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NATIONAL DAM INSPECTION PROGRAM SINGLETARY POND DAM (MA 1/1
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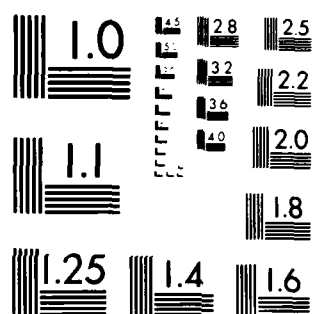
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BLACKSTONE RIVER BASIN
MILLBURY, MASSACHUSETTS

SINGLETARY POND DAM
MA 00144

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



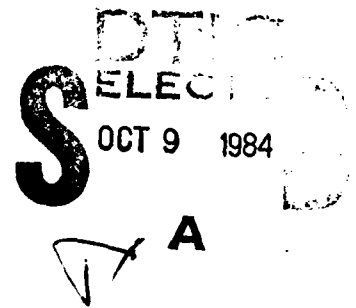
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DEPARTMENT OF THE ARMY
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WALTHAM, MASS. 02154

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number) DAMS, INSPECTION, DAM SAFETY, Blackstone River Basin Millbury, Mass.		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Singletary Pond Dam is an earthen dam approximately 50 feet long and 17 feet high. The crest width of the dam is approximately 80 feet. The dam is considered in fair condition due primarily to the existence of a depression in the ground surface over the outlet conduit. Based on the intermediate size and significant hazard classification, the spillway test flood is the ½ PMF.		



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:
NEDED

MAY 29 1979

Honorable Edward J. King
Governor of the Commonwealth of
Massachusetts
State House
Boston, Massachusetts 02133

Dear Governor King:

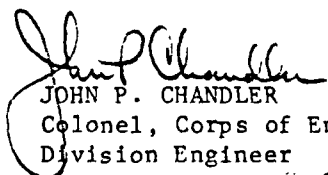
I am forwarding to you a copy of the Singletary Pond Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological 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, Singletary Corporation, c/o Mr. Terrance Windle, Windle Industries, Inc., 65 Canal Street, Millbury, Massachusetts 01527.

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,


JOHN P. CHANDLER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated



A 1

SINGLETON POND DAM
MA 00144

BLACKSTONE RIVER BASIN
MILLBURY, MASSACHUSETTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Identification No.: MA 00144
Name of Dam: SINGLETARY POND DAM
Town: MILLBURY
County and State: WORCESTER COUNTY, MASSACHUSETTS
Stream: SINGLETARY BROOK
Date of Inspection: 14 SEPTEMBER and 20 SEPTEMBER 1978

BRIEF ASSESSMENT

Singletary Pond Dam is an earthen dam approximately 50 feet long and 17 feet high. The crest width of the dam is approximately 80 feet. There are two gate houses on the crest of the dam. A concrete channel within the pond leads to the intake gate house. When closed, the gate within the structure will cut off all spillway discharges. The gate house at the downstream edge of the dam crest contains both a spillway and a gated outlet which serves as the reservoir drain. Flow from the outlet works enters into Singletary Brook.

The dam is considered in fair condition due primarily to the existence of a depression in the ground surface over the outlet conduit. It was reported to the investigating team that the conduit had failed in the past and had been replaced in part with a pipe of unknown diameter. The reason for the existence of the depression must be established before this dam could be considered in better than fair condition. The conduit underlying this depression is the only existing outlet for the pond.

Based on the intermediate size and significant hazard classifications, in accordance with Corps of Engineers Guidelines, the spillway test flood is the 1/2 Probable Maximum Flood (1/2 PMF). Hydraulic and hydrologic analyses indicate that the dam site is basically a high surcharge - low spillage project with limited outlet capacity. The pond level would rise to elevation 559.6 during the test flood which is approximately 1-ft. below the top of dam. The outlet works would release a maximum outflow of 26 cfs with the downstream gate closed and is considered to be adequate for the passage of the test flood.

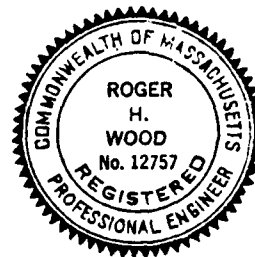
Recommendations made in the report include an investigation to determine the cause of the depression over the outlet conduits and its present condition, an investigation to determine the effect of seepage observed at the downstream toe of the dam and a topographic survey and evaluation of the actual embankment configuration with respect to stability and available freeboard. Remedial measures recommended in the report include the clearing of brush and trees, including stumps, from the embankments and the backfilling of resulting holes, the repair of stone slope protection on the upstream face of the dam and maintenance of the exterior

of the downstream gate house. It is also recommended that the Owner establish a formal operations procedure and formal emergency procedures plan and warning system. The recommendations and remedial work should be carried out by the Owner within 1 year after receipt of this report.

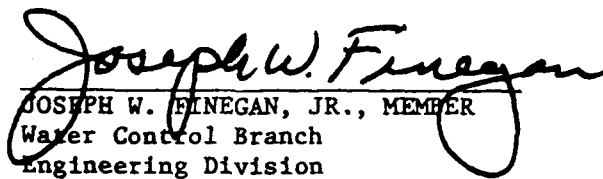
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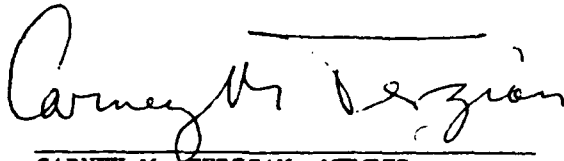
Roger H. Wood

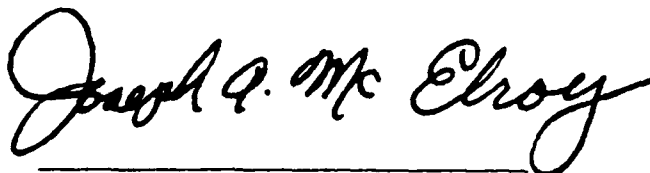
Roger H. Wood
Vice President



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


JOSEPH W. FINEGAN, JR., MEMBER
Water Control Branch
Engineering Division


CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division


JOSEPH A. MCELROY, CHAIRMAN
Chief, NED Materials Testing Lab.
Foundations & Materials Branch
Engineering Division

APPROVAL RECOMMENDED:


JOE B. FRYAR
Chief, Engineering Division

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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 analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

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

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

Phase I Investigations are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the test flood is based on the estimated "probable maximum flood" for the region (greatest reasonably possible storm runoff), or a fraction 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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1. TELEPHOTO OVERVIEW OF UPSTREAM FACE OF DAM AND INTAKE GATE HOUSE.



DAM: SINGLETARY POND

IDENTIFICATION NO.: MA.00144



LOCATION MAP
USGS QUADRANGLE
WORCESTER-SOUTH, MA.
SCALE: 1" = 2000'

PHASE 1 INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
SINGLETTY POND DAM
MA 00144

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.

Camp Dresser & McKee 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 Camp Dresser & McKee Inc. under letters of 12 July 1978 and 23 October 1978 from Colonel John P. Chandler, Corps of Engineers. Contract No. DACW 33-78-C-0354 has been assigned by the Corps of Engineers for this work. Haley and Aldrich, Inc. has been retained by Camp Dresser & McKee Inc. for soils and geological portions of the work.

- b. Purpose - The primary purpose of the investigation is to:
- (1) Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.
 - (2) Encourage and assist the States to initiate quickly effective dam safety programs for non-Federal dams.
 - (3) Update, verify and complete the National Inventory of Dams.

