperation in carrying out this program.

Sincerely yours,

Incl
As stated

JOHN P. CHANDLER
Colonel, Corps of Engineers Division Engineer
Identification No.: MA. 00521
Name of Dam: Northampton Reservoir (Upper Dam)
Town: Whately
County and State: Franklin County, Massachusetts
Stream: West Brook
Date of Inspection: May 25, 1978

This dam is a 940 foot long earth embankment dam with a concrete spillway. The dam was designed in the mid 1960's and constructed in 1970. The engineering data made available were a set of construction drawings and specifications. These were furnished by the City of Northampton, owners of the dam.

The visual inspection did not disclose any findings that indicate an immediate unsafe condition. Based on size and hazard classification in accordance with Corps guidelines, the test flood is the Probable Maximum Flood. However, the dam's spillway will not pass the PMF without overtopping.

It is recommended that the areas of erosion both on the upstream and downstream faces where the abutments and embankment interface be repaired. Surface water in these areas should be redirected to prevent future erosion. The riprap on the upstream face should be extended to the dam's crest. The water exiting from the toe and core wall drains should be directed to a control channel and weir where the flow can be periodically measured.

This dam has a thin concrete core wall and, although the dam is in earthquake zone 2 and not normally requiring earthquake evaluation...
the effects of earthquake shaking on the integrity of the core wall should be investigated.

The 20" capped pipe running beneath the dam to the downstream toe should be uncapped and extended to the lower reservoir. This will prevent the potential of a pressurized pipe (should the outlet gate be left open) from bursting and undermining the dam.

Although the spillway can not discharge the test flood without overtopping the dam, the spillway capacity is comparatively large. Because of the hydrologic and safety relationships between this dam and the lower reservoir, it is necessary that future hydrologic studies concerning spillway capacities at either project should simultaneously encompass studies for both projects.

These recommendations are not of an urgent nature but should be implemented within a period of 2 to 4 years.

Ronald H. Cheney, P.E.
Associate
Hayden, Harding & Buchanan, Inc.
Boston, Massachusetts

Northampton Upper Dam
This Phase I Inspection Report on Northampton Reservoir (Upper 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, Chairman
Chief, Foundation and Materials Branch
Engineering Division

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

SAUL COOPER, Member
Chief, Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division  SEP 17, 1973
PREFACE

This report is prepared under guidance contained in Department of the Army, Office of the Chief of Engineers, Recommended Guidelines for Safety Inspection of Dams, for a Phase I Investigation. 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

Northampton Upper Dam
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 reasonably 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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**LETTER OF TRANSMITTAL**

**BRIEF ASSESSMENT**

**REVIEW BOARD SIGNATURE SHEET**

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PHASE I
NATIONAL DAM INSPECTION PROGRAM
NORTHAMPTON RESERVOIR (UPPER 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. Hayden, Harding & Buchanan, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Massachusetts. Authorization and notice to proceed was issued to Hayden, Harding & Buchanan, Inc. under a letter of May 3, 1978, from Mr. Ralph T. Garver, Colonel, Corps of Engineers. Contract No. DACW 33-78-C-0307 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.
Section 1.1 Continued

(2) Encourage and assist 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

Northampton Reservoir Upper Dam is located in the Town of Whately in Franklin County, Massachusetts, just upstream of Northampton Reservoir Lower Dam.

b. Dam and Appurtenances

The dam is a 940' long, 80' high earth embankment structure having a riprap upstream face sloping at 2:1 and a turf covered downstream face sloping at 2:1. Located within the center of the dam is a 2' wide concrete core wall. The top of the dam embankment section has a width of 20 feet. Located adjacent to the embankment on the eastern side is a 66' wide 35' high concrete spillway, having a vertical upstream face and downstream face sloping at approximately 3:4. Located within the upstream embankment approximately 70' north of the top of the dike is a gate structure. This structure has a 20" diameter low level intake pipe and two intermediate level intake gates. Two 20" diameter D.I. pipes exit from the bottom. One pipe empties into the lower reservoir directly below this site. The other pipe is capped just beyond the toe of the dam.
Section 1.2 Continued

c. Classification

The dam can be classified by size as intermediate due to its hydraulic height of 80 feet and its storage capacity of 2865 a.f.

d. Hazard Classification

The dam has a high hazard potential for loss of life should a complete failure occur. Approximately 15 habitable structures could be damaged by the dam's failure.

e. Ownership

The dam is owned by the City of Northampton and has always been part of their water supply system.

f. Operation

The dam is maintained and operated by the Board of Public Works - Water Division located at 237 Prospect Street, Northampton, Massachusetts. Mr. Leon Murray is the Superintendent of the Water Division (tel. 413-584-1401).

g. Purpose of Dam

The dam's purpose is water supply. Water is drawn into the intake structure flowing through the 20" diameter D.I. discharge pipe and empties into the lower reservoir directly below the dam.

h. Design and Construction History

The dam was designed by the engineering firm of Whitman & Howard, Inc., Wellesley, Massachusetts. The construction was completed in 1970 and no major repair program has been instituted since its completion.
1.3 Pertinent Data

a. Drainage Area

Drainage Area (2897 acres - 4.52 s.m.) is comprised of wooded, rolling hills, containing several drainage paths. The main drainage path is the Avery Brook. It's length is 3.6 miles and has a drop in elevation of 550 feet. Steep changes in the brook's elevation are intercepted by "flat" areas in several locations.

There are very few homes within the area and roads appear to be unimproved dirt roads.

Below the dam is the area known as West Whately. There are several buildings and homes located within 1000 feet of the dam. These buildings are located within 400' of the discharge stream known as West Brook. The brook flows for about a mile before any buildings come within 200 feet of the stream bed. Beyond that, development is scattered and not close to the brook.

b. Discharge at Dam Site

This dam has two 20 inch diameter D.I. pipes exiting from the intake structure at Inv. El. 624.17. One pipe discharges directly into the lower reservoir. The other pipe is capped just below the toe of the dam. Other than the active 20 inch pipe there is no other means of dewatering this site.

The dam was constructed in 1970 and no record of maximum impoundment or spillway discharge is known. Area residents have witnessed flows of approximately 12 to 18 inches maximum above the spillway crest.
Section 1.3 Continued

The spillway is ungated and has an approximate capacity of 3320 c.f.s. (735 c.s.m.) at elevation 680.5.

c. Elevation (ft. above MSL)
   (1) PMF surcharge - 681.0
   (2) Top Dam - 680.5
   (3) Water Supply Pool - varies 675.0
   (4) Spillway crest (gated)-nongated 675.0
   (5) Upstream portal invert diversion tunnel-
       no diversion tunnel
   (6) Streambed at centerline of dam-600.±
   (7) Maximum tailwater-flows through spillway channel
        directly into lower reservoir elev. 601.±

d. Reservoir
   (1) Length of Water Supply Pool - 4000'±
   (2) Length of PMF Pool - 5000'

e. Storage (acre-feet)
   (1) Water Supply Pool - 2460
   (2) Top of Dam - 2820
   (3) PMF Surcharge - 4367
f. Reservoir Surface (acres)
   (1) Water Supply Pool - 79
   (2) Top Dam - 90
   (3) PMF Pool - 91
g. Dam

(1) Type-Gravity straight earth embankment
(2) Length-940'
(3) Height-90' (structural includes cutoff)
(4) Top Width-20'
(5) Side Slopes-2:1 riprap U.S., 2:1 turfed D.S.
(6) Zoning -none
(7) Impervious Core -Concrete Wall
(8) Cutoff -Core wall set on rock and till.
(9) Grout curtain -none

i. Spillway

(1) Type -Broad crest, concrete ogee
(2) Length of weir-66'
(3) Crest elevation-675.0
(4) Gates -none
(5) U/S Channel -none
(6) D/S Channel -Concrete paved for 60'

j. Regulating Outlets

The regulating outlets for this facility consists of the two 20" dia. D.I. outlet pipes from the intake structure. As described previously only one of these pipes is active, the other being capped. The active pipe flows directly into the lower reservoir. The Inv. elevation for both of these pipes is 624.17.
Section 1.3 Continued

The intakes consist of a lower level 20" dia. D.I. pipe at Inv. El. 629.17 and two 16" dia wall openings at Inv. Elevations 649.33 and 664.33.

All of the intakes and outlets are controlled by their own manually operated gate.

The intake structure is a reinforced concrete tower with inside dimensions of 7'-0" X 6'-0". It is founded on ledge at elevation 620.0± and the top slab is at elevation 680.0.
SECTION 2
ENGINEERING DATA

2.1 Design
This dam was designed by the Engineering firm of Whitman and Howard, Wellesly, Ma. The Construction drawings are dated 1965 with additional test borings added in 1969.

