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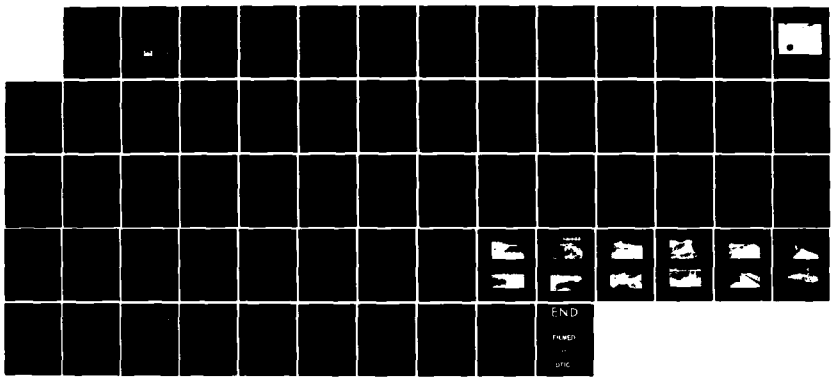

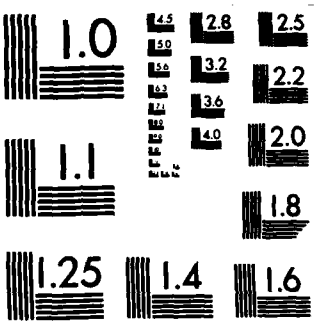

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MASSACHUSETTS / RHODE ISLAND COASTAL BASIN

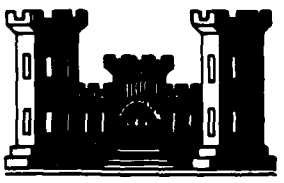
LYNN, MASSACHUSETTS

LYNN RESERVOIR DAM

MA 01285

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM



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

JULY, 1981

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER MA 01285	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Lynn Reservoir Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDED 424 TRAPELO ROAD, WALTHAM, MA. 02254		12. REPORT DATE July 1981 13. NUMBER OF PAGES 55
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

APPROVAL FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. 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.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Massachusetts/Rhode Island Coastal Basin

Lynn, Massachusetts

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The dam has a hydraulic height of 10 ft. and is 1920 ft. long. The top width is 18 ft. The dam is considered to be in poor condition. The dam is small in size with a hazard potential of high. A major breach of the dam would cause flow to be directed down Sunnyside Rd. and Linwood St., several houses in the area would be affected.

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LYNN RESERVOIR DAM

MA 01285

MASSACHUSETTS/RHODE ISLAND COASTAL BASIN
LYNN, MASSACHUSETTS

PHASE I - INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM
PHASE I - INSPECTION REPORT
BRIEF ASSESSMENT

Identification No.:	MA 01285
Name of Dam:	Lynn Reservoir Dam
City:	Lynn
County and State:	Essex County, Massachusetts
Stream:	None
Date of Inspection:	December 2, 1980

The Lynn Reservoir Dam, owned and operated by the City of Lynn, is an earthen embankment structure located in the central portion of Lynn, Massachusetts. The dam has a hydraulic height of 10 feet and is 1,920 feet long. The top width is 18 feet.

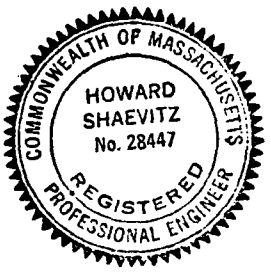
The dam impounds water for the Lynn Reservoir, used to maintain pressure in the City's water distribution system. The reservoir has a storage capacity of 74 acre-feet, and is considered low service as it serves a portion of the city which is low in elevation.

As a result of the visual inspection and the review of available data, the Lynn Reservoir Dam is considered to be in poor condition. Major concerns are: deterioration of the concrete foundation of the outlet works building, badly corroded and perforated structural members of the outlet works control bridge; deterioration of the outlet works abutments, and apparent erosion on the downstream slope of the dam.

The dam is classified as small in size and a high hazard structure in accordance with the recommended guidelines established by the Corps of Engineers. The test flood for this dam equals one half the Probable Maximum Flood (1/2 PMF). However, because of the neglible size of the drainage area, precipitation and not inflow is the basis of the analysis. One half the Probable Maximum Precipitation (1/2 PMP) is 13 inches (1.1 feet). The test flood analysis was based upon the water surface being at the normal pool elevation. Thus the test flood pool would rise to within 0.6 feet of the embankment crest. A major breach to the dam would cause flow to be directed down Sunnyside Road and Linwood Street; Linwood Street to be overtopped by approximately 2.6 feet. Several houses in the area would be affected. These houses would be subject to 2-3 feet of flooding.

It is recommended that the owner engage a qualified registered professional engineer to: investigate the cause of the apparent erosion channel on the downstream slope of the dam and specify measures required to prevent future erosion; inspect the condition of the embankment after excess vegetation is cleared; direct the repair or replacement of the footbridge to the outlet building, the bridge abutments, and the foundation for the outlet works building, as necessary; investigate the cause for the accidental overtopping of the dam and establish a means to insure that this condition cannot reoccur; and evaluate the seismic stability of the embankment and its foundation. The owner should also repair all cracked and spalled concrete and develop an emergency warning program. The dam and appurtenant structures should have a visual inspection once a month and a comprehensive technical inspection by a registered engineer once a year.

The recommendations and remedial measures are described in Section 7 and should be addressed by the owner within one year after receipt of this Phase I Inspection Report.



Howard Shaevitz
Project Manager
M.P.E. No. 28447

Schoenfeld Associates, Inc.
Boston, Massachusetts

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PREFACE

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 analysis 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 by 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 "1/2 Probable Maximum Flood" for the region (1/2 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.

The Phase I Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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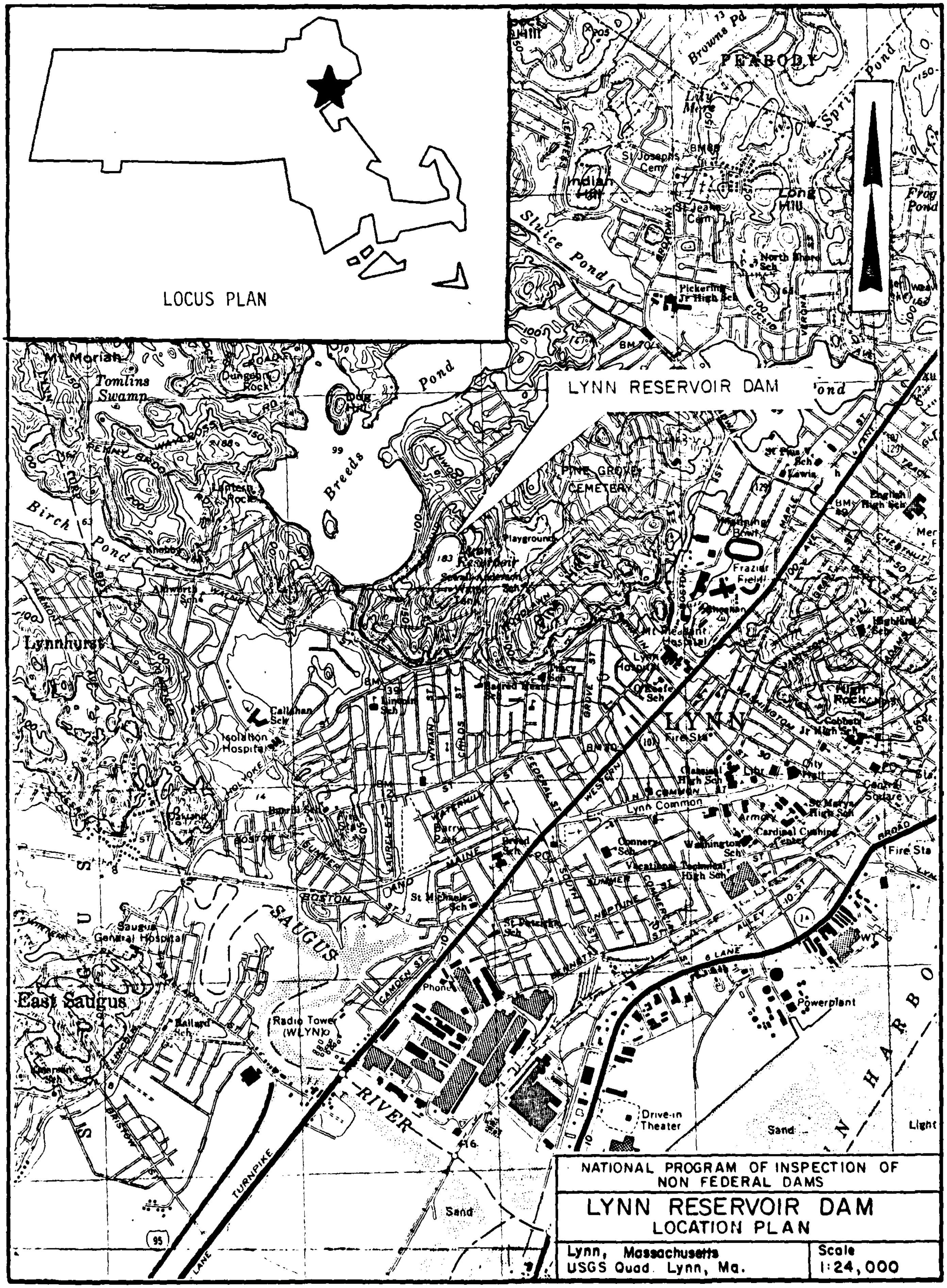
OVERVIEW PHOTOGRAPHY
LYNN RESERVOIR DAM


LOCUS PLAN
LYNN RESERVOIR DAM
PEABODY
Browns Pd
Sluice Pond
Breeds Pond
Birch Pond
Tomlins Swamp
Mt Moriah
Dungeon Rock
Lynnhurst
PINE GROVE CEMETERY
LYNN
Lynn Common
East Saugus
SAUGUS RIVER
Radio Tower (WLYN)
Drive-in Theater
Powerplant
Sand
LYNN HARBOR
TURNPIKE
NATIONAL PROGRAM OF INSPECTION OF
NON FEDERAL DAMS
LYNN RESERVOIR DAM
LOCATION PLAN
Lynn, Massachusetts
USGS Quad. Lynn, Ma.
Scale
1:24,000

NATIONAL DAM INSPECTION PROGRAM
PHASE I - INSPECTION REPORT
LYNN RESERVOIR 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. Schoenfeld Associates, Inc. has been retained by the New England Division to inspect and report on selected dams in the Commonwealth of Massachusetts. Authorization and notice to proceed were issued to Schoenfeld Associates, Inc. under a letter of October 30, 1980 from Colonel William E. Hodgson, Jr., Deputy Division Engineer. Contract No. DACW33-81-C-0010 has been assigned by the Corps of Engineers for this work.

b. Purpose

(1) To perform technical inspection and evaluation of nonfederal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by nonfederal interests.