1.2 Description of Project

- a. Location - Singletary Pond Dam is located on Singletary Brook approximately 2 miles upstream from the Blackstone River. The body of water impounded by the dam is named Singletary Pond. The dam is located at the north end of the pond and access is via a gravel driveway off of Harris Road in the Town of Millbury, Massachusetts, as shown on the report's location map.

- b. Dam and Appurtenances - Singletary Pond Dam consists of a short, poorly defined earth embankment between two private homes. A gated outlet conduit extends through the embankment, and has a wood frame gate house above concrete walls at each end. The private homes are on slightly higher ground close to either side of the dam area. There is no obvious spillway, but about 200 ft. to the right of the dam stone masonry walls form a U-shaped low area that extends inshore between two other private homes to a gravel access drive.

There are two wood-framed gate structures at the crest of the dam. The intake gate house is on the upstream edge of the crest of the dam. A concrete channel with provisions for stoplogs at its outboard end leads to the intake gate house. A bar rack is present at the entrance to the gate house. A single gate controls flow to a buried outlet conduit. The downstream gate house is on the downstream slope of the dam. It contains a single gate which serves as both reservoir drain and as a method of increasing discharges from the pond. A spillway is located above which controls the maximum reservoir level provided the gate in the intake gate house is in the open position and the gate in the downstream gate house is in the closed position.

The dam embankment appears to be on the order of 50 ft. in length, but about 200 ft. in width from toe to toe. It is about 17 ft. high. The upstream face is partially protected by concrete wingwalls extending out from the intake gate house foundation, while the downstream slope, below the gravel access drive, is at 3 horizontal to 1 vertical or flatter and has a cover of trees and brush. About 80 ft. of the distance between the two gate houses can be considered to be "crest" while the remainder slopes gently down toward the downstream gatehouse. The dam area has a cover of grass and weeds, except where the gravel access drive and turnaround have limited vegetative growth. There is marsh grass growing in a linear depression in the dam crest above part of the outlet conduit.

In the low area to the right of the dam, which may function as an overflow spillway, the residential access drive forms another short embankment, about 5 ft. high. The upstream face is a low stone masonry wall, while the downstream slope extends into trees and brush.

- c. Size Classifications - Singletary Pond Dam has a height of 17 feet measured from top of dam to invert of downstream gate house outlet. The estimated storage capacity at top of dam is 2,660 acre-feet. According to guidelines established by the Corps of Engineers, the dam is classified in the intermediate category because of its storage capacity.
- d. Hazard Classification - Based on the results of the Dam Failure Analysis (Section 5.1 f), it is recommended that Singletary Pond

Dam be classified as having a significant hazard potential. Analysis of the downstream impact area indicates that shallow depth-high velocity flooding would occur along portions of West Main Street and that a minimum of four homes and one factory would incur shallow depth flooding in the event of a dam failure.

- e. Ownership - The dam is owned by the Singletary Corporation. The Owner is represented by the Windle Corporation for which Mr. Terrence Windle serves as the contact person. The address is: Windle Industries, Inc., 65 Canal Street, Millbury, MA 01527, Telephone 617/865-4461.
- f. Operator - Mr. Terrance Windle serves as contact person for the Owners and operators of the dam.
- g. Purpose of Dam - Singletary Pond is currently used for recreational purposes only.
- h. Design and Construction History - No information was located with respect to the design and construction history on the dam. It is believed that the dam was originally constructed to control the flow of water to downstream mills. In recent times the outlet conduit from the dam partially collapsed and was replaced with a section of pipe of unknown diameter.
- i. Normal Operational Procedures - The pond is normally lowered in the fall in preparation for high spring runoff. This is accomplished by operation of the gate at the downstream gate house. Maintenance on the dam and spillway is performed on an as-needed basis. However, there is no written procedure for the operation and maintenance of the dam.

1.3 PERTINENT DATA

Elevations used in this report are on USGS Mean Sea Level Datum (MSL) and were obtained in part from field surveys which were performed in conjunction with the Flood Insurance Study for the Town of Millbury.

- a. Drainage Area - The sparsely developed drainage area tributary to the dam site is 4.0 square miles of which approximately 57 percent is woods, 25 percent meadow and 18 percent surface water. Singletary Pond accounts for approximately 13 percent of the total watershed. The length of the watershed is approximately four times it's width and the average slope through the basin is about 1 percent.

b. Discharge at Dam Site - There are no records of discharge for Singletary Pond Dam.

- (1) Outlet works - size unknown - invert elev. at upstream gate house is 547.2
- (2) Maximum known flood at damsite - unknown
- (3) Ungated spillway capacity at top of dam - 36 cfs at elevation 560.75
- (4) Ungated spillway capacity at test flood elevation - 26 cfs at elevation 559.6
- (5) Gated spillway capacity at normal pool elevation - 29 cfs of elevation 557.0
- (6) Gated spillway capacity at test flood elevation - 33 cfs at elevation 559.6
- (7) Total spillway capacity at test flood elevation - 27 cfs at elevation 559.6
- (8) Total project discharge at test flood elevation - 27 cfs at elevation 559.6

c. Elevation (ft above MSL)

- (1) Streambed at centerline dam----- 544.0
- (2) Test flood tailwater ----- 550.0(Est.)
- (3) Upstream portal invert diversion tunnel----- None
- (4) Recreation pool----- 557.0
- (5) Full flood control pool ----- N/A
- (6) Spillway crest----- 557.0
- (7) Design surcharge (Original Design)----- Unknown
- (8) Top Dam----- 560.75
- (9) Test flood design surcharge----- 559.6

d. Reservoir

- (1) Length of test flood pool----- 1.5 miles
- (2) Length of recreation pool----- 1.4 miles
- (3) Length of flood control pool----- N/A

e. Storage (acre-feet)

- (1) Recreation pool----- 1,340 (Est.)
- (2) Flood control pool----- N/A
- (3) Spillway crest pool----- 1,340 (Est.)
- (4) Top of dam----- 2,660 (Est.)
- (5) Test flood pool----- 2,250 (Est.)

f. Reservoir Surface (acres)

- (1) Recreation pool----- 335 (Est.)
- (2) Flood-control pool----- N/A
- (3) Spillway crest----- 335 (Est.)
- (4) Test flood pool----- 360 (Est.)
- (5) Top of dam----- 375 (Est.)

g. Dam

- (1) Type----- Earth embankment with partial concrete headwall
- (2) Length-----Est. approx. 50 ft.
- (3) Height----- Approx. 17 ft.
- (4) Top Width----- Approx. 80 ft.
- (5) Side Slopes----- Partial vertical concrete and stone walls U/S; irregular and flatter than 3:1 elsewhere and D/S

- (6) Zoning----- Unknown
- (7) Impervious Core----- Unknown
- (8) Cutoff----- Unknown
- (9) Grout Curtain----- Probably none

h. Diversion and Regulating Tunnel - None

i. Spillway

- (1) Type----- 3.6 ft. long weir with 25-ft long rectangular concrete flume
- (2) Length of weir----- 3.6 ft
- (3) Crest elevation----- 557.0
- (4) Gates----- provisions for 3 ft of flashboards
- (5) U/S Channel----- Conduit of unknown size from upstream gate house
- (6) D/S Channel----- Spillway flume drops 13 ft to a stone channel

- j. Regulating Outlets - The outlet works consist of an upstream gate house with a concrete approach channel, bar rack, and manually operated gate; a 180 ft. long conduit of unknown size; and a downstream gate house with a manually operated gate and a concrete spillway flume. Flow and pond level may be regulated by the operation of the upstream and/or downstream gates and by the insertion of flashboards on the spillway.

Normal operation consists of having the upstream gate open, the downstream gate closed and pond level maintained by the spillway either with or without flashboards. The pond can be lowered by opening the downstream gate.