A complete set of construction drawings and Specifications was furnished by the City of Northampton. Hydraulic and Stability Calculations have been requested of Whitman and Howard. However, they are having difficulty locating these in their files and as of the date of this report have not been found.

2.2 Construction
Construction was completed in 1970 and as far as is known the in place dam is in agreement with the Contract drawings.

2.3 Operation
There are no formal records of operational procedures for this dam. The Caretaker and Superintendent of the water division indicated that no major problems have occurred since the dam has been put into operation.

2.4 Evaluation
a. Availability
Construction drawings and Specifications were made available by the City. Hydraulic calculations have not been found as of this date.
Section 2.4 Continued

b. Adequacy

It is felt that the construction drawings and the specifications are adequate for a Phase I report regarding structural stability. The original hydraulic and stability calculations along with any original soils reports have not been found as of the date of this report. Therefore the adequacy of this dam must be based on the limited data supplied along with the visual inspection and hydrologic and hydraulic assumptions.

c. Validity

The visual inspection of this facility showed no reason to question the validity of the information supplied. The possible exception is with the top of the riprap referred to later in this report.
3.1 Findings

a. General

The phase I inspection of this dam was made on May 25, 1978. The water in the reservoir was running over the Spillway approximately one inch. All Items on the upstream slope including the slope were therefore inspected from the water surface elevation up.

b. Dam

Visual inspection of the embankment showed no signs of distress.

Upstream Slope

Only the upper 6 ft. of the U.S. slope was visible at the time of inspection. The upstream slope has been protected with riprap which is in good condition. The riprap protection stops about 3 ft. below the crest of the dam. (See photo 3*) Design drawings indicate that the riprap should have been carried to the crest elevation of 680.00 ft. It is not known if the crest elevation has been raised or the riprap stopped at a lower elevation than intended. Design drawings indicate full reservoir elevation at 675.0 which would mean about two feet of protected freeboard exists under full reservoir height. There is no sign of erosion above the top of the riprap and this condition does not pose an immediate safety hazard to the dam at this time, however, it is recommended that additional riprap be added to protect the entire upstream slope to the crest.

*See Appendix C for this and all subsequent photos.
Section 3.1 Continued

There has been erosion of the contact of the upstream slope of the dam and the left abutment due to surface water runoff. (See photo 1.) This condition does not pose an immediate threat to the safety of the dam, but provisions should be made to collect surface runoff and prevent continued erosion.

Crest

The crest of the dam has no pavement. No evidence of erosion or cracking of the embankment was observed. The abutment of the service bridge appeared to be in good alignment.

Downstream Slope

The face of the downstream slope was traversed along four lines, (1) along the crest, (2) at approximate elevation 665.0, (3) along the berm (elev. 640.0) and (4) along the toe.

The slope is in good condition with an excellent turf and grass cover. There were occasional rodent holes in the surface.

No seepage or damp areas were observed along the toe.

There is an area of minor surface sloughing 40 feet left of the left spillway wing wall. (See photo 4.) The area is approximately 18 ft. square with its upper boundary at the intersection of the crest and the slope. The topography within this area is hummocky with reliefs of about 2 ft.

There is a surface erosion channel at the contact of the left abutment and the downstream slope. The lower end of this erosion channel which intersect the left spillway wall, has been filled with rock cleaned out of the spillway apron in an effort
to minimize further erosion. In some areas the erosion is quite deep as can be seen in photo 6. This surface erosion is not an immediate threat to the safety of the dam but it is recommended that this condition be corrected soon.

Similar erosion has occurred on the right abutment at the embankment contact. This erosion is not as severe as on the left abutment but maintenance measures should be taken to eliminate this surface erosion.

A 6" diameter toe drain was installed in the downstream slope. Two drain pipes, one leading from each abutment exit into the area of the original brook channel. Both of these drains are flowing small amounts of clear water. The drain from the right abutment is shown in photo 9.

A third drain exits into the old brook channel at the dam toe. This drain leads from a horizontal drain along the base of the concrete core wall. This drain which is submerged is flowing a large amount of clear water. Disturbance to the surface of the pool into which this drain discharges is shown in photo 9. It is recommended that a control channel and weir be constructed to permit measurement of seepage from the three drain pipes.

c. Appurtenant Structures

The intake structure was inspected above the water surface. The concrete was found to be in good condition with no cracks, spalls or rusted reinforcement evident. The service bridge of steel trusses and galvanized grating was found to be

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in good condition with only minor rust showing.

The spillway with its concrete walls and concrete paved outlet channel is in good condition. The channel walls do have some shrinkage and temperature cracks at approximate mid points between construction joints. With the exception of one joint which appears to have been constructed out of alignment by approximately one inch, all joints are in align. Some minor spalls exist at the expansion joints. The pavement of the outlet channel is good with only minor areas of surface erosion (1" max. depth).

The spillway has one large spall approximately triangular in shape 5 feet long and 10 inches wide at its base. This spall is 0" deep at its apex and 2"+ deep at its base. The spall is located at the base of the spillway approximately 4 ft. off the \( x \). Also where the upstream walls abut the spillway proper, there are cracks and spalls. These are the same cracks referred to in the state's inspection reports. The plans tend to confirm that this is properly caused by the spillway extending to rock while the walls are placed on soil foundation well above the rock. These cracks are shown in photo no. 13.

d. Reservoir Area

The reservoir area consists of wooded rolling hills. An indepth description of the drainage area is given in section 1.3a of this report. The amount of silation within the reservoir is unknown.

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Northampton Upper Dam
Section 3.1 Continued

e. Downstream Channel

Three recent landslides have occurred in the spillway discharge channel. These landslides are shown in photos 7 and 8. They present no immediate safety hazard to the dam but should be repaired soon to prevent continued erosion and further landsliding.

3.2 Evaluation

Visual examination indicates no immediate safety problems, however, erosion at the abutment/embankment contact areas due to surface water runoff should be stopped by redirecting the runoff or providing a suitably designed drainage way.
SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures

The water from this reservoir is used to supply the City of Northampton. The normal operating procedure is with the gate on the 20" dia. pipe which feeds water to the lower reservoir open allowing water to flow into the lower reservoir.

4.2 Maintenance of Dam

The City normally cuts the down stream slope once a year and inspects for animal burrows, filling those holes which are found.

4.3 Maintenance of Operating Facility

All manually operated gates for the intake structure and the outlet pipes are operated once a year by the City.

4.4 Description of Warning Systems

There are no warning systems associated with this dam.

4.5 Evaluation

The normal procedure of cutting turf and operating all the gates at least once a year appears adequate for this facility. This dam, however, should be inspected yearly by qualified personnel who can identify any areas of concern which could in time lead to serious deficiencies.
5.1 Evaluation of Features

a. Design Data

As of this report, the hydraulic computations for this dam have not been provided. Therefore the required test flood was developed as noted in "d" below.

b. Experience Data

Maximum impoundments and spillway flows for this dam are unknown. Residents of the area indicate the maximum height of water observed over the spillway to be 12 to 18 inches.

c. Visual Observations

Visual observations of the drainage area and general vicinity of the dam show them to be in general agreement with area U.S.G.S. map. Description of the drainage areas is given in Section 1.3 of this report.

d. Overtopping Potential

This dam carries an intermediate classification for size with a high hazard potential and as such should be capable of passing a PMF. This test flood was computed by determining the watershed drainage area from USGS maps in combination with Corps discharge guide curves. A PMF inflow of 8500 cfs was developed and results in a discharge of 7550 cfs. This discharge would result in the dam being overtopped by about 0.5 ft. (El. 681). With the reservoir level at 680.5, the spillway discharge is 3320 cfs (735 csm), which is equivalent to about a ½ PMF.
SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations
The visual inspection did not disclose any apparent stability problems.

b. Design and Construction Data
Design drawings and construction specifications exist and indicate that the dam is a homogeneous embankment consisting of "compacted pervious fill" with a concrete core wall. The embankment is founded on glacial till with a cut-off trench extending into the till on the right and to bedrock on the left side of the dam. The concrete core wall extends to the base of the cut-off trench. Both the upstream and downstream slopes of the embankment were designed on a 2H to 1V slope. A 10 ft wide berm exists 12 ft above the toe on the downstream and upstream slopes.

c. Operating Records
No operating records were made available.

d. Post-construction Changes
There are no known post-construction changes to the dam embankment.

e. Seismic Stability
The dam is located in Seismic Zone 2 according to U.S. Corps of Engineers guidelines and normally it would be assumed that there is no hazard from earthquake loading provided...
Section 6.1 Continued

static stability conditions are satisfactory and conventional safety margins exist. However, because the dam relies on a thin concrete core wall as a water barrier and the embankment is a homogeneous pervious fill, it is recommended that the owner engage a knowledgeable consulting engineer to evaluate the possibility of the occurrence of damage to the core wall during earthquake shaking.
SECTION 7
ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment
   a. Conditions
      The visual inspection did not disclose any findings that indicate an immediate unsafe condition.
   b. Adequacy
      The information available is such that a Phase I level investigation can be performed adequately.
   c. Urgency
      The recommendations presented in Sections 7.2 and 7.3 should be implemented by the owner within two to four years.
   d. Necessity of Additional Investigations
      The findings of the visual inspection do not warrant an additional investigation.