(2) To encourage and prepare the states to initiate quickly effective dam safety programs for nonfederal dams.

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

1.2 Description of Project

a. Location. Lynn Reservoir Dam is located in the central portion of Lynn, Massachusetts and is approximately 500 feet east of the southern section of Breeds Pond. The dam is shown on the U.S.G.S. quadrangle sheet for Lynn, Massachusetts. The approximate coordinates are N42°-28'-30" and W70°-58'-18". The location of the dam is shown on the preceding page.

b. Description of Dam and Appurtenances. The dam is an earthen embankment structure 19 feet high and 1,920 feet long. The dam encloses the Lynn Reservoir on the west, north, and east sides. The south side is abutted by a cut in a 50-foot high hill. The crest of the dam, exterior slope, and interior slope to the top of the riprap are covered with grass, weeds, and small trees. There is no emergency spillway or open channel to carry flow from the reservoir.

Interior and exterior faces are sloped at 2H:1V and 3H:1V, respectively. The interior slope is riprapped from an elevation 1 to 2 feet below the crest of the dam to an unknown elevation beneath the water level of the reservoir at the time of the inspection. A gravel access roadway encircles the reservoir. A chain link fence completely surrounds the dam at the toe of the downstream slope to restrict unauthorized access.

A control building of masonry construction on the southern side of the dam houses the inlet controls to the reservoir. A bridge provides access to the building. The inlet lines consist of a 20-inch line and a 30-inch line accessible via a footbridge.

The 30-inch outlet of the dam is located on the eastern side of the dam. Flow through the outlet is controlled by a sluice gate. The water then passes through a chlorination building where it is chlorinated before entering the distribution system.

c. Size Classification. The dam is considered to be small in size because the hydraulic height is 10 feet and the storage is 72.6 acre-feet. This is in accordance with the Recommended Guidelines for Safety Inspections for Dams, which defines a small dam as having a storage capacity of 50 to 1,000 acre-feet.

d. Hazard Classification. The potential for hazard posed by this dam is classified as high. This is in accordance with the Recommended Guidelines for Safety Inspection for Dams, which defines a high hazard structure as one where failure poses a threat to more than a few lives.

e. Ownership. The dam is owned by the City of Lynn, Water Department, City Hall, Lynn, Massachusetts 01901.

f. Operator. The dam is operated and maintained by the City of Lynn, Water Department. The commissioner of Public Works is Mr. John Casey. The superintendant of the Water Department is Mr. Patrick McGrath. The telephone number is (617) 598-4000.

g. Purpose of Dam. The reservoir is used to maintain pressure in the water distribution system. It is considered to be a low service reservoir because it is utilized to serve a portion of the city which is low in elevation.

h. Design and Construction History. According to documentation obtained from the owner, the reservoir was completed in 1872 by Mr. George Norman. The reservoir was built by leveling a hill, excavating into it, and constructing the embankment completely around the excavated area. The Board detected leakage in unacceptable amounts and resolved the problem by replacing "the bottom and that portion of the slopes made by the excavation, with a puddle of clay and gravel to a depth of two feet."

Lynn Reservoir was at one time called the Distributing Reservoir by the Public Water Board of the City of Lynn. With the passage of time, however, its original name became obsolete.

i. Normal Operation Procedures. Water is pumped into the reservoir as needed. Pumping may be either continuous or intermittent. Water then flows from the reservoir with an increase in demand.

1.3 Pertinent Data

a. Drainage Area. The area tributary to the Lynn Reservoir is 5.6 acres (0.01 square mile) consisting of a gravel roadway and land containing brush, weeds and other vegetation. The maximum watershed elevation is at about 186 feet. Full reservoir elevation is at 184.7 feet.

The area around the reservoir is mostly wooded. There are no houses along the shoreline.

b. Discharge at Damsite

(1) Outlet works for Lynn Reservoir Dam consist of distribution piping only. The outlet works, consisting of a screen and a sluice gate, are housed in a concrete structure on the east side of the site. Maximum discharge of the pipe is considered negligible. There is no emergency spillway.

(2) Daily records of maximum discharge have been maintained at the site. The maximum known elevation was 184.8 and resulted when a workman forgot to close a valve at the pumping station, thus allowing water to continue to enter Lynn Reservoir until the reservoir was overtopped.

(3) Spillway capacity with the water surface at the top of the dam - N/A

(4) Spillway capacity with the water surface elevation at the test flood elevation - N/A

(5) Total project discharge at the test flood elevation - none

(6) Gated spillway capacity at test flood elevation - N/A

(7) Total spillway capacity at test flood elevation - N/A

(8) Total project discharge at top of dam - none

(9) Total project discharge at test flood elevation - none

c. Elevation (feet above NGVD)

(1) Streambed at toe of dam - 174.7 (at toe of downstream embankment on easterly side of dam)

(2) Bottom of cutoff - unknown

(3) Maximum tailwater - none

(4) Normal pool - 183.0 (from U.S.G.S. quadrangle sheet)

(5) Full flood control pool - N/A

(6) Spillway crest (gated) - N/A

(7) Design surcharge (original design) - unknown

(8) Top of dam - 184.7

(9) Test flood surcharge - 184.1

d. Reservoir (length in feet)

(1) Normal pool - 730

(2) Flood control pool - N/A

(3) Spillway crest pool - N/A

(4) Top of dam - 765

(5) Test flood pool - 765

e. Storage (acre-feet)

(1) Normal pool - 65.5

(2) Flood control pool - N/A

(3) Spillway crest pool - N/A

(4) Top of dam - 74

(5) Test flood pool - 70.5

f. Reservoir Surface (acres)

(1) Normal pool - 4.6

(2) Flood control pool - N/A

(3) Spillway crest - N/A

(4) Top of dam - 4.8

(5) Test flood pool - 4.8

g. Dam

(1) Type - earth

(2) Length - 1,920 feet at center of top width

(3) Hydraulic height - 10 feet

(4) Top width - 18 feet

(5) Side slopes - Interior: 3:1 horizontal to vertical; Exterior: 2:1 horizontal to vertical

(6) Zoning - unknown

(7) Impervious core - unknown

(8) Cutoff - unknown

(9) Grout curtain - unknown

(10) Other - none

h. Diversion and Regulating Tunnel - N/A

i. Spillway - N/A

j. Regulating Outlet

(1) Invert - 165.2

(2) Size - 30-inch

(3) Description - distribute water to Lynn water distribution system

(4) Control mechanisms - gate valves

(5) Other - none

SECTION 2
ENGINEERING DATA

2.1 Design

Design data were not available for the Lynn Reservoir Dam.

2.2 Construction

The dam was constructed in 1872 by Mr. George Norman. Although some historical information was obtained, construction records were not available.

2.3 Operation

No engineering operational data were found.

2.4 Evaluation

a. Availability. Engineering data were not available.

b. Adequacy. The existing engineering documentation is considered adequate for a Phase I investigation.

c. Validity. The field investigation indicated that the external features of the Lynn Reservoir Dam have not substantially changed from descriptions of the original construction.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. The visual inspection of the Lynn Reservoir Dam was conducted on December 2, 1980. The field inspection team consisted of personnel from Schoenfeld Associates, Inc., D. Baugh Associates, Inc., and Geotechnical Engineers, Inc. A representative from the City of Lynn was also present. Inspection checklists, completed during the field site visit, are included in Appendix A.

The dam encloses the reservoir on three sides - west, north, and east. The south side of the reservoir is abutted by a cut in a 50-foot high hill which trends roughly northeast-southwest. The natural ground drops off on the west, north, and east sides of the reservoir, and there is no downstream channel in the sense that there is a downstream channel for a dam constructed across a river valley.

The structural condition of the dam and its appurtenant structures is poor.

b. Dam. The dam consists of an earthen embankment. The crest of the dam, the exterior slope, and the interior slope (down to the top of the riprap) are covered with a dense growth of grass, coarse weeds, brush, and small trees up to about 2 inches in diameter (Photo Nos. 1 and 2). Brush has been cut and left lying on the embankment at several locations (Photo No. 3). Because of the standing weeds and brush and the piles of cut brush, it is not possible to adequately inspect the embankment.

At one location on the northwest side of the reservoir there is a channel about 1 to 2 feet deep on the exterior slope. This channel is now completely grown over with weeds and grass (Photo No. 3) but gives the appearance of having been caused by erosion.

There is riprap on the interior slope from an elevation 1 to 2 feet below the crest of the dam to some unknown elevation beneath the level of the reservoir at the time of the inspection (Photo No. 4). The riprap is in good condition.

At the toe of the exterior slope there is a chain-link fence which completely encircles the reservoir and which prevents trespassing on the dam. Adjacent to the chain-link fence there is a gravel roadway which also completely encircles the reservoir (Photo No. 5).

No evidence of seepage was observed anywhere on the exterior slope.

c. Appurtenant Structures. A control building of masonry construction houses the inlet controls to the impoundment (Photo Nos. 6 and 7). This building has a bridge which is used for access to the building. The bridge bears on a concrete footing on the dam side of the bridge, and this concrete exhibited some spalling. The bridge walkway, which is constructed of welded wire mesh, shows evidence of welding repair. The inlet control building and access bridge are structurally sound.