SECTION 2: ENGINEERING DATA

- 2.1 Design - There are no known design records for the dam.
- 2.2 Construction - No records of the original construction were located.
- 2.3 Operation - There are no known operational records other than County and State inspection reports.
 - A. Availability - There are no known records on the dam except for County and State inspection reports.
 - B. Validity - No Engineering data was located for the dam.
 - C. Adequacy - In the absence of engineering data on the dam, the evaluation, for the purposes of this investigation, must be based on the visual examination described in the following section.
- 2.4 Evaluation - Since no engineering records are available, the evaluation of the dam must be based primarily on the results of the visual examination which is detailed in Section 3.

SECTION 3: VISUAL INSPECTION

3.1 Findings

- a. General - The Phase I visual examination of Singletary Pond Dam was conducted on 20 December 1978.

In general, the earthen embankment, spillway and gatehouses were observed to be in good condition. However, due to the existence of a depression in the earth over the outlet conduit the dam must be considered only in fair condition until the cause of the depression and the condition of the outlet conduit is determined.

Visual inspection checklists for the site visit are included in Appendix A and selected photographs are shown in Appendix C.

- b. Dam - The earth embankment that forms the dam is considered to be in fair condition because of the depression over the outlet conduit a short distance behind the upstream gate house. There is no visual evidence of lateral embankment movement, but there has been surface settlement associated with the apparent conduit failure. Furthermore, seepage is evident at the toe of the downstream slope, approximately 30-ft. to the right of the downstream gate house, which has a full head present during normal operation.

The following specific items were noted:

- (1) The embankment "crest" behind the upstream Gate House has a linear depression which extends about 30 ft. downstream along the conduit alignment. There is marsh grass growing in the depression, as shown in Photo 4.
- (2) The "crest" of the dam between the private homes is overgrown with weeds, and the downstream slope below the access drive has a heavy cover of trees and brush, as shown in Photos 5 and 6.
- (3) There is a gap in the shore protection to either side of the upstream Gate House wingwalls, where stone erosion protection is either lacking or incomplete, as shown in Photo 1.
- (4) An area in the downstream slope, to the right of the downstream Gate House, is wet and soggy, and there is slight seepage flow evident at the toe of the slope. No movement of soil particles was observed.
- (5) Portions of the adjacent private property may actually be part of the dam embankment, and features of the residential

development may reduce the effective dam cross section. As an example, the stone masonry wall at the basement garage to the right of the dam may effectively shorten the potential seepage path through the dam.

- (6) The embankment at the low area of the shoreline about 200 ft. to the right of the dam, shown in Photos 10 & 11, lacks downstream slope erosion protection.
- c. Appurtenant Structures - The gate houses were found to be in good condition. The exterior of the downstream gate house is in need of repainting. The interiors of both gate houses were found to contain some debris but the gate operators were readily accessible, well lubricated and appeared to be in good condition.
- d. Reservoir Area - The area surrounding Singletary Pond is generally wooded and significantly developed. There are more than 75 structures located at or below elevation 565.0 along the shoreline of the pond. Although the dam site is located in the Town of Millbury, about 80% of the pond is the Town of Sutton. The side slopes into the pond are highly variable and generally wooded. There is no significant potential for landslides into the pond which could create waves that might overtop the dam. No conditions were noted which could result in a sudden increase in sediment load into the pond.
- e. Downstream Channel - Singletary Brook conveys the discharge from the outlet works of the dam to the Blackstone River, a distance of about 2 miles. Approximately 9 culverts and bridges, 7 dams and hydraulic control structures and 7 ponds are located along the course of the brook which falls a total of 175 feet from Singletary Pond to the Blackstone River.

3.2 Evaluation

While the Singletary Pond Dam appears to be performing satisfactorily at the present time, the uncertain condition of the outlet conduit and the seepage that is evident at the downstream toe, could provide significant potential for dam failure under conditions of higher than normal water levels.

SECTION 4: OPERATIONAL PROCEDURES

- 4.1 Procedures - In general, there is no established routine for the operation of the dam.
- 4.2 Maintenance Of Dam - The dam has received only minimal maintenance other than the maintenance of the abutments by adjacent property owners. There is no established formal procedure for the maintenance of the dam. The area between intake and outlet gate houses and the downstream channel has become overgrown with weeds and brush.
- 4.3 Maintenance Of Operating Facilities - There is no formal procedure for maintenance of operating facilities. The gate operators appear to have been routinely lubricated and the exterior of the gate houses have been maintained.
- 4.4 Description Of Any Warning System In Effect - There is no established warning system or emergency preparedness plan in effect for the dam.
- 4.5 Evaluation - There is no formal operational procedure for the dam. Operational procedures, maintenance programs, warning systems and emergency preparedness plan should be established for the dam. The operational procedure should include the opening of intake and outlet gates during periods of unusual precipitation. The procedure should also include a listing of methods of sandbagging low points along the reservoir and at the dam for the protection of private property and safety of the dam during periods of unusually high pond levels and discharge through the outlet works. The outlet works should be kept under observation during periods of high pond level and unusual precipitation.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

- a. General - Singletary Pond Dam is basically a high surcharge - low spillage project with limited outlet capacity and no provision for auxiliary overflows. The pond is normally lowered in the fall in preparation of high spring runoff. At the time of inspection, the pond was being dewatered and was approximately 2.3 feet below spillway crest. The discharge capacity of the outlet works is low, having an estimated range of 29 cfs with pond level at spillway crest (elev. 557.0) to 35 cfs with pond at top of dam (elev. 560.7). The width of the main dam between the upstream and downstream gate houses is in excess of 180 feet. The narrowest section is an earth embankment approximately 4 feet high and 21 feet wide located approximately 200 feet to the right of the gate houses.
- b. Design Data - No hydraulic/hydrologic design data are available for the dam site.
- c. Experience Data - No records of past floods are available for the dam site. Discussions with the Owner indicate that the flood of August 1955 nearly overtopped the dam and that sand bags were placed along the 21-foot wide portion of the embankment to the right of the gate houses.
- d. Visual Observations - A visual inspection was made of the portions of the outlet works that are accessible and not submerged, which include the upstream gate house approach channel and bar rack, and the downstream gate house spillway and discharge channels. All were observed to be in good hydraulic condition. No inspection was possible of the outlet works conduit between the intake at the upstream gate house and the outlet from the downstream gate house because it was functioning. Consequently, the hydraulic capacity was determined from flow and water level measurements made at the time of inspection.
- e. Test Flood Analysis - Based upon the Corps of Engineers Guidelines, the recommended test flood for the size (intermediate) and hazard potential (significant) is within the range of 1/2 PMF to a full PMF (Probable Maximum Flood). The PMF was determined using the Corps of Engineers Guideline curves for "Estimating Maximum Probable Discharge" in the Phase I, Dam Safety Investigations. The watershed terrain was determined to have moderately steep side slopes draining to a mildly sloped valley. A peak inflow rate of 1600 cfs per square mile was selected and is equal to 85 percent of the value given for a drainage area of 4 square miles with a rolling terrain. This

results in a PMF inflow of approximately 6,400 cfs. Since the dam site is at the bottom end of the intermediate size and the low range of the significant hazard, the 1/2 PMF inflow of 3,200 cfs was adopted as the test flood.

Evaluation of the effect of the test flood inflow on the dam site was based on the following assumptions:

- (1) Pond level at start of test flood is at spillway crest (elev. 557.0).
- (2) Both upstream and downstream gates are open.
- (3) Average discharge through outlet works during test flood is 30 cfs.