7.2 Recommendations
   The owner should engage a qualified consultant to evaluate the effect of earthquake shaking on the integrity of the concrete core wall.

7.3 Remedial Measures
   Although this dam is basically in good condition it is considered important that the following items be accomplished.
   a. Alternatives
      It is recognized that the dam will not pass the test flood without overtopping the dam. The spillway capacity is

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Northampton Upper Dam
comparatively large, however, because it could discharge a flood equivalent to a ½ PMF. Because of the hydrologic and safety relationships between the upper and lower water supply reservoirs, it is necessary that future hydrologic studies concerning spillway capacities at either project simultaneously encompass studies for both projects. Refer to the Northampton Reservoir Lower Dam, MA. 00520, Phase I Inspection Report.

b. Operation and Maintenance Procedures

(1) Repair surface erosion channels at abutment/embankment contacts upstream and downstream.

(2) Redirect and collect surface water along abutments to prevent further erosion.

(3) Riprap should be added to the upstream slope above the existing riprap to the crest elevation.

(4) A control channel and weir should be constructed to permit periodic measurement of flow from the three drainage pipes in the embankment.

(5) The 20 inch diameter capped pipe extending beyond the toe of the dam should be uncapped and extended to the lower reservoir. In lieu of extending the pipe, an adequately designed and riprapped channel could be provided. As it now stands, this pipe could be surcharged by a 50 foot head if the outlet gate at the intake structure is opened. Should the pipe

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burst while under this 50 foot head, serious undermining of the dam could ensue.

(6) This dam should be inspected annually by qualified personnel who can identify areas of concern which could, in time, lead to serious deficiencies.

(7) Around the clock surveillance should be provided during periods of unusually heavy precipitation. In addition, the owner should develop a formal system for warning downstream residents in case of emergency.
APPENDIX A

VISUAL INSPECTION CHECK LIST
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PERIODIC INSPECTION CHECK LIST

<table>
<thead>
<tr>
<th>AREA EVALUATED</th>
<th>CONDITIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAM EMBANKMENT</td>
<td></td>
</tr>
<tr>
<td>Crest Elevation</td>
<td>680.5</td>
</tr>
<tr>
<td>Current Pool Elevation</td>
<td>One inch above spillway crest</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>No pavement</td>
</tr>
<tr>
<td>Movement or Settlement of Crest</td>
<td>None observed</td>
</tr>
<tr>
<td>Lateral Movement</td>
<td>None observed</td>
</tr>
<tr>
<td>Vertical Alignment</td>
<td>No misalignment observed</td>
</tr>
<tr>
<td>Horizontal Alignment</td>
<td>No misalignment observed</td>
</tr>
<tr>
<td>Condition at Abutment and at Concrete Structures</td>
<td>Left abutment has surface water erosion on upstream side</td>
</tr>
<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>Left abutment has surface erosion at upstream and downstream contact with embankment</td>
</tr>
<tr>
<td>Rock Slope Protection - Riprap Failures</td>
<td>No failures observed</td>
</tr>
<tr>
<td>Unusual Movement or Cracking at or near Toes</td>
<td>None observed</td>
</tr>
<tr>
<td>Unusual Embankment or Downstream Seepage</td>
<td>None observed</td>
</tr>
<tr>
<td>Piping or Boils</td>
<td>None observed</td>
</tr>
<tr>
<td>Foundation Drainage Features</td>
<td>None observed</td>
</tr>
<tr>
<td>Toe Drains</td>
<td>None observed</td>
</tr>
<tr>
<td>Instrumentation System</td>
<td>None</td>
</tr>
</tbody>
</table>
PERIODIC INSPECTION CHECK LIST

PROJECT Northampton Wately Complex       DATE May 25, 1978
PROJECT FEATURE Upper Dam               NAME D. P. LaGatta
DISCIPLINE Geotechnical Engineer         NAME R.H. Cheney
Structural Engineer

AREAS EVALUATED

<table>
<thead>
<tr>
<th>OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Approach Channel</td>
</tr>
<tr>
<td>Slope Conditions</td>
</tr>
<tr>
<td>Bottom Conditions</td>
</tr>
<tr>
<td>Rock Slides or Falls</td>
</tr>
<tr>
<td>Log Boom</td>
</tr>
<tr>
<td>Debris</td>
</tr>
<tr>
<td>Condition of Concrete Lining</td>
</tr>
<tr>
<td>Drains or Weep Holes</td>
</tr>
<tr>
<td>b. Intake Structure</td>
</tr>
<tr>
<td>Condition of Concrete</td>
</tr>
<tr>
<td>Stop Logs and Slots</td>
</tr>
</tbody>
</table>

CONDITIONS

This facility has no approach channel.

Condition of Concrete

Good

Stop Logs and Slots

None
<table>
<thead>
<tr>
<th>AREA EVALUATED</th>
<th>CONDITIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTLET WORKS - CONTROL TOWER</td>
<td></td>
</tr>
<tr>
<td>a. Concrete and Structural</td>
<td>Control tower and intake structure are one and the same</td>
</tr>
<tr>
<td>General Condition</td>
<td>Good</td>
</tr>
<tr>
<td>Condition of Joints</td>
<td>Good</td>
</tr>
<tr>
<td>Spalling</td>
<td>None observed</td>
</tr>
<tr>
<td>Visible Reinforcing</td>
<td>None observed</td>
</tr>
<tr>
<td>Rusting or Staining of Concrete</td>
<td>None observed</td>
</tr>
<tr>
<td>Any Seepage or Efflorescence</td>
<td>None observed</td>
</tr>
<tr>
<td>Joint Alignment</td>
<td>No misalignment observed</td>
</tr>
<tr>
<td>Unusual Seepage or Leaks in Gate Chamber</td>
<td>None observed</td>
</tr>
<tr>
<td>Cracks</td>
<td>None observed</td>
</tr>
<tr>
<td>Rusting or Corrosion of Steel</td>
<td>None observed</td>
</tr>
<tr>
<td>b. Mechanical and Electrical</td>
<td></td>
</tr>
<tr>
<td>Air Vents</td>
<td>All gates are manually operated.</td>
</tr>
<tr>
<td>Float Wells</td>
<td>City checks gates for operational ability once a year.</td>
</tr>
<tr>
<td>Crane Hoist</td>
<td>Only operational outlet is 20&quot; dia. D.I. pipe which flows into lower reservoir.</td>
</tr>
<tr>
<td>Elevator</td>
<td></td>
</tr>
<tr>
<td>Hydraulic System</td>
<td></td>
</tr>
<tr>
<td>Service Gates</td>
<td></td>
</tr>
<tr>
<td>Emergency Gates</td>
<td></td>
</tr>
<tr>
<td>Lightning Protection System</td>
<td></td>
</tr>
<tr>
<td>Emergency Power System</td>
<td></td>
</tr>
<tr>
<td>Wiring and Lighting System in Gate Chamber</td>
<td></td>
</tr>
</tbody>
</table>
PERIODIC INSPECTION CHECK LIST

PROJECT: Northampton Wately Complex  DATE: May 25, 1978

PROJECT FEATURE: Upper Dam

DISCIPLINE: Geotechnical Engineer
NAME: D.P. LaGatta

DISCIPLINE: Structural Engineer
NAME: R.H. Cheney

<table>
<thead>
<tr>
<th>AREA EVALUATED</th>
<th>CONDITIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTLET WORKS - TRANSITION AND CONDUIT</td>
<td>There is no transition and conduit.</td>
</tr>
<tr>
<td></td>
<td>20&quot; dia. D.I. pipe outlet only.</td>
</tr>
<tr>
<td>General Condition of Concrete</td>
<td></td>
</tr>
<tr>
<td>Rust or Staining on Concrete</td>
<td></td>
</tr>
<tr>
<td>Spalling</td>
<td></td>
</tr>
<tr>
<td>Erosion or Cavitation</td>
<td></td>
</tr>
<tr>
<td>Cracking</td>
<td></td>
</tr>
<tr>
<td>Alignment of Monoliths</td>
<td></td>
</tr>
<tr>
<td>Alignment of Joints</td>
<td></td>
</tr>
<tr>
<td>Numbering of Monoliths</td>
<td></td>
</tr>
</tbody>
</table>
**PERIODIC INSPECTION CHECK LIST**