The outlet works (Photo No. 8) consisting of a sluice gate housed in a concrete structure, are near a chlorination building of masonry construction (Photo No. 9). They were reported operable by the owner. The concrete foundation of the service bridge to the outlet works has deteriorated at the water line. The service bridge is in very poor condition (Photo No. 10). The bridge stringers are badly corroded with extensive perforation of the flanges and web. The bridge footing is spalled and cracked (Photo No. 11). The bridge footing on the dam embankment has failed. This footing, of concrete construction, has broken into three distinct parts and is falling into the impoundment. The steel mesh walkway has also deteriorated. Several parts of the mesh have broken and are weakening the rest of the walkway.

d. Reservoir Area. The reservoir is enclosed on three sides by the dam. No evidence of seepage was observed.

e. Downstream Channel. As noted in 3.1.a, there is no downstream channel, as such. The area affected by a breach would be in the vicinity of Sunnyside Road and Linwood Street (Photo No. 12).

3.2 Evaluation

Overall the structural condition of the dam and its appurtenant structures is poor. The visual inspection revealed items that lead to this assessment, such as:

(1) Deterioration of the concrete foundation of the outlet works building.

(2) Badly corroded and perforated structural members of the outlet works control bridge.

(3) Deterioration of the outlet works bridge abutments.

At one location there is a channel on the exterior slope. Although now covered with grass and weeds, it appears that the channel resulted from erosion. If it is an erosion channel, it is not possible to determine on the basis of the visual inspection alone whether the erosion was due to rainfall runoff or an overtopping of the dam sometime in the past. Erosion of the embankment, if not prevented, could lead to breaching of the dam.

SECTION 4
OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

a. General. The Lynn Reservoir Dam is used primarily for the impoundment of the water in the Lynn Reservoir, which is part of the water supply system for the City of Lynn. Water is pumped from Breeds Pond via a 20-inch pipe and a 30-inch pipe to Lynn Reservoir. Upon an increase in demand, water enters the distribution system via a 30-inch pipe.

b. Description of Any Warning System in Effect. There is no written warning system for the dam.

4.2 Maintenance Procedures

a. General. The owner, the City of Lynn, is responsible for maintenance of the dam. The site is visited daily for the purpose of recording the water level.

b. Operating Facilities. No formal plan for maintenance of operating facilities was disclosed.

4.3 Evaluation

The current operation and maintenance procedures for the Lynn Reservoir Dam are considered to be inadequate to ensure that all problems encountered can be remedied within a reasonable period of time. The owner, however, should establish a written operation and maintenance procedure as well as a warning system to follow in the event of flood flow conditions or dam failure. The dam should be visually inspected once a month and a comprehensive technical inspection made once a year.

SECTION 5
EVALUATION OF HYDROLOGIC/HYDRAULIC FEATURES

5.1 General

The Lynn Reservoir Dam is an earthen embankment structure approximately 19 feet high and 1,920 feet long. There is no emergency spillway or channel to carry flow from the reservoir. The dam impounds the Lynn Reservoir, which serves as a water source for the City of Lynn.

5.2 Design Data

No hydrological or hydraulic design data were enclosed.

5.3 Experience Data

It is known that because a workman forgot to close a valve at the pumping station that feeds water to the reservoir, the dam has been overtopped. The approximate elevation for this event was 184.8.

5.4 Test Flood Analysis

Due to the absence of detailed design and operational information, the hydrologic evaluation was performed utilizing data gathered during the field inspection, watershed size, and an estimated test flood resulting from one half the Probable Maximum Precipitation (1/2 PMP). The drainage basin is flat.

The test flood was routed through the dam in accordance with the Corps of Engineers procedure for Estimating Effect of Surcharge on Maximum Probable Discharge. The reservoir water surface was assumed to be at elevation 183 prior to analysis. Because of the negligible size of the drainage area, precipitation and not inflow is the basis of analysis. One half Probable Maximum Precipitation (1/2 PMP) is 13 inches (1.1 feet). This analysis indicated that the test flood pool would rise to within 0.6 feet of the embankment crest.

5.5 Dam Failure Analysis

The impact of dam failure with the reservoir surface at the dam crest was assessed utilizing the "Rule of Thumb" Guidance for Estimating Downstream Dam Failure Hydrographs provided by the Corps of Engineers. The analysis covered a reach extending approximately 1,500 feet to Linwood Street. A failure flow of 8,500 cfs would run down Sunnyside Road at about 19 feet per second. At least 6 homes along Sunnyside Road would experience 2-3 feet of flooding. Linwood Street would be overtopped by approximately 2.6 feet. Excessive property damage and loss of more than a few lives are possible.

SECTION 6
EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observations

The inlet control building shows no sign of instability. The outlet control building is in poor condition with a deteriorating concrete foundation. The access bridge to the outlet control building is also in poor condition and is not structurally sound.

One channel on the exterior slope appears to be due to erosion which, if not prevented, could lead to breaching of the dam and long-term structural instability.

A dense growth of grass, coarse weeds, brush, and some trees, and some piles of cut brush at a few locations, make it impossible to inspect the embankment adequately.

6.2 Design and Construction Data

No design and construction data were available for this dam.

6.3 Post-Construction Changes

No significant post-construction changes could be ascertained.

6.4 Seismic Stability

This dam is in Seismic Zone 3. Phase I guidelines recommend, as a minimum that suitable analysis made by conventional equivalent static load methods should be in record for dams in Zone No. 3. As far as can be determined, no such analysis has been made.

SECTION 7
ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. Based on the results of the visual inspection, contact with the owner of the dam, and review of available information, Lynn Reservoir Dam is judged to be in poor condition. The following conditions are indicative of potential long-term problems:

(1) An apparent erosion channel on the downstream face. Erosion of the embankment, if not prevented, could lead to breaching of the dam.

(2) The poor condition of the outlet control building, with its deteriorating concrete foundation and structurally unsound access bridge.

b. Adequacy of Information. A dense growth of grass, coarse weeds, brush, and some trees, and some piles of cut brush at a few locations, make it impossible to inspect the embankment adequately. Therefore, the embankment should be inspected again, as recommended in Section 7.2, after the embankment has been cleared.

c. Urgency. The owner should implement the recommendations in Sections 7.2 and 7.3 within one year after receipt of this Phase I report.

7.2 Recommendations

The following investigations should be carried out and needed corrections performed under the direction of a registered professional engineer qualified in the design and construction of dams:

(1) Investigate the cause of the apparent erosion channel on the downstream slope of the dam and specify measures required to prevent future erosion.

(2) Inspect the embankment for erosion, animal burrows, etc. after the grass, weeds, brush, and trees growing on the embankment have been cleared as recommended in Section 7.3.

(3) Rehabilitate the footbridge to the outlet works building, including the bridge abutments.

(4) Repair the foundation for the outlet works building as necessary.

(5) Repair all cracked and spalled concrete.

(6) Investigate the cause for the accidental overtopping of the dam and establish a means to insure that this condition cannot reoccur.

(7) Evaluate the seismic stability of the embankment and its foundation.

7.3 Remedial Measures

a. Operating and Maintenance Procedures. The owner should:

(1) Clear the grass, weeds, brush, and trees growing on the embankment, and maintain the embankment by mowing the grass regularly.

(2) Visually inspect the dam and appurtenant structures once a month.

(3) Engage a registered professional engineer to make a comprehensive technical inspection of the dam once every year.

(4) Establish a downstream warning program to follow in case of emergency.

7.4 Alternatives

There are no practical alternatives to the remedial measures described in Section 7.3.

APPENDIX A

INSPECTION CHECK LIST

VISUAL INSPECTION CHECKLIST
PARTY ORGANIZATION

PROJECT Lynn Reservoir Dam

DATE Dec. 2, 1980

TIME 12:30 P.M.

WEATHER Cool, Cloudy

W.S. ELEV. 182.4 UPSTREAM
N/A DOWNSTREAM

PARTY:

1. Peter G. Palmieri, SAI
2. Michael Haire, DBA
3. Ronald Herschfeld, GEI
4. Pat McGrath, City of Lynn
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Hydrology/Hydraulics	Peter Palmieri	
2.	Structural Stability	Michael Haire	
3.	Soils and Geology	Ronald Herschfeld	
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECKLIST

PROJECT Lynn Reservoir Dam DATE Dec. 2, 1980

PROJECT FEATURE Dam Embankment NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
DAM EMBANKMENT	
Crest Elevation	184.7
Current Pool Elevation	182.4
Maximum Impoundment to Date	184.8
Surface Cracks	None observed
Pavement Condition	Not applicable
Movement or Settlement of Crest	None observed
Lateral Movement	None observed
Vertical Alignment	Good
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	Not applicable
Indications of Movement of Structural Items on Slopes	None observed
Trespassing on Slopes	No evidence of trespassing observed; reservoir is enclosed by chain link fence
Sloughing or Erosion of Slopes or Abutments	One channel on downstream slope is completely covered with grass and weeds; may be an old erosion channel
Rock Slope Protection - Riprap Failures	Riprap on upstream slope, in good condition
Unusual Movement or Cracking at or Near Toe	None observed
Unusual Embankment or Downstream Seepage	None observed
Piping or Boils	None observed
Foundation Drainage Features	None observed
Toe Drains	None observed
Instrumentation System	None observed
Vegetation	Heavy cover of grass, course weeds, brush & small (up to 2") trees on crest & downstream slope

PERIODIC INSPECTION CHECKLIST

PROJECT Lynn Reservoir Dam DATE Dec. 2, 1980

PROJECT FEATURE Dike Embankment NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
DIKE EMBANKMENT	No dike
Crest Elevation	
Current Pool Elevation	
Maximum Impoundment to Date	
Surface Cracks	
Pavement Condition	
Movement or Settlement of Crest	
Lateral Movement	
Vertical Alignment	
Horizontal Alignment	
Condition at Abutment and at Concrete Structures	
Indications of Movement of Structural Items on Slopes	
Trespassing on Slopes	
Sloughing or Erosion of Slopes or Abutments	
Rock Slope Protection - Riprap Failures	
Unusual Movement or Cracking at or Near Toe	
Unusual Embankment or Downstream Seepage	
Piping or Boils	
Foundation Drainage Features	
Toe Drains	
Instrumentation System	
Vegetation	