Because of the shape of the watershed and the available storage upstream of Singletary Pond, the test flood inflow to Adams Pond was developed. The drainage area tributary to Adams Pond is 1.23 square miles and a peak test flood inflow of 1180 cfs was determined based on 85 percent of the value given for rolling terrain. Utilizing the shape of the unit hydrograph for this portion of the watershed which was developed as part of the Flood Insurance Study for the Town of Millbury, flood routing resulted in a peak outflow of 280 cfs. This outflow was then lagged and added to the test flood inflow hydrograph for the intervening drainage area tributary to Singletary Pond. The resulting peak inflow to Singletary Pond was estimated to be 2,520 cfs. Analysis of the storage characteristics of Singletary Pond indicate that the pond will rise to approximately elevation 559.5 under the assumed conditions and the dam will not be overtopped. Further analysis indicates that if the downstream gate is in the closed position and an averaged discharge of 20 cfs were to occur over the spillway, then the pond would rise to elevation 559.6 and the dam would still not be overtopped. Consequently, the dam and outlet works are considered adequate to pass the test flood, provided the assumed operating conditions are met.

- f. Dam Failure Analysis - Hydraulic analyses of Singletary Brook were performed to determine the downstream hazards in the event of a dam failure. A peak failure outflow of 670 cfs was estimated based on a breach width of 50 feet at the narrowest section of the earth embankment. The analysis indicates that the first downstream culvert, Harris Road, would be overtopped but that no hazards exist. The second downstream culvert, West Main Street, would also be overtopped and shallow depth-high velocity flood waters would flow 800 to 1000 feet down the road before entering Brierly Pond. Brierly Pond, in turn, would overtop it's banks causing flooding of about 4 homes and 1 factory. The outflow would enter Mayo Pond where adequate capacity exists downstream to convey the discharge without any severe potential

hazards. The potential for loss of life is significant and economic losses would not be severe. Accordingly, it is recommended that this dam be classified as having a "significant" hazard potential.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

- a. Visual Observations - There was no visible evidence of dam embankment instability during the site examination on 20 September 1978. There was no evidence of active erosion or piping at the location of slight seepage at the toe of the downstream slope; the pond level had been lowered by a few feet a short time before the inspection, but the seepage may still have reflected the previously higher pond level. There was also no indication of recent change in the linear depression over the outlet conduit; a 1972 inspection report had noted what was apparently the same depression.

Thus, neither the seepage nor the apparent conduit failure are considered to pose an immediate hazard to the stability of the dam embankment.

- b. Design and Construction Data - As far as is known, there is no available design or construction information on the Singletary Pond Dam; the irregular geometry indicates that there may well have been no formal design. Previous inspection reports indicate that the low area to the right of the dam was formerly an outlet channel and was partially filled to construct the present gravel access drive, presumably with no design to function as a dam embankment. The present owner of the house between the low area and Harris Road advised the inspection team that he had encountered what appeared to be the remains of an old discharge channel at the further end of his house, to the east.

Without information on the dam cross section and the physical properties of the materials in the embankment, a theoretical analysis of the structural stability of dam embankment is not possible. However, the dam has a wide crest and relatively flat slopes, and, in the absence of significant seepage or conduit problems, would be expected to have adequate stability under static loading conditions.

- c. Operating Records - No operating records, other than State and County inspection reports, were located.
- d. Post-Construction Changes - There are no known post-construction changes to the dam embankment, although it may be that grading for the adjacent private homes has had some effect on the dam. As noted in Section 6.1b., there has apparently been partial filling of one or more previous discharge channels to the right of the dam. It is reported that the outlet conduit experienced a partial collapse and a section of pipe was installed to replace the failed section.

- e. Seismic Stability - Singletary Pond Dam is located in Seismic Zone 2, and, according to the Corps of Engineers Guidelines, does not warrant seismic analysis.

SECTION 7: ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

- a. Condition - Except for the depression over the outlet conduit, the visual examination of Singletary Pond Dam did not reveal any evidence of conditions which would warrant urgent remedial treatment. However, because of the uncertainty as to the conduit condition, and the need for maintenance and additional investigations that are outlined hereinafter, the project is considered to be in fair condition.
- b. Adequacy of Information - All of the information for the Phase I Investigation had to be obtained from visual examination and limited measurements at the site. This information has been sufficient for the purpose of this investigation, but it does not permit detailed evaluation of stability, seepage or available freeboard.
- c. Urgency - The recommended additional investigations and remedial measures outlined in Sections 7.2 and 7.3, respectively, should be undertaken within 1 year after receipt of this report by the Owner.
- d. Need for Additional Investigations - Additional investigations should be performed by the Owner as outlined in the following section.

7.2 Recommendations

It is recommended that the following additional investigations be performed by the Owner:

1. An investigation of the cause of the depression over the outlet conduit and the condition of the outlet conduit to determine if the subsidence is due to a failed section of conduit, a loss of material into the conduit or the result of improper backfilling during replacement of the failed section of conduit. The investigation should include the inspection of the remaining portions of the conduit to determine its condition and the hydraulic condition of the inlet and outlet gates. The capacity of the outlet works should be verified based on the results of the investigation.
2. An investigation to determine whether or not the seepage that is occurring at the downstream toe of the dam can have a significant effect on long-term dam stability. This would include regular monitoring of the seepage locations, including checks during higher than normal pond levels and various conditions of conduit flow.

3. Topographic survey of the dam and any appurtenant embankments, and evaluation of actual embankment configuration with respect to stability and available freeboard. If the survey does not provide sufficient information to confirm adequate stability it may be necessary to carry out test borings and/or test excavations to determine the character of the embankment material.

7.3 Remedial Measures

- a. Operation and Maintenance Procedures - It is recommended that the following remedial work be undertaken by the Owner, in addition to the investigations outlined in section 7.2, to correct deficiencies noted during the visual examination:
 - (1) Clear brush and trees from the dam crest and slopes and any appurtenant embankments, establish vegetative cover, and cut grass and weeds on the embankments at least once a year.
 - (2) Repair and extend stone slope protection on upstream dam slopes to either side of the Gate House walls.
 - (3) Perform maintenance on the downstream gate house in the form of repainting the exterior of the structure.

The Owner should also develop a formal emergency procedure plan and warning system in cooperation with local officials. The Owner should establish a formal operations plan for the dam and initiate a program of annual technical inspections.

7.4 Alternatives - Not applicable.

APPENDIX A

INSPECTION TEAM ORGANIZATION AND CHECKLIST

	<u>Page No.</u>
<u>VISUAL INSPECTION PARTY ORGANIZATION</u>	A-1
<u>VISUAL INSPECTION CHECKLIST</u>	
Dam Embankment	A-2
Dam Embankment, Earth-Dike (Access Drive)	A-3
Spillway	A-4
Outlet Works	A-5
Outlet Works - Continued	A-6
Hydrologic-Hydraulic Considerations	A-7
Field Sketches of Gate Houses and Bar Screen	A-8

VISUAL INSPECTION PARTY ORGANIZATION
NATIONAL DAM INSPECTION PROGRAM

DAM: Singletary Pond

DATE: 20 September 1978

TIME: 8:00 A.M.