<table>
<thead>
<tr>
<th>PROJECT FEATURE</th>
<th>Northampton Wately Complex</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATE</td>
<td>May 25, 1978</td>
</tr>
<tr>
<td>NAME</td>
<td>D.P. LaGatta</td>
</tr>
<tr>
<td>NAME</td>
<td>R.H. Cheney</td>
</tr>
</tbody>
</table>

**PROJECT**

**NAME**

**DISCIPLINE**

**AREA EVALUATED**

**CONDITIONS**

<table>
<thead>
<tr>
<th>OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL</th>
<th>CONDITIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Condition of Concrete</td>
<td>No outlet structure.</td>
</tr>
<tr>
<td>Rust or Staining</td>
<td>Pipe discharges directly into lower reservoir.</td>
</tr>
<tr>
<td>Spalling</td>
<td>Stone varying in size from 4&quot; to 2'± covers end of pipe.</td>
</tr>
<tr>
<td>Erosion or Cavitation</td>
<td>Most of pipe outlet is actually covered.</td>
</tr>
<tr>
<td>Visible Reinforcing</td>
<td>None</td>
</tr>
<tr>
<td>Any Seepage or Efflorescence</td>
<td>See Section 3.1 of Report for description of three slides along channel walls.</td>
</tr>
<tr>
<td>Condition at Joints</td>
<td></td>
</tr>
<tr>
<td>Drain Holes</td>
<td></td>
</tr>
<tr>
<td>Channel</td>
<td></td>
</tr>
<tr>
<td>Loose Rock or Trees Overhanging Channel</td>
<td></td>
</tr>
<tr>
<td>Condition of Discharge Channel</td>
<td></td>
</tr>
</tbody>
</table>
**PERIODIC INSPECTION CHECK LIST**

**PROJECT** Northampton Wately Complex  
**PROJECT FEATURE** Upper Dam  
**DISCIPLINE** Geotechnical Engineer  
**NAME** D.P. LaGatta  
**DISCIPLINE** Structural Engineer  
**NAME** R.H. Cheney

<table>
<thead>
<tr>
<th>AREA EVALUATED</th>
<th>CONDITIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS</td>
<td></td>
</tr>
<tr>
<td>a. Approach Channel</td>
<td>This facility has no approach channel.</td>
</tr>
<tr>
<td>General Condition</td>
<td></td>
</tr>
<tr>
<td>Loose Rock Overhanging Channel</td>
<td></td>
</tr>
<tr>
<td>Trees Overhanging Channel</td>
<td></td>
</tr>
<tr>
<td>Floor of Approach Channel</td>
<td></td>
</tr>
<tr>
<td>b. Weir and Training Walls</td>
<td></td>
</tr>
<tr>
<td>General Condition of Concrete</td>
<td>Good</td>
</tr>
<tr>
<td>Rust or Staining</td>
<td>None observed</td>
</tr>
</tbody>
</table>
| Spalling | *
| Any Visible Reinforcing | Small area base of spillway off center line. |
| Any Seepage or Efflorescence | None observed |
| Drain Holes | Small amount at joints. |
| c. Discharge Channel | None |
| General Condition | Good |
| Loose Rock Overhanging Channel | None |
| Trees Overhanging Channel | None |
| Floor of Channel | Rock strewn |
| Other Obstructions | None |

*Some spalling at joints where upstream walls abut spillway.*
PERIODIC INSPECTION CHECK LIST

PROJECT Northampton Wately Complex

DATE May 25, 1978

PROJECT FEATURE Upper Dam

NAME D.P. LaGatta

DISCIPLINE Geotechnical Engineer

NAME R.H. Cheney

Structural Engineer

<table>
<thead>
<tr>
<th>AREA EVALUATED</th>
<th>CONDITIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTLET WORKS - SERVICE BRIDGE</td>
<td></td>
</tr>
<tr>
<td>a. Super Structure</td>
<td></td>
</tr>
<tr>
<td>Bearings</td>
<td>Good</td>
</tr>
<tr>
<td>Anchor Bolts</td>
<td>Good</td>
</tr>
<tr>
<td>Bridge Seat</td>
<td>Good</td>
</tr>
<tr>
<td>Longitudinal Members</td>
<td>Good</td>
</tr>
<tr>
<td>Under Side of Deck</td>
<td>Galv. grating - good</td>
</tr>
<tr>
<td>Secondary Bracing</td>
<td>Good</td>
</tr>
<tr>
<td>Deck</td>
<td>Galv. grating - good</td>
</tr>
<tr>
<td>Drainage System</td>
<td></td>
</tr>
<tr>
<td>Railings</td>
<td>Painted steel - good</td>
</tr>
<tr>
<td>Expansion Joints</td>
<td>None - slotted holes in bearings</td>
</tr>
<tr>
<td>Paint</td>
<td>Some rust - not serious at this time</td>
</tr>
<tr>
<td>b. Abutment and Piers</td>
<td></td>
</tr>
<tr>
<td>General Condition of Concrete</td>
<td>Good</td>
</tr>
<tr>
<td>Alignment of Abutment</td>
<td>Good</td>
</tr>
<tr>
<td>Approach to Bridge</td>
<td>None</td>
</tr>
<tr>
<td>Condition of Seat and Backwall</td>
<td>One spalled area approximately 6&quot; long in backwall.</td>
</tr>
</tbody>
</table>
APPENDIX B

1. LIST OF DESIGN, CONSTRUCTION AND MAINTENANCE RECORDS

2. PAST INSPECTION REPORTS

3. PLANS AND DETAILS
LIST OF AVAILABLE ENGINEERING DATA

1) Set of Construction Drawings.

2) Set of Construction Specifications.
   Location: City of Northampton, Board of Public Works
   Water Division. 237 Prospect Street, Northampton,
   Massachusetts.

3) Construction Drawings are also on Micro-film at the
   Engineering office of Whitman & Howard. 45 Williams
   Street, Wellesly, Massachusetts.

To this point in time, Whitman & Howard has not been
able to find design calculations.
February 25, 1977

Re: Inspection Dam #2-6-337-3
Northampton's West Whately Reservoir
Upper Dam
Whately, Ma.

Dear Sir:

On May 26, 1976, an engineer from the Massachusetts Department of Public Works made a visual inspection of the above dam. Our records indicate the owner to be the City of Northampton. If this information is incorrect will you please notify this office.

The inspection was made in accordance with the provisions of Chapter 253 of the Massachusetts General Laws as amended (Dams Safety Act). Chapter 705 of the Acts of 1975 transferred the jurisdiction of the so-called "Dams Safety Program" to the Commissioner of the Department of Environmental Quality Engineering.

The results of the inspection indicate that this dam is safe; however, the following conditions were noted that require attention:

See "Remarks & Recommendations" on reverse side

We call these conditions to your attention before they become serious and more expensive to correct. With any correspondence please include the number of the Dam as indicated above.

Very truly yours,

John J. Hannon, P.E.
Chief Engineer

Cc: Francis J. Hoey
Russell Salls
File
Several animal burrows were noted in the downstream slope and toe of slope. Erosion of spillway channel bed at lower end of outlet is becoming more noticeable. Area is rough paved with boulders which are becoming misplaced by water action. It do not appear to pose any problem to safety of dam at present.

The settlement cracks between wingwalls and abutment walls of overflow spillway noted in last inspection have been repaired as has the face of spillway dropwall. The wingwalls appear to have stabilized now and only hairline cracks were noted.

Considerable seepage flows were noted in the stone paving or riprap along toe of dam. It how much of this is surface storm water draining off was difficult to determine. The seepage drainpipe outletting on the westerly toe of slope had a strong flow of water emerging and a small amount of fine deposits were noted in brook bed directly below outlet end of pipe.

It would seem advisable for the Water Department to maintain a log of this seepage flow as a reference check for any possible unwarranted future increase in flow which could be indicative of a problem in the dam's structure.
LOCATION:
City/Town: Whately  County: Franklin  Dam No.: 26-337-3
Name of Dam: Northampton's West Whately Reservoir - Upper
Mass. Rect.
Topo Sheet No.: 11A  Coordinates: N 527,600  E 279,900


OWNER/S: As of May 26, 1976
per: Assessors  Reg. of Deeds  Prev. Inspe.  Per. Contact

City of Northampton
1. Board of Public Works, Water Division, 237 Prospect St., Northampton, Mass.
Name  St. & No.  City/Town  State  Tel. No.