PERIODIC INSPECTION CHECKLIST

PROJECT Lynn Reservoir Dam DATE Dec. 2, 1980

PROJECT FEATURE Intake Channel NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel	No intake channel; reservoir is fed by pipe
Slope Conditions	
Bottom Conditions	
Rock Slides or Falls	
Log Boom	None
Debris	None
Condition of Concrete Lining	Not applicable
Drains or Weep Holes	
b. Intake Structure	Masonry construction - good condition
Condition of Concrete	
Stop Logs and Slots	None

PERIODIC INSPECTION CHECKLIST

PROJECT Lynn Reservoir Dam DATE Dec. 2, 1980

PROJECT FEATURE Control Tower NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural	
General Condition	Fair
Condition of Joints	Good
Spalling	Deteriorated concrete at water line
Visible Reinforcing	None
Rusting or Staining of Concrete	None
Any Seepage or Efflorescence	None
Joint Alignment	Good
Unusual Seepage or Leaks in Gate Chamber	No
Cracks	No
Rusting or Corrosion of Steel	None
b. Mechanical and Electrical	
Air Vents	
Float Wells	
Crane Hoist	
Elevator	
Hydraulic System	
Service Gates	
Emergency Gates	
Lightning Protection System	
Emergency Power System	
Wiring and Lighting System	

PERIODIC INSPECTION CHECKLIST

PROJECT Lynn Reservoir Dam DATE Dec. 2, 1980

PROJECT FEATURE Transition & Conduit NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT	Not applicable
General Condition of Concrete	
Rust or Staining on Concrete	
Spalling	
Erosion or Cavitation	
Cracking	
Alignment of Monoliths	
Alignment of Joints	
Numbering of Monoliths	

PERIODIC INSPECTION CHECKLIST

PROJECT Lynn Reservoir Dam DATE Dec. 2, 1980

PROJECT FEATURE Outlet Structure NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	No outlet channel
General Condition of Concrete	
Rust or Staining on Concrete	
Spalling	
Erosion or Cavitation	
Visible Reinforcing	
Any Seepage or Efflorescence	
Condition at Joints	
Drain Holes	
Channel	
Loose Rock or Trees Overhanging Channel	
Conditions of Discharge Channel	

PERIODIC INSPECTION CHECKLIST

PROJECT Lynn Reservoir Dam DATE Dec. 2, 1980

PROJECT FEATURE Spillway Weir NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	No spillway
a. Approach Channel	
General Condition	
Loose Rock Overhanging Channel	
Trees Overhanging Channel	
Floor of Approach Channel	
b. Weir and Training Walls	No weir
General Condition of Concrete	Not applicable
Rust or Staining	Not applicable
Spalling	Not applicable
Any Visible Reinforcing	Not applicable
Any Seepage or Efflorescence	Not applicable
Drain Holes	
c. Discharge Channel	
General Condition	
Loose Rock Overhanging Channel	
Trees Overhanging Channel	
Floor of Channel	
Other Obstructions	

PERIODIC INSPECTION CHECKLIST

PROJECT Lynn Reservoir Dam DATE Dec. 2, 1980

PROJECT FEATURE Service Bridge NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - SERVICE BRIDGE	
a. Super Structure	
Bearings	Poor (see b. below)
Anchor Bolts	None
Bridge Seat	Poor (see b. below)
Longitudinal Members	Webs & flanges are perforated extensively due to rust
Underside of Deck	Not applicable
Secondary Bracing	None
Deck	Fair to poor condition
Drainage System	Not applicable
Railings	Fair condition & functional
Expansion Joints	Not applicable
Paint	Railings have been painted, but stringers have not
b. Abutment & Piers	
General Condition of Concrete	Poor
Alignment of Abutment	Abutment at dam has failed
Approach to Bridge	Fair
Condition of Seat & Backwall	Concrete has spalled and broken into pieces at dam end of bridge & outlet building end of bridge

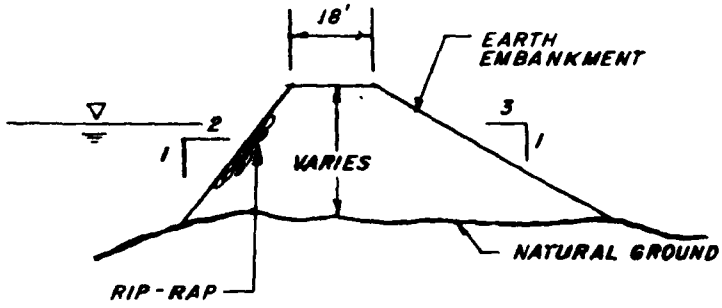
APPENDIX B

ENGINEERING DATA

Available Engineering Data

Engineering data for Lynn Reservoir Dam were not available.