WEATHER: Clear and Dry ~ 60°F

WATER SURFACE ELEVATION UPSTREAM: 6.0 ft. below sill of Gate House

STREAM FLOW: 10'/12 sec X (4.33'W X 7.25'D) = 26.2 cfs @ inlet to
upstream gate house

INSPECTION PARTY:

1. Joseph E. Downing - CDM
2. Roger H. Wood - CDM (performed recon. and struct. on 14 September
1978 also)
3. Peter LeCount - H & A
4. _____
5. _____
6. _____

PRESENT DURING INSPECTION:

1. Terrance Windle of Windle Industries Inc. part of the time
2. _____
3. _____
4. _____

APPENDIX A-1

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VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Singletary Pond

DATE: 9/20/78

EMBANKMENT: Dam

CHECK LIST	CONDITION
1. Upstream Slope a. Vegetation b. Sloughing or Erosion c. Rock Slope Protection - Riprap Failures d. Animal Burrows 2. Crest a. Vegetation b. Sloughing or Erosion c. Surface cracks d. Movement or Settlement 3. Downstream Slope a. Vegetation b. Sloughing or Erosion c. Surface cracks d. Animal Burrows e. Movement or Cracking near toe f. Unusual Embankment or Downstream Seepage g. Piping or Boils h. Foundation Drainage Features i. Toe Drains 4. General a. Lateral Movement b. Vertical Alignment c. Horizontal Alignment d. Condition at Abutments and at Structures e. Indications of Movement of Structural Items f. Trespassing g. Instrumentation Systems	1. a. Typically grass above walls, local weeds. b. Local slight erosion where no wall c. Typically mortared stone masonry walls along shore, locally absent or without mortar. d. None observed. 2. a. Varies from lawn grass & shrubs to weeds. b. None evident c. None evident d. None evident 3. a. Trees, brush & weeds below drive & landscaped areas. b. Not evident c. Not evident d. None observed e. None observed f. Area of standing water and apparent slight seepage about 25 ft. below downstream gate house. g. None observed h. None evident i. None 4. - a., b., c. Dam has no regular shape. d. Apparent cave-in over outlet culvert. e. See "d" f. Area of private homes g. None

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Singletary Pond DATE: 9/20/78

EMBANKMENT: Earth-Dike (Access drive)

CHECK LIST	CONDITION
1. Upstream Slope a. Vegetation b. Sloughing or Erosion c. Rock Slope Protection - Riprap Failures d. Animal Burrows 2. Crest a. Vegetation b. Sloughing or Erosion c. Surface cracks d. Movement or Settlement 3. Downstream Slope a. Vegetation b. Sloughing or Erosion c. Surface cracks d. Animal Burrows e. Movement or Cracking near toe f. Unusual Embankment or Downstream Seepage g. Piping or Boils h. Foundation Drainage Features i. Toe Drains 4. General a. Lateral Movement b. Vertical Alignment c. Horizontal Alignment d. Condition at Abutments and at Structures e. Indications of Movement of Structural Items f. Trespassing g. Instrumentation Systems	1. a. Weeds in rock wall b. Few fallen rocks c. Dry stone masonry 2 ft. <u>±</u> high d. None observed 2. a. Grass & weeds along drive b. Slight due to traffic c. None evident d. None evident 3. a. Weeds, brush, trees to 12" dia. <u>±</u> b. None evident c. None evident d. None observed e. None evident f. None evident g. None evident h. None i. None 4. a., b., c. No regular shape d. N/A e. N/A f. Private drive g. None

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Singletary Pond

DATE: Sept. 14, 1978

SPILLWAY: _____

CHECK LIST	CONDITION
1. Approach Channel a. General Condition b. Obstructions c. Log Boom etc. 2. Weir a. Flashboards b. Weir Elev. Control (Gate) c. Vegetation d. Seepage or Efflorescence e. Rust or Stains f. Cracks g. Condition of Joints h. Spalls, Voids or Erosion i. Visible Reinforcement j. General Struct. Condition 3. Discharge Channel a. Apron b. Stilling Basin c. Channel Floor d. Vegetation e. Seepage f. Obstructions g. General Struct. Condition 4. Walls a. Wall Location _____ (1) Vegetation (2) Seepage or Efflorescence (3) Rust or Stains (4) Cracks (5) Condition of Joints (6) Spalls, Voids or Erosion (7) Visible Reinforcement (8) General Struct. Condition	Spillway - There is no spillway present at this dam; only an outlet works. From the configuration of the shoreline, shoreline walls and natural terrain it appears that there may have been a spillway present 200 feet to the south-east of the outlet works. This appears to be confirmed by former inspection reports. This area has been filled for a traveled way to private residences.

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Singletary Pond DATE: 9/14 & 9/20/78

OUTLET WORKS: _____

CHECK LIST	CONDITION
1. Inlet a. Obstructions b. Channel c. Structure d. Screens e. Stop Logs f. Gates 2. Control Facility a. Structure b. Screens c. Stop Logs d. Gates e. Conduit f. Seepage or Leaks 3. Outlet a. Structure b. Erosion or Cavitation c. Obstructions d. Seepage or Leaks 4. Mechanical and Electrical a. Crane Hoist b. Hydraulic System c. Service Power d. Emergency Power e. Lighting f. Lightning Protection	1. a. None observed b. Concrete channel - pond end is underwater - condition appears good. c. See 2b. d. None observed e. Stop log slot at pond end of channel underwater; not accessible for inspection. f. See 2d. 2. a. Timber superstructure on concrete base. Condition good. Grating within structure starting to rust. b. Bar rack at channel entrance to gate house. Debris at face of rack (burlap bag, twigs etc.) c. None observed d. Single manually operated gate-size unknown - operable by not accessible for inspection. e. Conduit between gate houses - underground not accessible for inspection. Estimated and reported to be field stone condition. One portion (approx. 25' lg) caved in and reported to be replaced with pipe. Depression still present in ground surface. f. Loss of ground beneath gatehouse threshold. May be surface runoff erosion. Wet at bottom of depression mentioned in 2e. 3. a. Timber structure on fieldstone foundation. Foundation not accessible for inspection. Superstructure appears whitewashed-needs new coatings. Interior manually operated gate-maintained (Operator). Size unknown - not accessible for inspection. Fieldstone channel with concrete chute above downstream of gatehouse. Concrete good-Few fieldstones missing from walls. Bar present at chute entrance and stop log guides. Corrosion present on guides.

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Singletary Pond

DATE: 9/14 & 9/20/78

OUTLET WORKS: Continued

CHECK LIST	CONDITION
1. Inlet a. Obstructions b. Channel c. Structure d. Screens e. Stop Logs f. Gates 2. Control Facility a. Structure b. Screens c. Stop Logs d. Gates e. Conduit f. Seepage or Leaks 3. Outlet a. Structure b. Erosion or Cavitation c. Obstructions d. Seepage or Leaks 4. Mechanical and Electrical a. Crane Hoist b. Hydraulic System c. Service Power d. Emergency Power e. Lighting f. Lightning Protection	3. b. None observed c. None observed d. Water exiting beneath downstream end of left wall. 4. a. None observed b. None observed c. None observed d. None observed e. None observed g. None observed

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Singletary Pond

DATE: 20 September 1978

HYDROLOGIC-HYDRAULIC CONSIDERATIONS: _____

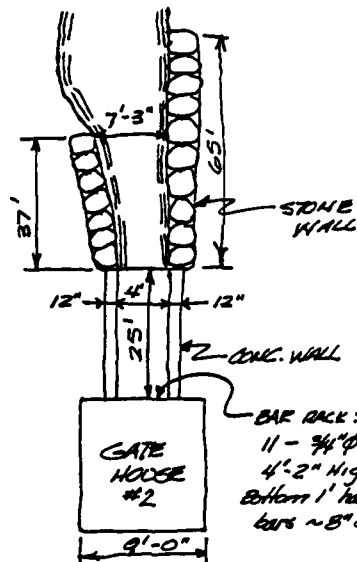
CHECK LIST	CONDITION
1. Upstream Watershed a. Type of Terrain b. Hydrologic Controls 2. Reservoir a. Type of Terrain b. Development 3. Spillway a. Adjacent Low Points b. Spillway Approach (Slope) c. Spillway Discharge (Slope) d. Spillway Type 4. Downstream Watershed a. Reach No. (1) Control (Bridge, dam, culvert, etc.) (2) Channel Characteristics (3) Development (4) Visible Utilities (5) Special Problems (Hospital, etc.)	1. a. Watershed is approx. 4 miles long by 1 mile wide. Terrain is moderately rolling. b. The upper basin has a series of six small ponds. 2. a. In general, the shoreline is moderately steep with forested side slopes of approx. 12%. b. The shoreline is substantially developed with better than 50 homes and cottages at or below elevation 560. 3. None 4. Singletary Brook conveys discharges from the pond approx. 2 miles to the Blackstone River. There are 7 small ponds and 6 street and one railroad crossings. Development is extensive.