2. Name  St. & No.  City/Town  State  Tel. No.

3. Name  St. & No.  City/Town  State  Tel. No.

CARETAKER: (if any) e.g. superintendent, plant manager, appointed by absentee owner, appointed by multi owners.
Mr. Leon Murray,
Supt. of Water Division, 237 Prospect St., Northampton, Mass.
Name  St. & No.  City/Town  State  Tel. No.

DATA:
No. of Pictures Taken: None  Sketches: See description of Dam

DEGREE OF HAZARD: (if dam should fail completely)*


Comments: Approx. 250 million gallons impoundment - would overtop lower reservoir and at least 10 homes and 5 highway bridges would be affected.

*This rating may change as land use changes (future development).
OUTLET CONTROLS AND DRAWDOWN

Easterly end of dam - concrete overflow chute spillway.

No. 1 Location and Type: 66' wide x 5' high with 32' high conc. agee dropwall.
Controls: None, Type: None.
Comments: Minor spalling of face of dropwall.

No. 2 Location and Type: 66' north of dike - conc. gate house - 2 ea. 20" dia. ductile iron pipes.
Controls: Yes, Type: Screw lift gate valves.
Comments: Controls operable per word of Water Div. personnel.

No. 3 Location and Type: 50' north of gatehouse - 20" dia. low intake pipe.
Controls: Yes, Type: Screw lift gate valve.
Comments: Operable per Water Division personnel.

DRAWDOWN present: Yes, No.
Operative: Yes, No.
Comments: See No. 3 above.

DAM UPSTREAM FACE:
Slope: 2:1, Depth Water at Dam: 45' to 50'.
Other: Stoned paved slope.
Comments: 5. Erosion.

DAM DOWNSTREAM FACE:
Slope: 2:1 variable, Depth Water at Dam: 45' to 50'.
Other: Stoned paved slope.
Comments: Erosion near outlet, Faded at lower end.
DAM NO. 2-6-337-3

EMERGENCY SPILLWAY: Available ___ yes ___ needed ___

Height Above Normal Water: ___ 0 ___ Ft. water level at time of inspection.

Width: ___ 66 ___ Ft. Height: ___ 5 ___ Ft. Material: ___ concrete ___

Condition: 1. Good ___ x ___ 3. Major Repairs ___

Comments: Wingwall cracks and face of dropwall have been repaired since last inspection of 11/29/33. Structure appears good at present time.

WATER LEVEL AT TIME OF INSPECTION: ___ 5 ___ Ft. Above ___ Below ___ x ___

Top Dam ___ x ___ F.L. Principal Spillway ___
Other: ___
Normal Freeboard ___ 5 ___ Ft. to top of dam ___

SUMMARY OF DEFICIENCIES NOTED:

Growth (Trees and Brush) on Embankment: None found ___
Animal Burrows and Washouts: 5 woodchuck holes found on downstream slope ___
Damage to Slopes or Top of Dam: See burrows above - some areas of sparse turf cover ___
Cracked or Damaged Masonry: Minor surface cracks in repaired area of wingwalls ___
Evidence of Seepage: Several seepage flows noted in stone paved toe of slope ___
Evidence of Piping: None found ___
Leaks: None found ___
Erosion: Erosion of lower end of spillway runoff channel had noted ___
Trash and/or Debris Impeding Flow: None found ___
Clogged or Blocked Spillway: None found ___
Other: ___
OVERALL CONDITION:

1. Safe
2. Minor repairs needed
3. Conditionally safe - major repairs needed
4. Unsafe
5. Reservoir impoundment no longer exists (explain)

Recommend removal from inspection list.

REMARKS AND RECOMMENDATIONS: (Fully Explain)

Mr. Craig Nehring, work crew foreman of the Northampton Water Dept., was present during this inspection and all problems noted in report were discussed with him.

Several animal burrows were noted in the downstream slope and toe of slope. Erosion of spillway channel bed at lower end of outlet is becoming more noticeable. This area is rough paved with boulders which are becoming misplaced by water action but do not appear to pose any problem to safety of dam at present.

The settlement cracks between wingwalls and abutment walls of overflow spillway noted in last inspection have been repaired as has the face of spillway dropwall. The wingwalls appear to have stabilized now and only hairline cracks were noted.

Considerable seepage flows were noted in the stone paving or riprap along toe of dam but how much of this is surface storm water draining off was difficult to determine. The seepage drainpipe outletting on the westerly toe of slope had a strong flow of water emerging and a small amount of fines deposits were noted in brook bed directly below outlet end of pipe.

It would seem advisable for the Water Dept. to maintain a log of this seepage flow as a reference check for any possible unwarranted future increase in flow which would be indicative of a problem in the dam's structure.

At the present time this dam appears to be safe.
December 21, 1973

Leon Murray, Superintendent
Water Division
Board of Public Works
237 Prospect Street
Northampton, Massachusetts 01060

Re: Inspection-Dam # 2-6-337-3
Northampton's Irrigation
Reservoir—Upper Dam

Dear Mr. Murray:

On November 29, 1973, an engineer from the Massachusetts Department of Public Works inspected the above dam, owned by the City of Northampton.

The inspection was made in accordance with Chapter 253 of the Massachusetts General Laws, as amended by Chapter 595 of the Acts of 1970.

The results of the inspection indicate that this dam is safe; however, the following conditions were noted that require attention:

1. The upstream wingwalls of the chute spillway are cracked away from the abutment joints by as much as 3/4 of an inch at the top surface, with the possibility that the northerly ends may have settled slightly.
2. A crack in the face of the spillway dropwall, about 6 feet above the floor, with wetness of the surface indicates continuous seepage.

The above conditions should be investigated and repaired as necessary. We call these conditions to your attention now, before they become serious and more expensive to correct.

Very truly yours,

Fred. C. Schweb
Deputy Chief Engineer

cc: F.J. HOEY
    R. SALLS
# INSPECTION REPORT - DAMS AND RESERVOIRS

**LOCATION:**

- **County:** Franklin
- **Dam No.:** 2-6-37-3

**Name of Dam:** Northampton's West Whately Reservoir - Upper Mass. Rect.

**Topo Sheet No.:** 11A  
**Coordinates:** N 527,600, E 279,900

**Inspected by:** Harold T. Shumway, On Nov. 29, 1973  
**Date:**

**Last Inspection:** 1970

**OWNER/S:** As of November, 1972

- **per:** Assessors _X_, Reg. of Deeds, Prev. Insp., Per. Contact _X_.

- **City of Northampton,**
  - **Board of Public Works, Water Division, 237 Prospect Street, Northampton, Ma. 01060**
    - **Name:**
    - **St. & No.:**
    - **City/Town:**
    - **State:**
    - **Tel. No.:**

- **2. Name:**
  - **St. & No.:**
  - **City/Town:**
  - **State:**
  - **Tel. No.:**

- **3. Name:**
  - **St. & No.:**
  - **City/Town:**
  - **State:**
  - **Tel. No.:**

**CARETAKER:** (if any) e.g. superintendent, plant manager, appointed by absentee owner, appointed by multi owners.

- **Leon Murray,**
  - **Superintendent of Water Division, 237 Prospect Street, Northampton, Ma. 01060**
    - **Name:**
    - **St. & No.:**
    - **City/Town:**
    - **State:**
    - **Tel. No.:**

**DATA:**

- **No. of Pictures Taken:** None
- **Sketches:** See description of Dam.
- **Plans, Where:** In Water Division Offices

**DEGREE OF HAZARD:** (if dam should fail completely)*

1. **Minor**
2. **Moderate**
3. **Severe** _X_
4. **Disastrous**

**Comments:** At least 10 homes and 5 bridges would be affected

*This rating may change as land use changes (future development).
OUTLETS: OUTLET CONTROLS AND DRAWDOWN

Easterly end dam - concrete overflow chute spillway -

No. 1 Location and Type: 66' W. x 5' H. with 32' H. concrete ogee dropwall.

Controls: No. TYPE:___________________________________________________________.

Automatic____  Manual____  Operative Yes____  No____.  

Comments: This is an emergency overflow spillway.

No. 2 Location and Type: 66' northerly of dike - concrete gatehouse.

Controls X____  Type: 2 - 20" M.J. ductile iron pipes with screw lift gate valves.

Automatic____  Manual X____  Operative Yes X____  No____.  

Comments: One of these pipes is a feed pipe to lower reservoir.

No. 3 Location and Type: 50' north of gatehouse - low intake pipe - 20" dia.