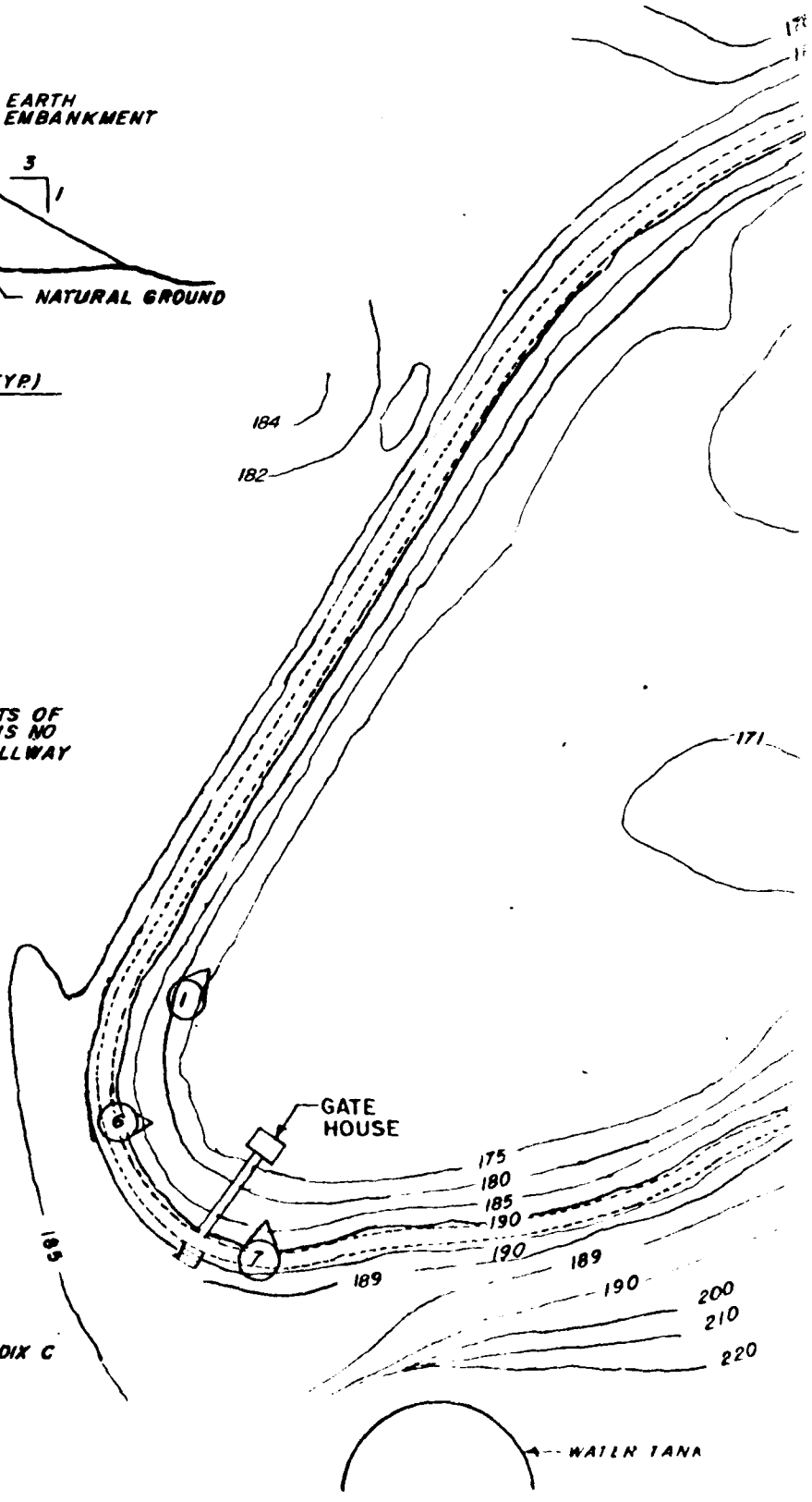
10 F 2



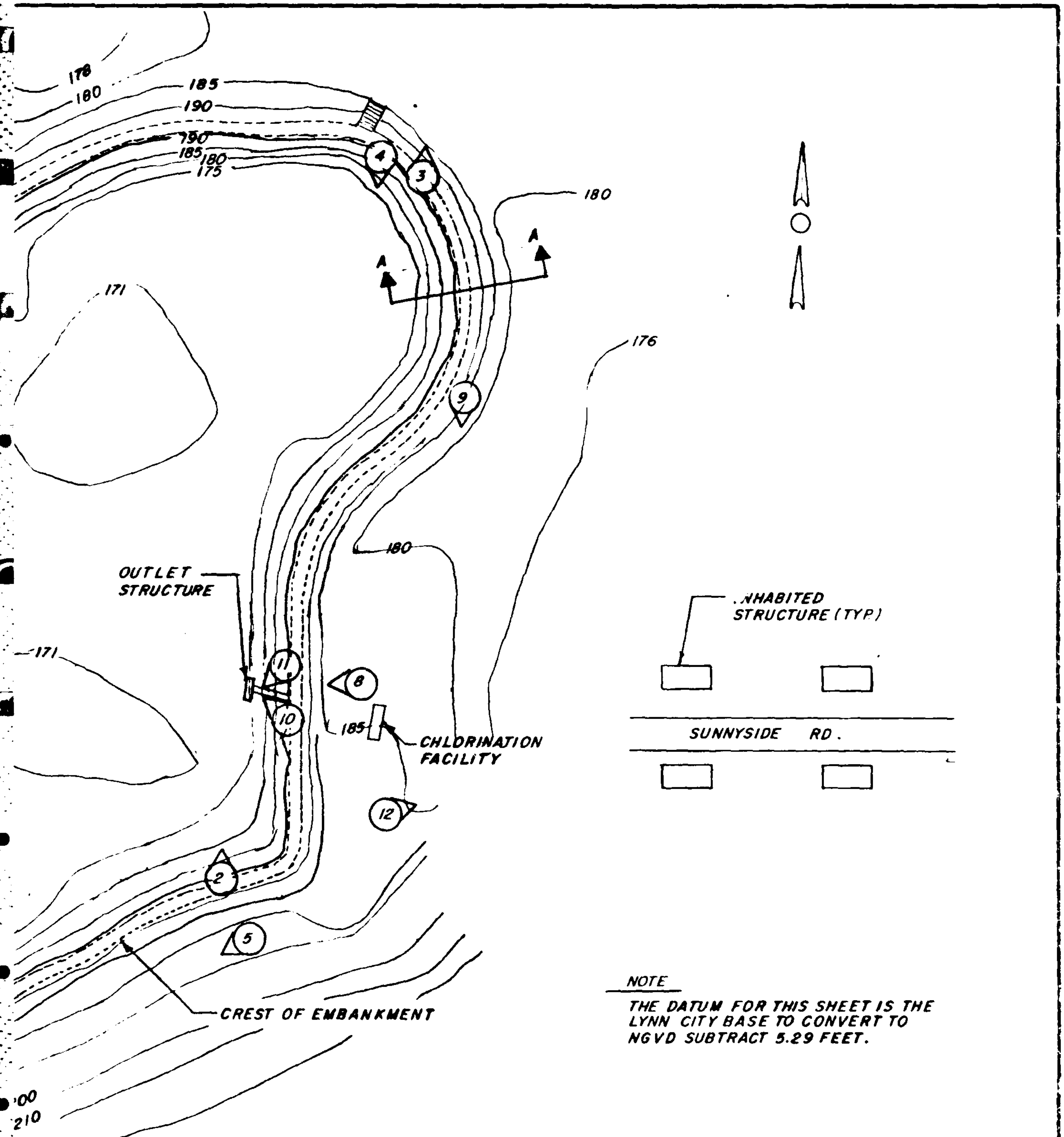
SECTION A-A (TYP.)
NOT TO SCALE

NOTE

THE OUTLET STRUCTURE CONSISTS OF UNDERGROUND PIPING. THERE IS NO PRINCIPAL OR EMERGENCY SPILLWAY FOR THE RESERVOIR.



(23) NUMBER AND ORIENTATION OF PHOTOGRAPHS IN APPENDIX C



NATIONAL PROGRAM OF INSPECTION OF NON FEDERAL DAMS

LYNN RESERVOIR DAM
PLAN

Lynn, Massachusetts	Scale 1" = 80'

L.E. WILKINSON 9/9/71 1

ON WESTERLY SHOULDER OF PINE HILL. BEGIN ON WALNUT ST. AT DUNGEON AVE. TAKE DUNGEON AVE. & RESERVOIR ROAD NORTHEASTERLY 0.40 MI. TO RESERVOIR.

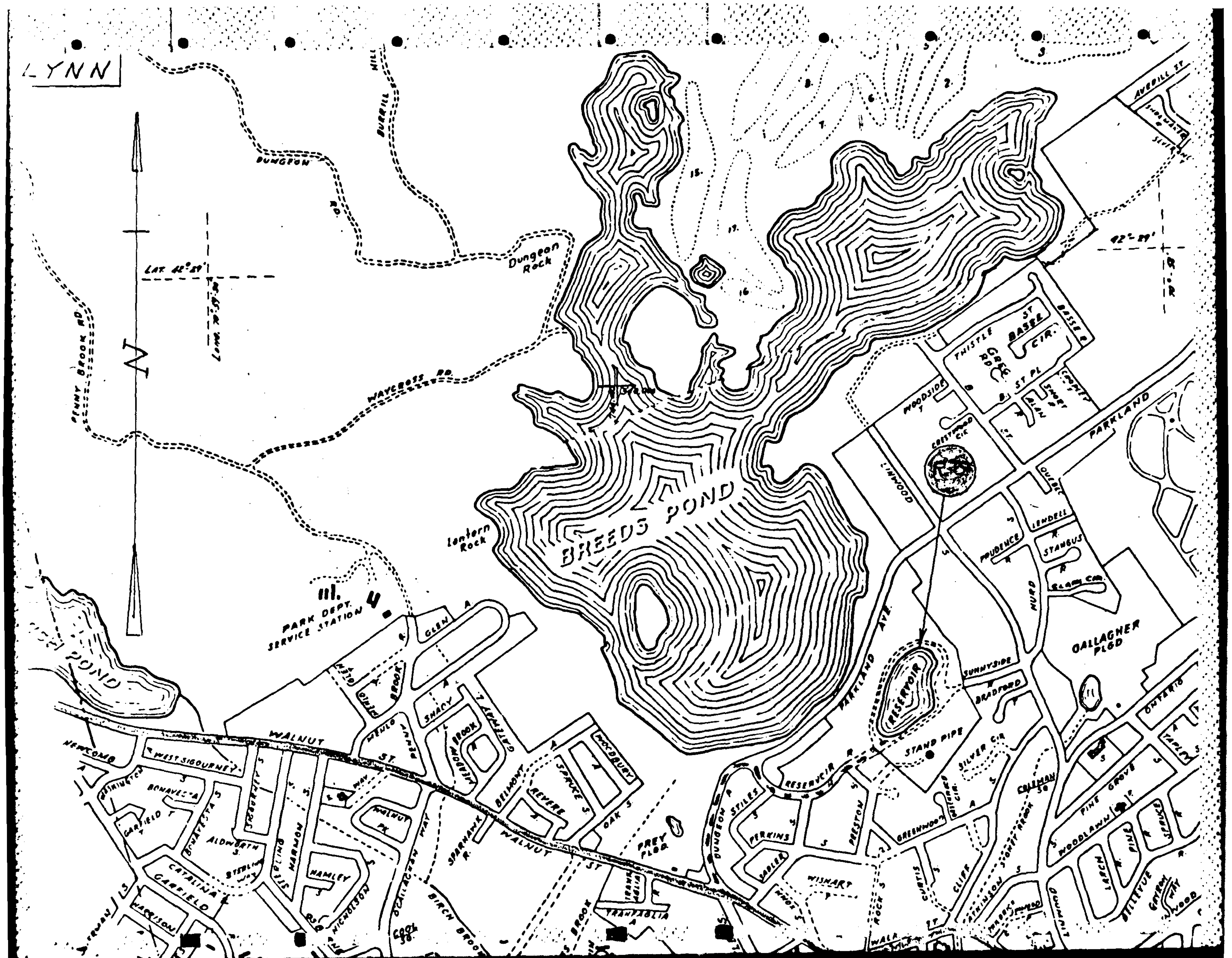
CITY OF LYNN

WATER SUPPLY

EARTH PAVED WITH LARGE FLAT STONES WITH PUDDLED IMPERVIOUS MATERIAL ON BOTTOM

20,000,000

THIS RESERVOIR IN EXCELLENT CONDITION. WATER LEVEL TO-DAY 3.0 FT BELOW TOP OF CONCRETE AT OVERFLOW STRUCTURE ON EASTERLY SIDE OF RESERVOIR. MAN CUTTING SMALL TREES ON EMBANKMENT.


LYNN
N
Lat. 42° 29'
Long. 70° 59' 30"
PENNY BROOK RD.
DUNGEON RD.
BURRILL HILL
WAYCROSS RD.
Dungeon Rock
Lantern Rock
BREEDS POND
POND
PARK DEPT. SERVICE STATION
WALNUT ST.
PARKLAND AVE.
PARKLAND
RESERVOIR
STAND PIPE
GALLAGHER PLGD
PREY PLGD.
GLEN
BROOK
MENLO
PENNY
SHADY
MEADOW BROOK
GATEWAY
BELMONT
REVERE
SPRUCE
WOODBURY
OAK S.
SPARHAWK
BIRCH BROOK
NEWCOMB
WEST SIGOURNEY
SIGOURNEY
HARMON
NICHOLSON
HAMLEY
GARFIELD
CATALINA
HARRISON
ALDWORTH
STERLING
BONAVESTA
WASHINGTON
DUNGEON
STILES
PERKINS
SADLER
WISHART
PRESTON
RESERVOIR
ROCK S.
CURTIS
CLIFF
GREENWOOD
SILVER CIR.
SUNNYSIDE
BRADFORD
HURD
PRUDENCE
LENDELL
STANGUS
QUEBEC
GOODWIN
WOODSIDE
CRESTWOOD CIR.
THISTLE ST
BASSE CIR.
GREG RD.
BASSE R
COUNTY
AVERILL ST.
ONTARIO
TAPLEY
PINE GROVE
WOODLAWN
PINE
SPRUCE
LARCH
BELLEVUE
SUMMIT
COLEMAN
STONY BROOK
ATKINSON
42° 29'
15.
17.
16

1964 March 1965. P.D.K. & K.M.J. Insps. Trees and brush growing in rip-rap should be removed.

1964 Report to Co. Comm. Trees and brush growing in riprap and on the outside banks should be removed.

1966 March 5, 1967. P.D.K. & K.M.J. Insps. Conditions the same.

1966 Report to Co. Comm. Safe and in reasonably good condition.

1968 Pine Hill Reservoir. April 30, 1969. P.D.Killam & J. Fitzgerald. Trees on the rim of the reservoir should be cut.

1950 Report to Co. Comm. At Pine Hill Reservoir, as stated in previous reports, the embankments should be repaired to prevent further erosion and endanger the reservoir.

1952 Oct. 2, E.H.Page, Insp. Gave a copy of the notice to Mr. John Hines at the Hawkes Pond Pumping Station for Mr. Callahan and went to the reservoir alone. No repairs since last inspection. Water level today: about 2.5 ft. below top of conc. wall at the outlet. Places on the outside slope that have been washed out see about the same. The inside of the reservoir inspected by looking through the fence at tht high end and the outside slope inspectad by walking around reservoir and looking through the fence

1952 Report to Co. Comm. At Pine Hill Reservoir, the embankments, where eroded, should be repaired and kept in good condition, as previously stated in former reports.

1954, May 19, E.H.Page, Insp . Elev of water: 2' ± below top of conc. at outlet. Slight erosion of banks. Condition of dam is reasonably good. Inspection was made from outside the fence by walking completely around reservoir.