CAMP DRESSER & McKEE
Environmental Engineers
Boston, Mass

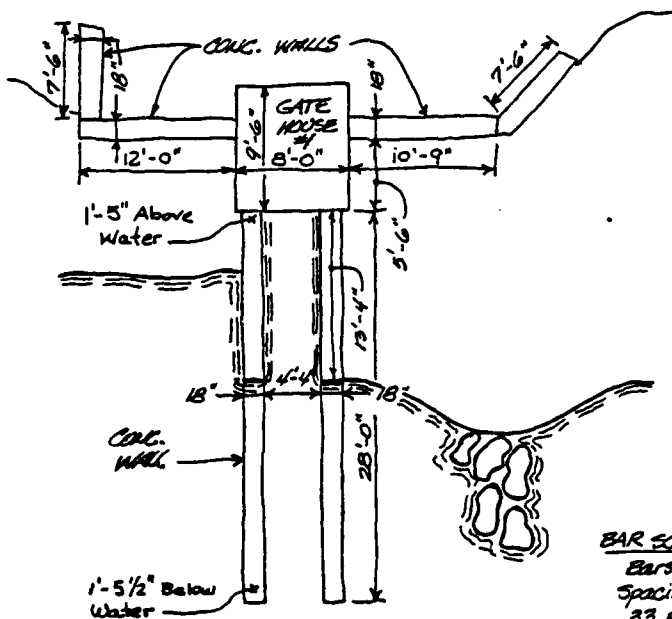
CLIENT _____
PROJECT SINGLETARY POND
DETAIL _____

JOB NO. _____
DATE CHECKED _____
CHECKED BY _____

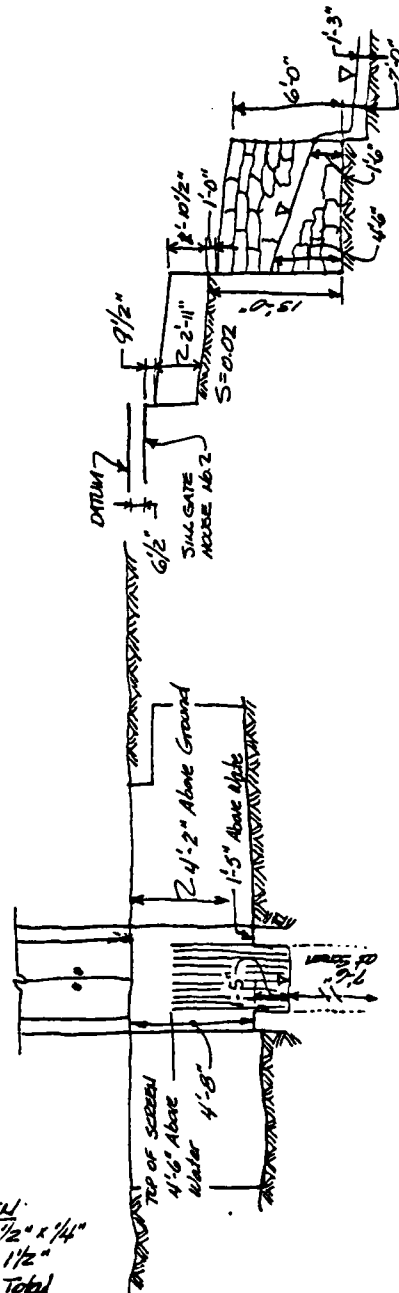
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DATE _____
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BAR RACK:
11 - 3/4" ϕ bars 4" OC.
4'-2" High
Bottom 1' has only 6 - 3/4" ϕ
bars ~8" OC.



BAR SCREEN
Bars: 2 1/2" x 1/4"
Spacing: 1 1/2"
33 Bars Total



APPENDIX B

LIST OF AVAILABLE DOCUMENTS AND
PRIOR INSPECTION REPORTS

Page No.

LIST OF AVAILABLE DOCUMENTS

- | | |
|-------------------------|-----|
| 1. List of Documents | B-1 |
| 2. Dam County File Card | B-2 |

PRIOR INSPECTION REPORTS

<u>DATE</u>	<u>BY</u>	
July 17, 1925	County of Worcester, Mass.	B-3
September 29, 1932	County of Worcester, Mass.	B-4
September 23, 1935	County of Worcester, Mass.	B-5
April 3, 1936	County of Worcester, Mass.	B-6
May 13, 1937	County of Worcester, Mass.	B-7
October 18, 1938	County of Worcester, Mass.	B-8
December 11, 1940	County of Worcester, Mass.	B-9
December 9, 1942	County of Worcester, Mass.	B-10
October 5, 1944	County of Worcester, Mass.	B-11
March 16, 1953	County of Worcester, Mass.	B-12
March 17, 1953	County of Worcester, Mass.	B-13
September 13, 1955	County of Worcester, Mass.	B-14
April 6, 1960	County of Worcester, Mass.	B-15
October 15, 1963	County of Worcester, Mass.	B-16
May 12, 1967	County of Worcester, Mass.	B-17
March 18, 1969	County of Worcester, Mass.	B-18
February 7, 1972	County of Worcester, Mass.	B-19

LIST OF DOCUMENTS

SINGLE TARY POND DAM

DOCUMENT

NONE AVAILABLE

LOCATION

NONE AVAILABLE

DAM NO. 3 J 10

C.C. DOCKET NO.

PLAN NO.

SECTION NO.

PROPERTY

LOCATION

DESCRIPTION OF DAM

DESCRIPTION OF RESERVOIR & WATERSHED

MEASUREMENTS

GENERAL REMARKS

Brannonville Earth-dike to east of Gate House El 100'		Singletary Pond	
Type	Earth-dike	Length of Main Stream	5' 10'
Height	10'	Width of Watershed	10'
Thickness top	10'	Is Watershed Cultivated	
Thickness bottom	10'	Percent in Forests	
Downstream Slope		Steepness of Slope	
Upstream		Kind of Soil	
Length of Spillway	Natural Depression	No. of Acres in Watershed	
Site of Gates	El 80.0	" " " Reservoir	
Location of Gates	Near north end dam	Length of Reservoir	
Flashboards used		Width "	
Width Flashboards or Gates		Max Flow Cu Ft per Sec	
Dam designed by		Head or Flashboards Low Water	
" constructed by		" " High	
Year constructed		GENERAL REMARKS	
Owners:	West End Thread Co.	Inspected:	Dec 11, 1940 - L.H. Spafford
Inspected	Mayo Woolen Co.		Dec 7, 1942 - J.A. Herkholz
"	Nov 15, 1928 - L.O. Marden		Oct 5, 1944 - L.O. Marden
"	Sept 29, 1932 - " "		Feb 1944 - Linn Thread Co. Inc., Millbury
"	23, 1935 - " "		
"	May 19, 1937 - K.M. Finlayson		
"	Oct 4, 1938 - " "		
"	April 2, 1936 - L.O. Marden		

COUNTY OF WORCESTER MASSACHUSETTS
COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Nov. 15, 1913

Inspected by L.O. Marden Date July 17, 1925 Dam No. 30-16

Town Hillbury Location Singletary Pond.
West End Thread Co. & other owners on stream below
Use storage

Material and Type Earth emb.-concrete gate
almost natural dam

Dam Designed by _____ Constructed by _____ Year _____

SPILLWAY none except gate
El. top Abutment 100. El. Crest _____ El. Apron _____ El. Streambed abt 90.
Width top Abutment _____ Width top Crest _____ Width bottom Spillway _____
Width Flashboards carried _____ Kind Flashboards _____
El. Flowline Cleanout Pipe _____ Size and Kind Cleanout Pipe _____
Kind of Foundation under Spillway _____
Condition _____

EMBANKMENT

El. Top _____ El. Natural Ground _____ Width Top _____
Width of Bottom _____ Upstream Slope _____ Downstream Slope _____
Kind of Corewall _____ Riprap _____
Material in Embankment _____ Foundation _____
Condition cut off brush

GATES Location near north end d. m.
Size _____ Kind _____ El. Flowline _____
Condition clean out opening to gate.