Controls X____  Type: Screw lift gate valve.

Automatic____  Manual X____  Operative Yes X____  No____.  

Comments: 

Drawdown present Yes X____  No____.  Operative Yes X____  No____.  

Comments: See No. 3 above.

DAM UPSTREAM FACE: Slope 2:1____  Depth Water at Dam 45' to 50'.

Material: Turf____  Brush & Trees____  Rock fill____  Masonry____  Wood____.

Other____  Stone paving____  


Comments: Stone paving appears stable - concrete gatehouse appears sound.

DAM DOWNSTREAM FACE: Slope 2:1 variable____.

Material: Turf X____  Brush & Trees____  Rock Fill____  Masonry____  Wood____.

Other____  


Comments: Strong seepage noted at toe of slope in area of 20" dia. pipe feeding lower reservoir. Also two animal burrows noted.
EMERGENCY SPILLWAY: Available Yes, Needed.

Height Above Normal Water 7 Ft. Water level at time of inspection

Width 66 Ft. Height 5 Ft. Material Concrete


Comments: Both upstream wingwalls have cracked at union with spillway abutment and appear to have settled—pulling away from abutment about 3/4 of an inch at top level.

WATER LEVEL AT TIME OF INSPECTION: 12 Ft. Above X Below

Top Dam X F.L. Principal Spillway

Other

Normal Freeboard 5 Ft.

SUMMARY OF DEFICIENCIES NOTED:

Growth (Trees and Brush) on Embankment None

Animal Burrows and Washouts Yes. Two animal burrows on downstream slope

Damage to Slopes or Top of Dam None except animal burrows

Cracked or Damaged Masonry East spillway abut wingwall cracked—minute cracks in spillway dropwall.

Evidence of Seepage Yes. Heavy seepage at toe of slope in area of 20" dia. feedpipe to lower reservoir. Some seepage noted through concrete spillway dropwall.

Evidence of Piping

Leaks None Noted

Erosion Minor erosion if spillway runoff channel

Trash and/or Debris Impeding Flow None

Clogged or Blocked Spillway None

Other
OVERALL CONDITION:

1. Safe______________________________.

2. Minor repairs needed ________________

3. Conditionally safe - major repairs needed________________.

4. Unsafe______________________________.

5. Reservoir impoundment no longer exists (explain)

Recommend removal from inspection list______________________________.

REMARKS AND RECOMMENDATIONS: (Fully Explain)

This is a relatively new dam - built in 1970. The grade and alignment of earthen dike, which has a two foot wide concrete core to within two feet of top is good. The stone paved upstream slope appears stable. The downstream slope is well turfed over and appears stable. On westerly end of dike, it was noted that downstream slope had eroded from surface water and had been stone riprapped to prevent further erosion.

Both of upstream wingwalls of chute spillway were cracked away from abutment joints from 1/2 to 3/4 of an inch at top surface. It would appear that northerly ends of walls may have settled slightly. A crack was noted in face of spillway dropwall about 6 feet above floor level. There was a wetness of surface around area of this crack indicating continuous seepage. Minor erosion of spillway drain channel floor was noted at lower end.

Heavy seepage of water coming through toe of slope in area of outlet end of 20" pipe feeding lower reservoir was noted. However, this toe of slope is riprapped with large rock and water seepage could be local surface drainage rather than water from dam.
<table>
<thead>
<tr>
<th>Name</th>
<th>Northampton Reservoir #2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner</td>
<td>City of Northampton</td>
</tr>
<tr>
<td>Location</td>
<td>Just upstream of #230</td>
</tr>
<tr>
<td>Type of Pond</td>
<td></td>
</tr>
<tr>
<td>Acreage</td>
<td></td>
</tr>
<tr>
<td>Drainage Area</td>
<td></td>
</tr>
<tr>
<td>Comments</td>
<td></td>
</tr>
<tr>
<td>Type of Dam</td>
<td></td>
</tr>
<tr>
<td>Length</td>
<td></td>
</tr>
<tr>
<td>Height</td>
<td></td>
</tr>
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<td>Head of Water</td>
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<td>Comments</td>
<td></td>
</tr>
<tr>
<td>Type of Spillway</td>
<td></td>
</tr>
<tr>
<td>Width</td>
<td></td>
</tr>
<tr>
<td>Height</td>
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<tr>
<td>Comments</td>
<td></td>
</tr>
<tr>
<td>Condition, Previous Report, Dated</td>
<td></td>
</tr>
<tr>
<td>Present Condition</td>
<td>Being constructed</td>
</tr>
</tbody>
</table>
DISTRICT II.

Submitted by Harold T. Shumway  Dam No. 2-6-337-3
Date November 29, 1973  City/Town Whately

Name of Dam Northampton's West Whately Reservoir - Upper

Location: Topo Sheet No. 11A  Mass. Rect.
Coordinates N 527,600  E 279,900

Provide 81/2" x 11" in clear copy of topo map with location of Dam clearly indicated.

On West Brook in West Whately just above Lower Reservoir, Number 2-6-337-2, or about 3/10 mile on Conway Road from Williamsburg Road intersection and just west of Conway Road.

2. Year built 1970  Year/s of subsequent repairs __________

Purpose of Dam: Water Supply X  Recreational __________
Flood Control __________  Irrigation __________  Other __________

4. Drainage Area: 81/4 sq. mi. __________ acres.
Type: City, Bus. & Ind.  Dense Res.  Suburban  Rural, Farm
Wood & Scrub Land X  Slope: Steep 50%  Med. 50%  Slight __________

Normal Ponding Area: 82± Acres; Ave. Depth 28 1/10 29'
Impoundment: 750 million gals.; 2296 acre ft.
Silted in: Yes  No X  Approx. Amount Storage Area _________

No. and type of dwellings located adjacent to pond or reservoir __________
i.e. summer homes etc. None

7. Dimensions of dam: Length 870±  Max. Height 60±
Freeboard 12' at time of inspection to top dike
Slopes: Upstream Face 2:1
Downstream Face 2:1 variable
Width across top 20±
Classification of Dam by Material:
- Core Wall
  - Earth
  - Conc. Masonry
  - Stone Masonry
- Timber
- Rockfill
- Other

Stone paved slope upstream

Dam Type:
- Gravity
- Straight
- Curved, Arched
- Other

Overflow
Non-overflow

A. Description of present land usage downstream of dam:

- 100% rural; ________% urban

B. Is there a storage area or flood plain downstream of dam which could accommodate the impoundment in the event of a complete dam failure? Yes ________ No X

C. Character Downstream Valley: Narrow
Wide
Developed rural homes
Rural 100%
Urban

Risk to life and property in event of complete failure.

- No. of people ________ 10
- No. of homes ________ 10
- No. of businesses None
- No. of industries None

- No. of utilities ________ 3
  Type Water, telephone and electric transmission lines, Northampton Water Works.

- Railroads None

- Northampton's West Whately Reservoir - Lower Dam, No. 2-6-337-2
- Other dams 2 - E. S. Crafts Dam, No. 2-6-337-1
- Other 5 Town Highway Bridges and 3 Town Highways.

Attach Sketch of dam to this form showing section and plan on 8½" x 11" sheet.

CS/vk/ed

 Attachments
Locus Plan
Sketches
Gate Station (Elevation)
APPENDIX C

PHOTOGRAPHS
LOCATION OF PHOTOGRAPHS
NORTHAMPTON RESERVOIR
UPPER DAM
IN
WHATELEY MA.
NOT TO SCALE  JULY 1978
PHOTO NO. 1 - Close-up of surface erosion shown in Photo 2.

PHOTO NO. 2 - General view of surface erosion on left abutment along contact between u.s. face and abutment.
of dam near left abutment.

Area of surface slumping on d.s. face.

PHOTO NO. 4 - About 3 ft. below crest of dam.

Upstream face showing riprap stoppling.

PHOTO NO. 3 - Upstream face showing riprap stoppling.
PHOTO NO. 5 - Channel of surface erosion on left abutment at contact of d.s. face and abutment.

PHOTO NO. 6 - Close-up of surface erosion channel shown in Photo 5.
PHOTO NO. 8 - Side on right bank of spillway channel.
PHOTO NO. 9 - Outlets of toe drains.

PHOTO NO. 10 - General view of d.s. slope from area of right abutment.
General view of spillway and outlet channel.

PHOTO NO. 12 - General view of spillway.

PHOTO NO. 11 - General view of spillway.
PHOTO NO. 13 - Spall where u.s. spillway wall abuts spillway.