1954 Report to Co. Comm. At Pine Hill Reservoir, the embankments where eroded should be repaired and kept in good condition, as previously stated in former reports.

1956 Sept. 6, E.H.Page, Insp. Condition: Same.

1956 Report to Co. Comm. At Pine Hill Reservoir, the embankments where eroded should be repaired and kept in good condition, as previously stated in former reports.

1958, Dec. 31, E.H.Page and K.M.Jackson, Insp. Erosion: Some erosion to banks. Condition: Fair.

1958 Report to Co. Comm. At Pine Hill Reservoir, the embankments where eroded should be repaired and kept in good condition as previously stated in former reports.

1961, January 3, E.H.Page & P.D.Killam, Insps. Erosion of Banks: Some - see previous report. Condition: Same.

1960 Report to Co. Comm. At Pine Hill Reservoir, the embankments, where eroded, should be repaired and kept in good condition, as previously stated in reports.

1963, Jan. 3, K.M.Jackson, Insp. Owner: City of Lynn Water Works. Elev. of water: Water about 3' below riprap. Condition same as last report. Partially frozen over.

1962 Report to Co. Comm. Safe and in reasonably condition.

Lynn R. 6

1938 October 18, C.C.Barker, Insp. This reservoir is in good condition, there has been no change. It is full of water today.

1938 Report to Co. Comm. Safe and in reasonably good condition.

1940 Sept. 26, C.C.Barker, Insp. This reservoir is in good condition and there has been no change. The water level is about one foot below the top of the paving.

1940 Report to Co. Comm. Safe and in reasonably good condition.

1942 July 22, C.C.Barker, Insp. This reservoir is in good condition, and there has not been any change. However, on the northerly side the earth slope is gouged out about one foot deep and eight feet wide. This is not serious. The reservoir is full.

1942 Report to Co. Comm. Safe and in reasonably good condition.

1944 June 30 S.W.Woodbury, Insp. I showed a copy of the notice to the watchman who went to the reservoir with me. The water level is 1.9 ft. below the bench mark at the outlet. (16.7 by the gauge.) The slope is washed out a little at the northwesterly corner and a small place on the northerly side. Conditions here are about the same.

1944 Report to Co. Comm. Safe and in reasonably good condition.

1946 Aug. 1, S.W.Woodbury, Insp. I gave a copy of the notice to Mr. Northy for Mr. James C. Callahan and went to reservoir alone. Water level today is 2.6' below monel plug in top of concrete at outlet. The place at the northwest corner, which is being washed out more and more each year, should be filled with rocks to prevent further erosion. There is another small washout at southwest corner which is not as bad. The concrete at the outlet is disintegrated at the water level, but this is not bad yet.

1946 Report to Co. Comm. Safe and in reasonably good condition.

1948 Sept. 9, S. W. Woodbury, Insp. Left a copy of the notice for Mr. Callahan at his office and went to reservoir alone. Water level today: 2.5' below monel plug in top of concrete at outlet. Places at the n.w. and s.w. corners which are being washed out are getting steadily worse and should be repaired. The concrete at the outlet is disintegrated but is not bad yet.

1948 Report to Co. Comm. The embankments at the Pine Hill Reservoir should be brought up to grade in several placed where erosion has taken place. Unless repairs are made, erosion will increase and cut through the embankments, endangering the reservoir.

1950 Sept. 15, S.W.Woodbury, Insp. Gave a copy of the notice to Mr. John Hines for Mr. Callahan and went to reservoir alone. A new chain-link fence has been built all around the reservoir. Water level today: About 2.5' below top of concrete wall at outlet. Condition of the dam: Places on outside slope which have been washed out seem to be about the same.

1917, March 26. Maximum height 20.0 ft. Apparent condition, Good.

1923, Dec. 3. R. R. Evans, Insp. Reservoir on Pine Hill is in good condition.

1923 Report to Co. Comm. The reservoir on Pine Hill is apparently in good condition.

1928, July 24. C. C. Barker, Insp. Reservoir on Pine Hill, east of Breeds Pond Dam, is owned by the Lynn Water works and is part of the Lynn water supply system. I did not try to see the owners as you will probably inspect this reservoir later. I do not think much damage would result in case of failure of this reservoir or there would be any loss of life, although the southwest side of the hill is quite thickly populated. The conditions are the same as at the last inspection. The reservoir is in good condition. The water level today is 2' 6" below top of reservoir.

1928 Report to Co. Comm. The reservoir on Pine Hill east of Breeds Pond, also owned by the city of Lynn and forming a part of the Lynn water supply system, was inspected and found to be in good condition, with no apparent changes since the last inspection.

1930, Sept. 9. C. C. Barker, Insp. Reservoir on Pine Hill, east of Breeds Pond Dam, is owned by the Lynn Water Works and is part of the Lynn water supply system. I left a copy of the notice at Mr. Heath's office. I do not believe there would be much damage in case of failure, or any loss of life, although the southeast side of the hill is quite thickly populated. The reservoir is in good condition and there have been no changes since the last inspection. Today the reservoir is full of water.

1930 Report to Co. Comm. Thereservoir on top of Pine Hill east of Breeds Pond, is a part of the Lynn water supply system and is of considerable importance through its location. The structure is apparently safe and in good condition.

1932, July 26. C. C. Barker, Insp. The reservoir is in good condition, there has been no change. The reservoir is nearly full of water.

1932 Report to Co. Comm. Safe and in reasonably good condition.

1934, Sept. 21. C. C. Barker, Insp. The reservoir is in good condition, and is full of water. There has been no change.

1934 Report to Co. Comm. Safe and in reasonably good condition.

1936 August 3, C.C.Barker, Insp. The reservoir is in good condition and hearly full of water. The crevices in the inner slope paving have been filled with crushed stone.

1936 Report to Co. Comm. Safe and in reasonably good condition

ENGINEERING DEPARTMENT

Inspection of Dams, Reservoirs, and Stand Pipes

SUB-NUMBER
D. R. S. P.
Neg. Nos. 433

Inspector C. C. Barker Date April 8, 1912 *Classification 1

City or Town Lynn Location Pine Hill, east of Breeds Pond Res. and north of Walnut St.

Owner Lynn Water Works Use Water Supply

Include such details as cores, cut off walls, paving, sodding, class of masonry, kind of cement, (nat. or port.) etc.

Material and Type Earth. Built above ground on S.W. & N. sides, paved on inside with large flat stones, sodded on outside slopes. Res on side hill

Elevations in feet: above (+) or below (−) full pond or reservoir level. (Cross out what does not apply.)

For Dam: ~~Bed of stream below~~ ~~Bottom of pond~~ ~~Bottom of spillway~~ ~~Top of dam~~ Top of flash boards.

For Res. or S. P.: Ground surface below ..... Bottom of res. 15 Level of over flow pipe ..... Top of res. +2

For dam: ~~Length in ft.~~ ~~Top width in ft.~~ ~~Pond area~~ ~~Area of watershed~~

For Res. or S. P. Inside dimensions Interior surface 5 acres Capacity 20,000,000 gal. ~~covered~~ — open.

Length of overflow or spillway ..... Outlet pipes (size and nature) .....

~~Stand pipe, thickness at base~~ ~~diam. of rivet head~~ ~~Pitch~~ Thickness .....

Foundation and details of construction .....

Constructed by and date 1871 by Geo. H. Norman, Newport, R.I. Geo. H. Bishop Eng.

Recent repairs and date .....

Evidence of leakage .....

Condition Good at present ~~S. P. when painted~~ Inside ..... Out .....

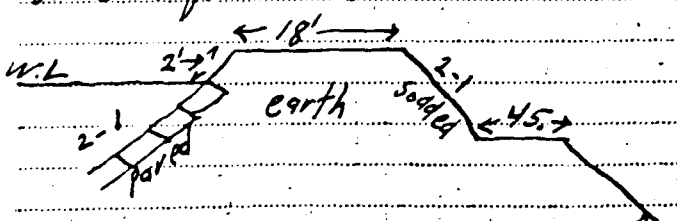
Topography of country below Steep hill side, some woods

Nature, extent, proximity, etc. of buildings, roads or other property in danger if failure should occur Thickly populated on S.W. side, however not a great deal of damage would ensue

Plans and data secured or available Report of Water Board City Hall Lynn.

Use separate sheet for sketches if necessary.

Notes, sketches, sections, etc. In 1872 a puddled clay & gravel 2 ft. deep was put over the reservoir & this was connected with the puddle in the embankment. Reservoir is divided into two parts. After puddling was completed in 1872 the reservoir was tight but before this was done it was unserviceable



Boulders large boulders westerly & N.W. sides

*Classify as to probable damage in case of failure. 3 slight. 2 moderate. 1 serious. No danger Inc. Oct 18, 1916 G.F.W.

APPENDIX C

SELECTED PHOTOGRAPHS

(The Index to these Photographs is found in Appendix B)

Photo No. 1 - Interior slope of dam, viewed from crest.

Photo No. 2 - View along interior slope looking at outlet structure.

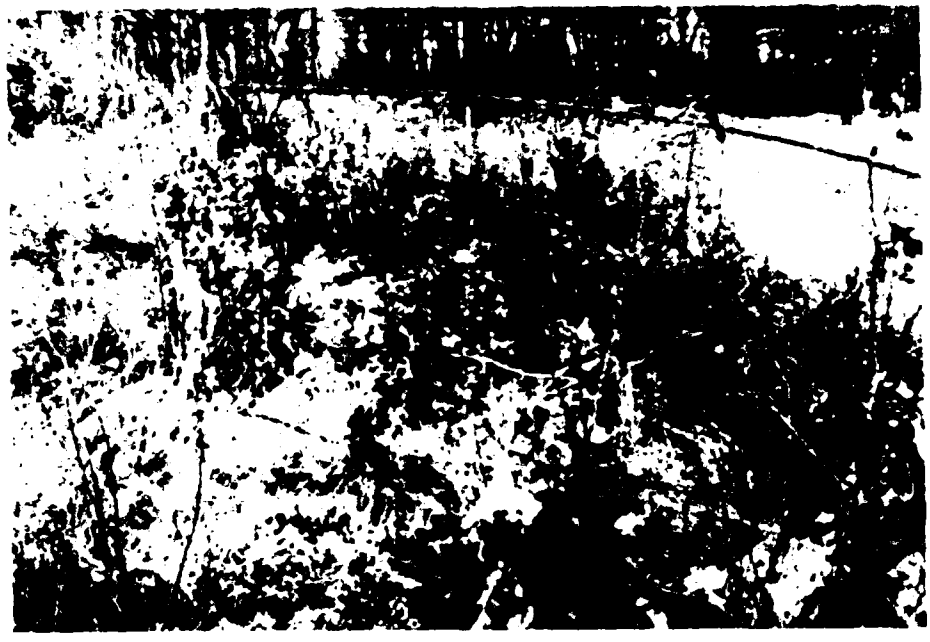


Photo No. 3 - Brush cut on exterior slope. There appears to be an erosion channel on the exterior slope in this area, although it is completely overgrown with grass and brush.