WHEEL Kind _____ Size _____ Rated H. P. _____
Location _____ Ave. Head _____
Evidence of Leaks in Structure _____

Recent Repairs and Date _____

Topography of Country below Dam _____

Nature of Buildings and Roads below Dam _____

Number Acres in Pond _____ Drainage Area in Square Miles _____

Discharge in Second Feet per Square Mile _____

Estimated Storage Million Cubic Feet _____

APPENDIX B- 3

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by L. O. Marden Date Sept. 29, 1932 Dam No. 30-16

Town Millbury Location Singletary Pond

Owner West End Thread Co. Use

Material and Type

Dam Designed by Constructed by Year

SPILLWAY—Length Feet Depth Feet

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition O. K. No hazard.

EMBANKMENT—Length overall Feet

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition Cut off brush.

GATES Location

Size Kind El. Flowline

Condition

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure None visible.

Recent Repairs and Date

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number of Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by L. O. Marden Date 9-23-35 Dam No. 70-16

Town MILLBURY Location Singletary Pond

Owner _____ Use _____

Material and Type _____

Dam Designed by _____ Constructed by _____ Year _____

SPILLWAY—Length _____ Feet. Depth _____ Feet

El. top Abutment _____ El. Crest _____ El. Apron _____ El. Streambed _____

Width top Abutment _____ Width top Crest _____ Width bottom Spillway _____

Width Flashboards carried _____ Kind Flashboards _____

El. Flowline Cleanout Pipe _____ Size and Kind Cleanout Pipe _____

Kind of Foundation under Spillway _____

Condition _____

EMBANKMENT—Length overall _____ Feet

El. Top _____ El. Natural Ground _____ Width Top _____

Width of Bottom _____ Upstream Slope _____ Downstream Slope _____

Kind of Corewall _____ Riprap _____

Material in Embankment _____ Foundation _____

Condition Cut brush and small tree.

GATES _____ Location _____

Size _____ Kind _____ El. Flowline _____

Condition Fair.

WHEEL _____ Kind _____ Size _____ Rated H. P. _____

Location _____ Ave. Head _____

Evidence of Leaks in Structure _____

Recent Repairs and Date _____

Topography of Country below Dam _____

Nature of Buildings and Roads below Dam _____

Number of Acres in Pond _____ Drainage Area in Square Miles _____

Discharge in Second Feet per Square Mile _____

Estimated Storage Million Cubic Feet _____

APPENDIX B- 5

Letter 11-3-37

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by L. O. M. Date 4/1/36 Dam No. 30-10

Town Millbury Location Singletary Pond

Owner West End Thread Co. Use

Material and Type Mr. Heyward states that Sutton Fish Hatchery Ponds are so handled that no flood flow retained.

Dam Designed by Constructed by Year

SPILLWAY—Length Feet Depth Feet

El. top Abutment El. Crest El. Apron El. Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition Found wasteway or gate of insufficient size to handle all of water.

EMBANKMENT—Length overall Feet

El. Top El. Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition Sand bags still in place at low places in embankment. Three(3) feet high at some places

GATES Location

Size Kind El. Flowline

Condition

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure

Recent Repairs and Date

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Number of Acres in Pond Drainage Area in Square Miles

Discharge in Second Feet per Square Mile

Estimated Storage Million Cubic Feet

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs.

Inspected by KMP Date 5-13-37 Dam No. 50-6

Town Millbury Location Springfield

Owner State Use Water Supply

Material and Type Concrete

Dam Designed by W. B. Smith Constructed by W. B. Smith Year 1934

SPILLWAY—Length 100 Feet Depth 10 Feet

El. top Abutment 100 El. Crest 100 El. Apron 100 El. Streambed 100

Width top Abutment 100 Width top Crest 100 Width bottom Spillway 100

Width Flashboards carried 100 Kind Flashboards None

El. Flowline Cleanout Pipe 100 Size and Kind Cleanout Pipe 100

Kind of Foundation under Spillway Concrete

Condition Good

EMBANKMENT—Length overall 100 Feet

El. Top 100 El. Natural Ground 100 Width Top 100

Width of Bottom 100 Upstream Slope 100 Downstream Slope 100

Kind of Corewall Concrete Riprap None

Material in Embankment Concrete Foundation Concrete

Condition Tapped by flood - was sandbagged

GATES None Location None

Size None Kind None El. Flowline None

Condition OK

WHEEL None Kind None Size None Rated H. P. None

Location None Ave. Head None

Evidence of Leaks in Structure None

Recent Repairs and Date None

Topography of Country below Dam None

Nature of Buildings and Roads below Dam None

Number of Acres in Pond None Drainage Area in Square Miles None

Flow in Normal Feet per Square Mile None

Flow in Flood Cubic Feet None

WORCESTER COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs

Inspected by K.M.F. Date 10-18-38 Dam No. 30-18

Town Millbury Location Singletary

Owner West End Thread Co. Use _____

SPILLWAY

El. top Abutment _____ El. Crest _____ El. Apron _____ El. St. Bed _____

Width top Abut. _____ Width top Crest _____ Width bottom Sp. way _____

Width flashboards _____ Kind Flashboards _____

El. Flowline Cleanout Pipe _____ Size and Kind Pipe _____

Kind of Foundation under Spillway _____

Condition Natural spillway about 150 feet southeast of gatehouse

now clogged with trees and brush

EMBANKMENT

El. Top _____ El. Natural Ground _____ Width Top _____

Width of Bottom _____ Upstream Slope _____ Downstream Slope _____

Kind of Corewall _____ Riprap _____

Material in Embankment _____ Foundation _____

Condition OK

GATES

Location _____

Size _____ Kind _____ El. Flowline _____

Condition OK

Evidence of Leaks in Structure _____

Recent Repairs and Date _____

Number Acres in Pond _____ Drainage Area in Sq. Miles _____

Discharge in Second Feet per Square Mile _____

Estimated Storage Million Cubic Feet _____

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs

Inspected by J. H. Spofford Date Dec 11/40 Dam No. 30

Town Milbury Location Impetary Lake

Owner West End Thread Co Use Impounding

Material and Type

Dam Designed by Constructed by Year

SPILLWAY

El. top Abutment EL Crest EL Apron EL Streambed

Width top Abutment Width top Crest Width bottom Spillway

Width Flashboards carried None Kind Flashboards

El. Flowline Cleanout Pipe Size and Kind Cleanout Pipe

Kind of Foundation under Spillway

Condition Good

EMBANKMENT

El. Top EL Natural Ground Width Top

Width of Bottom Upstream Slope Downstream Slope

Kind of Corewall Riprap

Material in Embankment Foundation

Condition It is

GATES Location In gate house

Size Kind El. Flowline

Condition Partly open - This gate controls entire flow from Lake

WHEEL Kind Size Rated H. P.