PHOTO NO. 14 - Outlet pipe at lower reservoir.
PHOTO NO. 16 - General View of Reservoir from Right

PHOTO NO. 15 - Intake Structure and Service Bridge
APPENDIX D

1. HYDROLOGIC COMPUTATION

2. DRAINAGE AREA
Phase I

Stage Normal 289' above

Stage 276' above

Height Structural 65'

Height Hyd. 60'

Size - intermediate

Hazard - high

Design CHK

PMF

Whitman-Howard

Area - Areal 2897 acres or 4.53 sq mi

Rolling to Univ Area 1875 cfs/sq mi.

\[ Q = F \frac{A}{T} = 1875 \times 4.53 = 8500 \text{ cfs} \]

\[ L = \frac{Q}{C} \]

\[ L = \frac{8500}{3.9} \]

\[ L = 2187 \text{ ft} \]

\[ \frac{Q}{C} = C \times L \times \frac{1}{H^{3/2}} \]

\[ 8500 = \frac{1}{3.9} \times 2187 \times (H)^{1.5} \]

\[ 1.025 = H^{1.5} \]

\[ H = 10.3 \text{ ft} \]

\[ Q = C \times L \times \frac{1}{H^{3/2}} \]

\[ Q = C \times 2187 \times \frac{1}{10.3^{1.5}} \]

\[ Q = 33,028 \text{ cfs} \]

\[ H = 10.3 \text{ ft} \]

\[ L = 2187 \text{ ft} \]
\[ G_1 = 2 \frac{5}{5} (1.1) \left( \frac{5.2}{5} \right) = 3.220 \text{ ft} \]

\[ G_2 = \text{remainder of lining} \quad \text{dv} = 85^\circ - 3320 = 51^\circ \text{ Cft} \]

\[ \frac{G_2}{12} = \frac{X}{12} \quad x = 4.17^\circ \text{ fl} \]

\[ \phi = \frac{0.4 \times 10}{3} \quad \text{say 9}^\circ \text{ fl} \]

\[ Q = V \phi \quad V = \frac{1.9 \times 10}{3} \times 2/3 \times 5/12 \]

\[ h + y = 2' \quad W = 2.5 + 8.6 + 8.2 - 6 = 173' \]

\[ L = 988 \times 2 + \frac{10}{3} + 65 \times \frac{1}{8} = 2245' \]

\[ K = 2.26' \times 12 \]

\[ Y = \frac{6.486}{0.04} \quad (1.17) (1.2) = 13.23 \text{ ft} \]

\[ G = 13 \times 13 \quad (210) = 282 \text{ ft} \]

\[ Y = \frac{1}{14,100} \quad (1.13) (1.2) = 8.47 \text{ ft} \]

\[ Q = 543 (1\text{ fl}) = 9240 \text{ ft} \]

\[ h + y = 1' \quad W = 940 \quad A = 980 + 2.5 + 15 \times 113 \text{ st} \]

\[ K = 1.20 \]

\[ Y = \frac{1}{14,100} \quad (1.13) (1.2) = 8.47 \text{ ft} \]

\[ Q = 543 (1\text{ fl}) = 9240 \text{ ft} \]

\[ h + y = 0.75 \quad W = 95 \quad A = 112 \quad 280 = 932 \]

\[ K = 0.99 \quad k^2 = 0.996 \]

\[ V = \frac{1}{14,100} \quad (0.998) (1.2) = 7.9 \text{ fl} \]

\[ Q = 7.97 (9.2) = 692 \text{ ft} \]

\[ h + y = 0.1 \quad 2 \times 681.3 = 1362 \text{ ft} \]
\[ \begin{array}{c|c|c|c|c|c}
\text{Ar} & 1.1 & 1.3 & 1.5 & 1.7 & 1.9 \\
\hline
120 & 60 & 30 & 15 & 7.5 & 5 \\
\hline
\end{array} \]

\[ \frac{27.71}{56.31} = 0.490 \]

\[ 59.01 \]

\[ 57.72 \]

\[ 31 \]

\[ 97 \]

\[ 891 \]

\[ 6 \]

\[ 7 \]

\[ 4 \]

\[ 1 \]

\[ 101 \]

\[ 37.5 \] / 20

\[ 0 \]

\[ 0.9 \]

\[ 3.7 \]

\[ 2.0 \]

\[ 8.9 \]

\[ 3.0 \]

\[ 6.9 \]

\[ 1.4 \]

\[ 12.2 \]

\[ 47.5 \]

\[ 6.65 \]

\[ \frac{2882}{1.157} \]

\[ 531 \] x 12 \( \div \) 21877 = 2.80 " Round.

\[ 8500 \times (1 - \frac{220}{19}) \approx 7500. \text{ cm}^3 \]

\[ 3230 - 4180 \]

\[ 920 \] / 5 = 184; 45 \times 5

\[ \frac{54}{15} = 66 \]

\[ \frac{4.167 \times 0.2}{4.2} = 0.1 \]

\[ 4.9 \] \( \times 2 \) = 79.8 \( \div \) \( \frac{1}{2} \), 4 (cm)

\[ 0.05 \] \( \times 4 \) = 0.2
\[
\begin{align*}
 \frac{492 + 241}{2} & = 517 \text{ ft} \quad \text{or} \quad 2.142'' \\
 Q_p & = 2500 \times \left(1 - \frac{2.142}{10.8873}\right) = 7542 \text{ cfs} \\
 Q_n & = \frac{6 \times 500 \times 32.2 \times (81.35)^{3/2}}{4.523} = 5468 \text{ cfs} \\
 \frac{K + \frac{d_m}{H}}{\pi} & = 350 + \text{cfs} \\
 & + \frac{754}{1900} = \text{cfs} \\
 \text{for spillway} & = \frac{-205}{8.372} = \text{cfs} \\
 \text{so} \quad C_n & = 0.81 - 0.84 \text{ cfs} \\
 y & = 1.6 \quad n & = 1.00 \quad m & = 1.35 \\
 x & = 1.75 \\
 A & = \frac{1}{2} \quad S & = 100 \\
 x & = 1.75 \\
 & \times 100 \\
 & = 175 \quad \text{cfs} \\
 \end{align*}
\]
<table>
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<tr>
<th>620</th>
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<th>4.99</th>
<th>9.49</th>
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<tr>
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<td>-63.48</td>
<td>0.05</td>
<td>4.6 a</td>
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<tr>
<td>610</td>
<td>6.72</td>
<td>9.72</td>
<td>25.11</td>
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<tr>
<td>600</td>
<td>5.87</td>
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<tr>
<td>58.78</td>
<td>-58.39</td>
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<td>2.4</td>
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<tr>
<td>610</td>
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<td>77.1</td>
<td>77.0</td>
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<td>15.5</td>
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</tr>
<tr>
<td>59.4</td>
<td>34.5</td>
<td>6.5</td>
<td>33.75</td>
<td>17.0</td>
<td></td>
</tr>
</tbody>
</table>

\[
Q_{Pc} = 453800 \left(1 - \frac{456}{3000}\right) = 338535 \text{ cfs}
\]

Use Unit 614: \(\text{Vol} = 488 \text{ a-f} \)
$$Q = 452,800 \text{ cfs}$$

Find 50% line: 6 ft. 5 in. level + 1 ft. 5 in.

$$L = \frac{12}{250} = 4.73 \% \text{ or } 0.0473$$

$$n = \frac{0.70}{10}$$

$$12 + y = 30' \text{ also } 570'$$

$$wp = 850'$$

$$A = 30'(13 \times 28') = 690 \text{ sf}$$

$$R = 7.06 \text{ ft.}$$

$$V = \frac{4.73}{10} (3.7) (1.2) = 11.72'$$

$$Q = 6,572 \text{ cfs} \left< 4,428 \text{ cfs} \text{ N.C.} \right>$$

$$y = 3 \text{ in.}$$

$$85.2 + 28 = 113.0'$$

$$A = 627.0 + 1(28.3 + 1.0) = 1845.0$$

$$R = 9.2$$

$$V = 14.31 (6.92) (1.2) = 18.12$$

$$Q = -135191 \text{ cfs}^2 < \text{ N.C.}$$

$$y = 5 \text{ in.}$$

$$wp = 1100 + 200 = 1300'$$

$$A = 10300 + 27(510) = 21900$$

$$R = 16.7$$

$$V = 14.86 (6.6) (1.2) = 19.61$$

$$Q = 4295594 < 45,100$$

$$y = 0.2$$

$$wp = 1320$$

$$A = 0$$

$$R = 17.5$$

$$V = 13.2 (6.5) (2) = 101.0$$

$$Q = 1474,261 \text{ cfs}$$

$$\text{ N.C.} < (6.0) \text{ cfs}$$
Vol.  = \frac{483 + 76^3}{2} = 561 \text{ c.f.}

q_{F2} = 458000 \left(1 - \frac{3.3}{3000}\right) = 359,000 \text{ c.f.}

Noise load: 4,000' below old dam

\begin{align*}
\gamma = \frac{570 \times 40}{40^2} = \frac{126}{4000} = 390 = 0.03' & \text{ c.f.} \\
n = 0.16
\end{align*}