Photo No. 4 - Riprap on interior slope.

Photo No. 5 - View of gravel road surrounding chain link fence.

Photo No. 6 - View of gatehouse and crest.

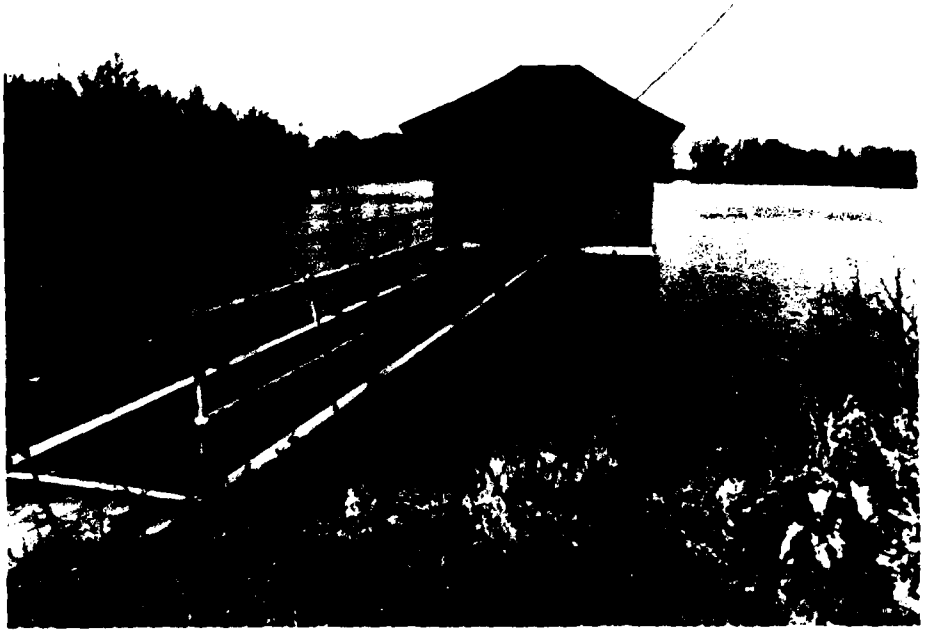


Photo No. 7 - View of gatehouse and service bridge.

Photo No. 8 - Service bridge to the outlet control structure.

Photo No. 9 - Chlorination building.

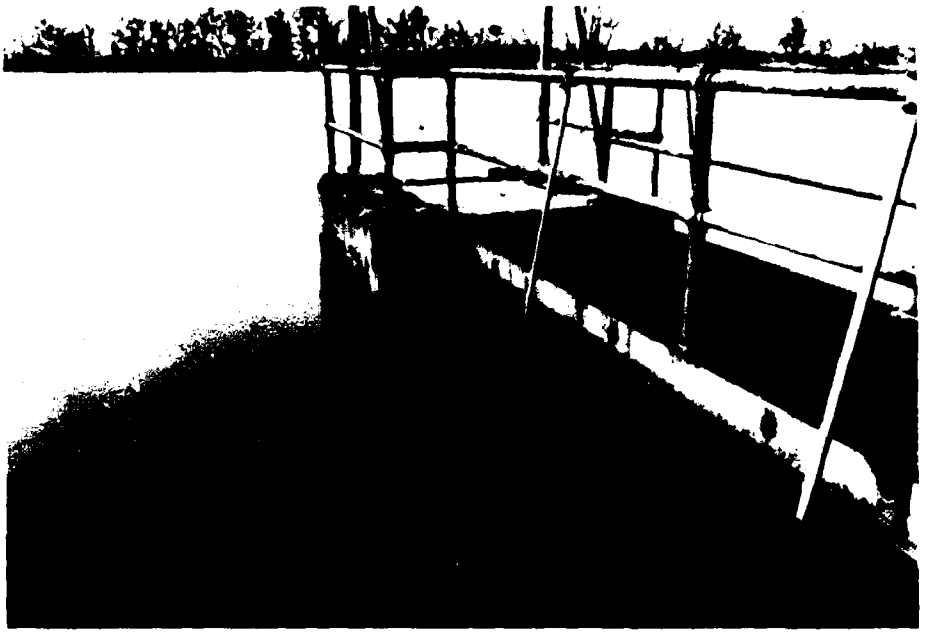


Photo No. 10 - Deterioration of the steel mesh walkway of the service bridge to outlet structure.

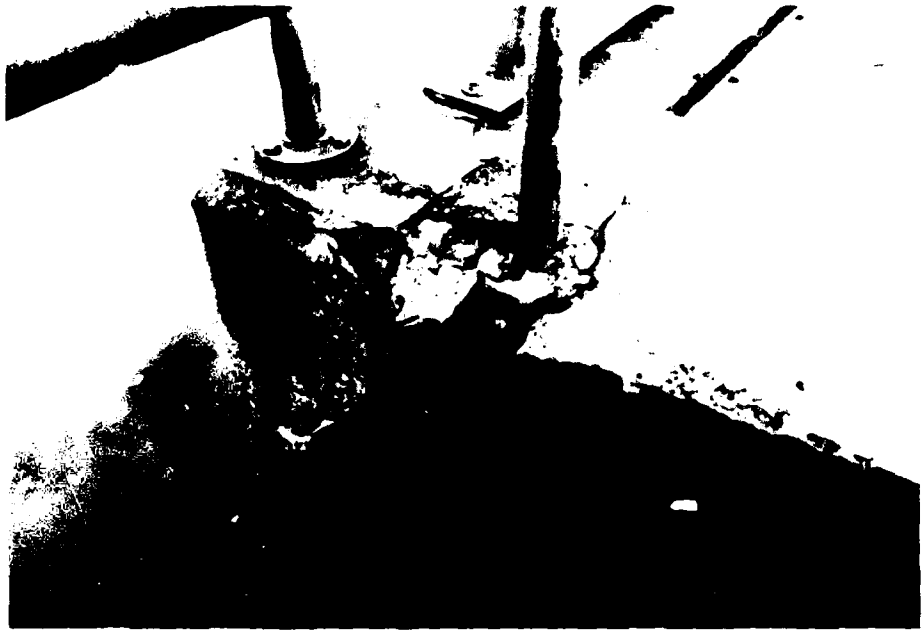


Photo No. 11 - Spalling at concrete footing of service bridge to outlet structure.

Photo No. 12 - End of Sunnyside Road from gravel road surrounding dam.

APPENDIX D

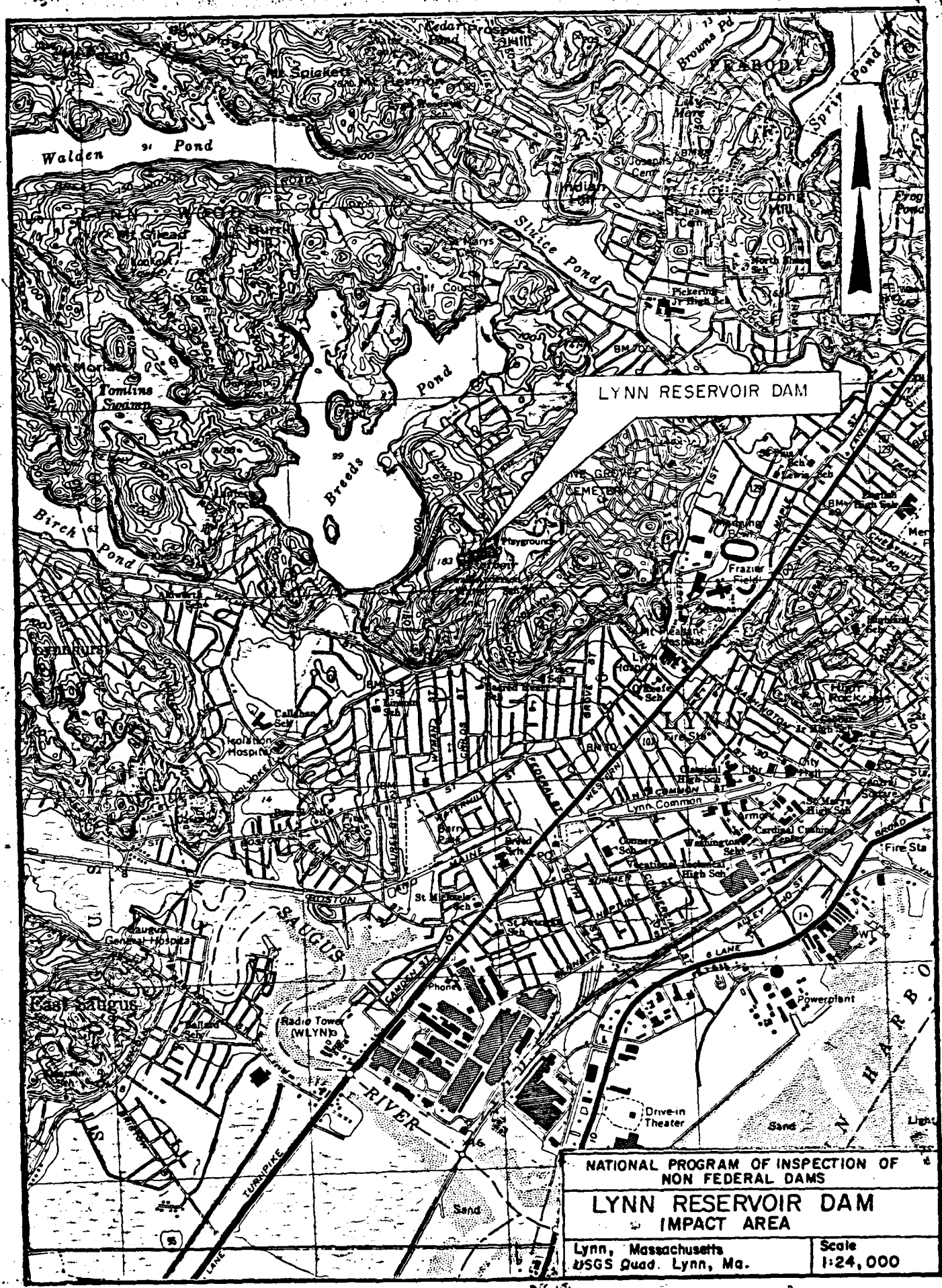
HYDROLOGIC AND HYDRAULIC COMPUTATIONS

NATIONAL PROGRAM OF INSPECTION OF
NON FEDERAL DAMS

LYNN RESERVOIR DAM
DRAINAGE AREA

Lynn, Massachusetts
USGS Quad. Lynn, Ma.