C_{\text{max}} = 253,400 \text{ c.f.}

1. \Delta y = 4' \Rightarrow \Delta A = 400

\begin{align*}
\Delta A &= 396 \times 0.136 = 53.9 \text{ c.f.} \\
\Delta v &= 2.39 \times 0.136 = 0.327 \\
\Delta f &= 1.72 \times 0.136 = 0.234 \\
\Delta C &= 3.63 > 2.54
\end{align*}

2. \Delta y = 4' \Rightarrow 475

\begin{align*}
\Delta A &= 396 \times 0.125 = 49.5 \text{ c.f.} \\
\Delta v &= 25.54 \times 0.125 = 3.276 \\
\Delta f &= 26.54 \times 0.125 = 3.32 \\
\Delta C &= 4.88 \times 0.125 = 0.61
\end{align*}
\[ C_{w} = \frac{0.79}{0.075} = 59.0 \, \text{cfs} \]
\[ C = \frac{59.0 - 5.12}{26.2} = \frac{53.88}{26.2} = 2.033 \, \text{cfs} \]
\[ V = \frac{140.6}{(7.97)(1.147)} = 17.69 \, \text{cfs} \]
\[ Q = \frac{160}{3.111}, c = \frac{369}{pgd} \]

\[ y = 52', s = 55' \]
\[ y = 455' \]
\[ y = 21.367 \]
\[ Q = 2867.32, \Delta \, \text{pgd} \]

\[ y = 62', s = 71' \]
\[ y = 124 \]
\[ A = 134.08 + 24(206) = 187 \, \text{ft} \]
\[ R = 36.77, 1116 \]
\[ V = 29.83 \]

\[ A = \frac{187 - 134}{1.8} = 17.24 \]

\[ 1_{1/2} (2000) = 568 \, \text{ft} \]
\[ C_{uv} = 359,600 \times \left(1 - \frac{0.925}{3000}\right) = 248,600 \pm 2.5 \]

\[ A = 248,600 \quad \frac{d}{s} \leq 558 \pm \]

\[ V = 13400 - 400 = 13000 \text{ ft} \]

\[ V_{ol} = \frac{13000 + 2000}{2} \times \frac{2000}{44500} = 832 \text{ cu ft} \]

\[ Q_{uv} = 359,600 \left(1 - \frac{0.881}{3000}\right) = 253,454 \pm 2.5 \]

\[ Q_{vol} = 253,454 \pm 568.6 \]
$$Q_{1/2} = 253,400 \left(1 - \frac{708}{3000}\right) = 194,658 \text{ ft}^2$$

$$V_{ol} = \frac{17740 + 1360}{2} \times \frac{2.00}{435.60} = 778 \text{ c.f.}$$

$$A = 13457 - 23 \times 2.00 = 9670$$

$$Q_{r2} = 253,400 \left(1 - \frac{2}{3000}\right) = 201,453 \text{ c.f.}$$

$$V_{ol} = \frac{17740 + 1360}{2} \left(\frac{2.00}{435.60}\right) = 519 \text{ c.f.}$$

$$CMT = 201,400 \text{ c.f.}$$

$$66 + 00 \quad C = 201,400, 0^\circ$$

$$37 + 00 \quad 40^\circ$$

$$34 + 00 \quad 90^\circ$$

$$29 + 00 \quad 0^\circ$$

$$25 + 00 \quad 0^\circ$$

$$21 + 00 \quad 0^\circ$$

$$17 + 00 \quad 0^\circ$$

$$13 + 00 \quad 0^\circ$$

$$9 + 00 \quad 0^\circ$$

$$5 + 00 \quad 0^\circ$$

$$\sum = 600^\circ$$

$$A = \cos(40^\circ) = 0.766$$

$$K = 6.87$$

$$V = 14.8 \times (5+7) \times 15 = 1777 \text{ ft}^2$$

$$Q = 3084 \text{ c.f.} > 500$$

$$\text{L.H.S.} = 201,400$$

$$\text{R.H.S.} = 488$$
438

\[ H = 15000 - 28(1254) = 121,700 \text{ ft} \]

\[ V_1 = \frac{12100 + 15600}{2} \left( \frac{28}{42560} \right) = 590 \text{ c.f.s} \]

\[ Q_2 = 201400 \left( 1 - \frac{590}{3000} \right) = 161700 \text{ c.f.s} \]

\[ A = 11400 \text{ ft}^2 \]

\[ V_2 = \frac{11400 + 15600}{2} \left( 0.6659 \right) = 562 \text{ c.f.s} \]

\[ V_3 = (57 + 590) \times \frac{1}{2} = 562 \text{ c.f.s} \]

\[ Q_3 = 201400 \left( 1 - \frac{562}{3000} \right) = 162300 \text{ c.f.s} \]

\[ H = 10.5 - 438 \]
Sta 79400  $= 162,300 cfs

\[ \theta = \frac{165 - 375}{1200} = \frac{30}{1200} = 2.3\% \times 0.0739 \]

Left \( y = 90' \)  20'  415
\( L = 975' \)
\( A = \frac{1}{2} (65) = 22,600 \text{ ft}^2 \)
\( T = 78.5' \times 8.2' \)
\( V = 15.88 \times (8.29) (15.6) = 19.68 \)
\( C = 975 \times 963.1 \times 15.6 \)

Left \( y = 25' \)  20'  400
\( L = 476' \)
\( V = 15.88 \times (15 \times 20) = 11,112 \text{ ft}^2 \)
\( V = 12.7' \times 5.5' \)
\( C = 137,698 < \text{avg} \)

Left \( y = 30' \)  20'  405
\( w_p = 975' \)
\( A = 1110' + 30' = 15,600' \)
\( T = 16.67' \times 6.5' \)
\( V = 14.94' \times 5.5' \)
\( C = 227 \times 963.1 \times 15.6 \)

42°
\[ A = 12720 + \] 
\[ V = \frac{12720 \cdot 12100}{2} \left( \frac{13000}{43960} \right) = 370 \text{ a-f} \] 
\[ C_{u2} = 162300 \left( 1 - \frac{370}{3000} \right) = 192,400 \text{ c.f.} \] 
\[ V_{a2} = 401 \] 
\[ A = 13860 - 2.5 (38 \times 2) = 11960 \] 
\[ V = 12100 + 1960 \left( \frac{13000}{43960} \right) = 359 \text{ a-f} \] 
\[ V_{a2} = \frac{359 + 370}{2} = 365 \text{ a-f} \] 
\[ C_{u2} = 162300 \left( 1 - \frac{365}{3000} \right) = 142,564 \text{ c.f.} \] 

Possible damage to 15 houses + 9 other structures
APPENDIX E

INFORMATION AS CONTAINED IN

THE NATIONAL INVENTORY OF DAMS
<table>
<thead>
<tr>
<th>Region/State</th>
<th>River or Stream</th>
<th>Nearest Downstream City-Town-Village</th>
<th>Population</th>
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<tbody>
<tr>
<td>01 08</td>
<td>WEST BROOK</td>
<td>WEST MARELY</td>
<td>1145</td>
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<table>
<thead>
<tr>
<th>Type of Dam</th>
<th>Year Completed</th>
<th>Purposes</th>
<th>Storage (acre ft)</th>
<th>Maximum Spillway Elevation (ft)</th>
<th>Power Capacity (kw)</th>
<th>Navigation Locks</th>
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<tbody>
<tr>
<td>RECTPO</td>
<td>1970</td>
<td>3</td>
<td>90</td>
<td>80</td>
<td>2020</td>
<td>2460</td>
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**Remarks**

**Spillway Information**

<table>
<thead>
<tr>
<th>Spillway Type</th>
<th>Volume (acre ft)</th>
<th>Power Capacity (kw)</th>
<th>Navigation Locks</th>
</tr>
</thead>
<tbody>
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<td></td>
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</table>

**Owner**

**Engineering by**

**Construction by**

**Design**

**Operation**

**Maintenance**

**Inspection by**

**Authority for Inspection**

<table>
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<tr>
<th>Hayden, Harding &amp; Buchanen Inc.</th>
<th>Date</th>
<th>Authority</th>
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<tbody>
<tr>
<td>26-4-76</td>
<td>PL 92-367</td>
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