Scale
1:24,000



NATIONAL PROGRAM OF INSPECTION OF NON FEDERAL DAMS

LYNN RESERVOIR DAM
IMPACT AREA

Lynn, Massachusetts
USGS Quad. Lynn, Ma.

Scale
1:24,000

SCHOENFELD ASSOCIATES, INC.
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JOB LYNN RES. DAM
SHEET NO. 1 OF 6
CALCULATED BY GUS S. DATE 18 MAR 81
CHECKED BY H.S. DATE APR 15, 1981
SCALE

TEST FLOOD ANALYSIS

Choose spillway design flood (SDF)

Classification – Size: Small
Hazard: High

Use 1/2 probable maximum flood (PMF) as SDF

From PMF guide curves for flat terrain:

For drainage area ≐ 5.6 ac = 0.01 mi^2,

Q_{p_1} = 1000 csm (intersection w/ ordinate)

Q_{p_1} = 1/2 (1000)(0.01) = 5 cfs

It is obvious that tributary drainage area is insignificant*

Assume 13 inches of water covers reservoir. (½PMP)▽
Normal pool elevation = 183.0
T.O. dam embankment elevation = 184.7
Available surcharge storage depth = 1.7 ft = 20.4 in.

A 1/2 PMF event would fill the reservoir to within about 7 inches (20.4 - 13) of the embankment crest.

* Reservoir surface area ≈ 5.1 ac., tributary drainage area ≈ 0.5 ac.

▽ (Probable maximum precipitation) 1/2

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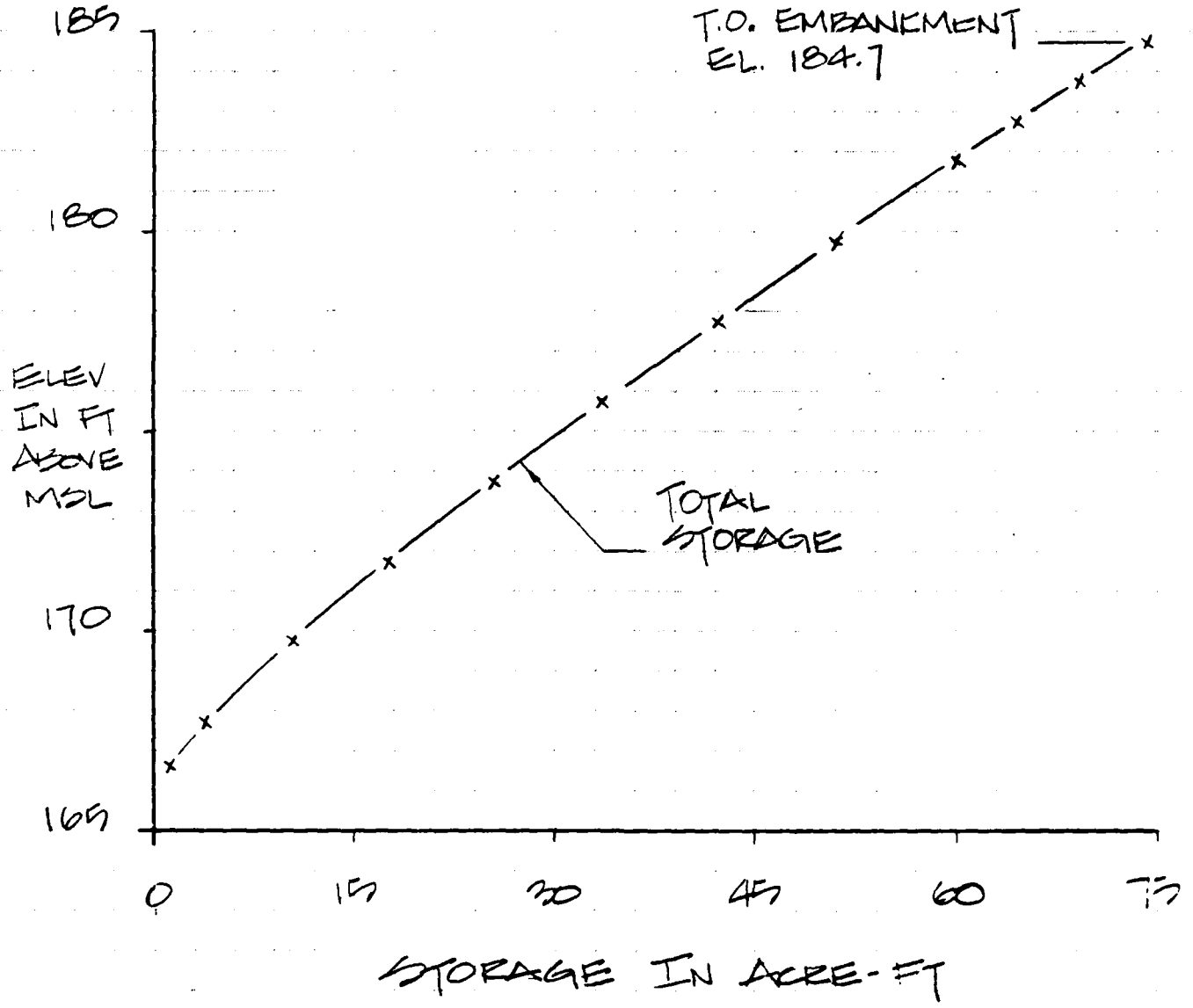
JOB LYNN RES. DAM
SHEET NO. 2 OF 6
CALCULATED BY GLS DATE 20 FEB 81
CHECKED BY H.S. DATE APR 15, 1981
SCALE

STAGE VS. STORAGE



NOTE: Surcharge storage is negligible. Therefore, no surcharge storage routing was performed.

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JOB LYNN RES. DAM
SHEET NO. 3 OF 6
CALCULATED BY GUS S. DATE 18 MAR 81
CHECKED BY H.S DATE APR 15, 1981
SCALE

BREACH ANALYSIS

Compute breach outflow, Q_{P_1}, @ dam. Assume breach occurs at east side of dam just north of the chlorination facility.

$$Q_{P_1} = 8/27\ W_b \sqrt{g}\ y_o^{3/2}$$

Use $W_b = 160$ ft., $y_o^* = 10$ ft.

$$Q_{P_1} = 8/27\ (160)\sqrt{32.2}\ (10)^{3/2} = 8507, \text{ say } \underline{\underline{8500}}\ \text{cfs}$$

REACH 1

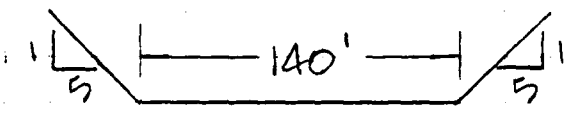
Downstream limit is Linwood St.

Extends down Sunnyside Rd., length = 700 ft.

$S = 0.125$, composite "n" value = 0.05

Develop rating curve for reach using the Manning equation:

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$



TYP. X-SECTION

* Water surface at top of dam embankment.

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JOB LYNN RES. DAM
SHEET NO. 4 OF 6
CALCULATED BY GUS S. DATE 18MAR81
CHECKED BY M.S DATE MAR 15 1981
SCALE

BREACH ANALYSIS (cont.)

REACH 1 (cont)

STAGE ABOVE CHANNEL INV (FT)	AREA (FT^2)	WETTED PERIMETER (FT)	Q (CFS)
1	145	150	1493
2	300	160	4800
2.5	381	166	7001
3	465	171	9557

see rating curve, SH 6/6 .

$Q_{P_1} = 8500$ cfs , stage = 2.8 ft.

$V_1 = \frac{\text{area (length)}}{43560} = \frac{431(700)}{43560} = 6.9$ ac-ft $< \frac{74}{2}$ ∴ OK

$Q_{P_2\,(TRIAL)} = Q_{P_1}\left(1 - \frac{V_1}{S}\right) = 8500\left(1 - \frac{6.9}{74}\right) = 7707$ cfs

stage = 2.6 ft. $V_2 = \frac{398(700)}{43560} = 6.4$ ac-ft

$V_{AVG} = 6.7$ ac-ft

$Q_{P_2} = Q_{P_1}\left(1 - \frac{V_{AVG}}{S}\right) = 8500\left(1 - \frac{6.7}{74}\right) = \underline{\underline{7730}}$ cfs

stage = 2.6 ft

Average flow velocity = $\frac{7730 \text{ ft}^3/\text{sec}}{398 \text{ ft}^2} = 19.4$ ft/sec

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JOB [illegible]

SHEET NO 5 OF 6

CALCULATED BY Gus S. DATE [illegible]

CHECKED BY H S DATE [illegible]

SCALE

BREACH ANALYSIS (cont.)

REACH 1 (cont.)

Reach 1 is actually a residential district located immediately downstream of the dam. The very high average flow velocity calculated above dictates a high potential for excessive damage and loss of life.

In summary, at least six homes along Sunnyside Rd. would be subject to 2-3 feet of fast-flowing floodwater. Therefore, the potential exists for the loss of ten or more lives.

Accordingly, Lynn Reservoir Dam is classified as High Hazard.

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

END

FILMED

8-85

DTIC