Location Ave. Head

Evidence of Leaks in Structure None

Recent Repairs and Date None

Topography of Country below Dam

Nature of Buildings and Roads below Dam

Area in Pond Drainage Area in Square Miles

in feet per Square Mile

COUNTY OF WORCESTER MASSACHUSETTS

COUNTY ENGINEER

Inspection of Dams, Reservoir Dams, and Reservoirs

Inspected by John A. Harlow Date 12-9-42 Dam No. 30

Town MILLBURY Location Head of Lake Simonds

Owner _____ Use _____

Material and Type Concrete & Natural Bed

Dam Designed by _____ Constructed by _____ Year _____

SPILLWAY

El. top Abutment _____ El. Crest _____ El. Apron _____ El. Streambed _____

Width top Abutment _____ Width top Crest _____ Width bottom Spillway _____

Width Flashboards carried _____ Kind Flashboards _____

El. Flowline Cleanout Pipe _____ Size and Kind Cleanout Pipe _____

Kind of Foundation under Spillway _____

Condition Natural Spillway

EMBANKMENT

El. Top _____ El. Natural Ground _____ Width Top _____

Width of Bottom _____ Upstream Slope _____ Downstream Slope _____

Kind of Corewall _____ Riprap _____

Material in Embankment _____ Foundation _____

Condition Good

GATES 1 Location North End

Size _____ Kind _____ El. Flowline _____

Condition Good

WHEEL _____ Kind _____ Size _____ Rated H. P. _____

Location _____ Ave. Head _____

Evidence of Leaks in Structure None

Recent Repairs and Date None

Topography of Country below Dam _____

Nature of Buildings and Roads below Dam _____

Number Acres in Pond _____ Drainage Area in Square Miles _____

Discharge in Second Feet per Square Mile _____

Volume of Storage in Million Cubic Feet _____

WORCESTER COUNTY ENGINEERING DEPT.
WORCESTER, MASS.

DATE Oct 5, 1949

SUBJECT: Dam 30-16 Singletary Lake Millbury
TO West End Throat Co.

Should rebuild spillway.

CAR USED _____
CAR MILEAGE _____
END TRIP _____
BEGIN TRIP _____
TRIP MILES _____

LOM

SIGNATURE

APPENDIX B-11

WORCESTER COUNTY ENGINEERING DEPT.

WORCESTER, MASS.

DATE 3-16-53

SUBJECT:

Singletary Pond

TO

Property Owner on W. Sutton Rd. in Millbury
complains lawns being flooded by high
water of pond.

Said that land where natural overflow
of pond was located has been sold and
has been filled in.

Only control of pond is at the gate

FOR FILED
FOR RECORD
FOR DEPT.
FOR OFFICE

SIGNATURE

TOWN Mellbury

LOCATION Singletery Pond

DAM NO. 3-28

STREAM Singletery

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

OWNED BY W.W. Windle

PLACE

USE

INSPECTED BY R.M.F.

DATE

3/17/63

TYPE OF DAM

CONDITION

SPILLWAY

FLASHBOARDS IN PLACE

RECENT REPAIRS

CONDITION Gravel Road about 12' wide has been built

REPAIRS NEEDED across natural outlet of pond - Only
control of flowage is by gate - Old stone culvert
caved in.

EMBANKMENT

RECENT REPAIRS

CONDITION

REPAIRS NEEDED

GATES

RECENT REPAIRS

CONDITION

Partially open

REPAIRS NEEDED

LEAKS

HOW SERIOUS

about 8' above normal &
about 15' below gate house sill.
These appear to be above
flow line.

DATE

COUNTY ENGINEER

TOWN Milbury

DAM NO. 30-76-3

LOCATION

STREAM

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

OWNED BY

PLACE

USE

INSPECTED BY St. J. P.P.

DATE Sept 13 - 1955

TYPE OF DAM

CONDITION

SPILLWAY

No change

FLASHBOARDS IN PLACE

RECENT REPAIRS

CONDITION

REPAIRS NEEDED

EMBANKMENT

RECENT REPAIRS

CONDITION

REPAIRS NEEDED

DATES

RECENT REPAIRS

CONDITION

REPAIRS NEEDED

LEAKS

HOW SERIOUS

DATE

COUNTY ENGINEER

TOWN Millbury DAM NO. 30-16

LOCATION W. side of Singletary Rd. STREAM Singletary Brook

"Singletary Pond"
WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

D A M I N S P E C T I O N R E P O R T

Owned by Singletary Associates Place Millbury Use Storage Pond

Inspected by WOC - GVC Date Apr 6, 1960

Type of Dam Earth Condition Good

SPILLWAY

Flashboards in Place _____ Recent Repairs _____

Condition No over flow spillway - old over flow spillway has

Repairs Needed been filled in - roadway on top

EMBANKMENT

Recent Repairs _____

Condition Earth embankment ok

Repairs Needed _____

GATES

Recent Repairs _____

Condition No visible gates - Pond level is quite low

Repairs Needed _____

LEAKS

How Serious No leaks visible

DATE _____ County Engineer _____

TOWN Millbury DAM NO. 30-16

LOCATION Southeast side - West Main St STREAM Singletary Brook

"Singletary Pond"

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

Owned by State Singletary Corp. Place Millbury Use Storage Pond

Inspected by WOL-616 Date Oct. 15, 1963

Type of Dam Earth and stone Condition Good

SPILLWAY

Flashboards in Place No boards Recent Repairs

Condition This spillway structure is good

Repairs Needed No boards are in place at this time

EMBANKMENT

Recent Repairs This embankment is 20' wide (average) on top - 11 1/2' h

Condition Slopes on both sides - there is up-iron wall along the

Repairs Needed shore line for 25'

GATES

Recent Repairs

Condition The gate is good and is now wide open

Repairs Needed

LEAKS

How Serious

DATE: _____ County Engineer: _____

TOWN Millbury DAM NO. 30-16
LOCATION on Harris Ave. STREAM Singletary Brook

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

Owned by 1944 C. Lincoln Thread Co., Inc. Place Millbury Use Storage P. 1
Inspected by WCT - W.C.C. Date May 12, 1967
Type of Dam old earth dam Condition Fair

SPILLWAY

Flashboards in Place No boards Recent Repairs _____
Condition Small spillway in gate structure
Repairs Needed 2" of water over crest

ENPANELMENT

Recent Repairs _____
Condition Good condition
Repairs Needed _____

GATES

Recent Repairs _____
Conditions Good condition
Repairs Needed Gate is closed on this date.
Brush has recently been cut along outlet channel, below gate structure

LEAKS

How Serious _____
DATE: _____

County Engineer

TOWN MILL ROCK

DAM NO. 20-16

LOCATION _____

STREAM _____

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

D A M I N S P E C T I O N R E P O R T

Owned by _____

Place _____

Use _____

Inspected by J ASPERO

Date MARCH 18, 19

Type of Dam _____

Condition _____

SPILLWAY

Flashboards in Place _____

Recent Repairs _____

Condition _____

NO SPILLWAY

Repairs Needed _____

EMBANKMENT

Recent Repairs _____

Condition _____

Repairs Needed _____

GATES

Recent Repairs _____

GATE ON A LITTLE

Condition _____

Repairs Needed _____

LEAKS

Recent Repairs _____

County Engineer

INSPECTION REPORT & DATA FOR DAMS

Owner: SINLETHRY CORPORATION & N.Y. HINDS COMPANY
 His Address: 55 CANAL ST., MILLBURY, MASS
 Function of Dam: STORAGE CONDO

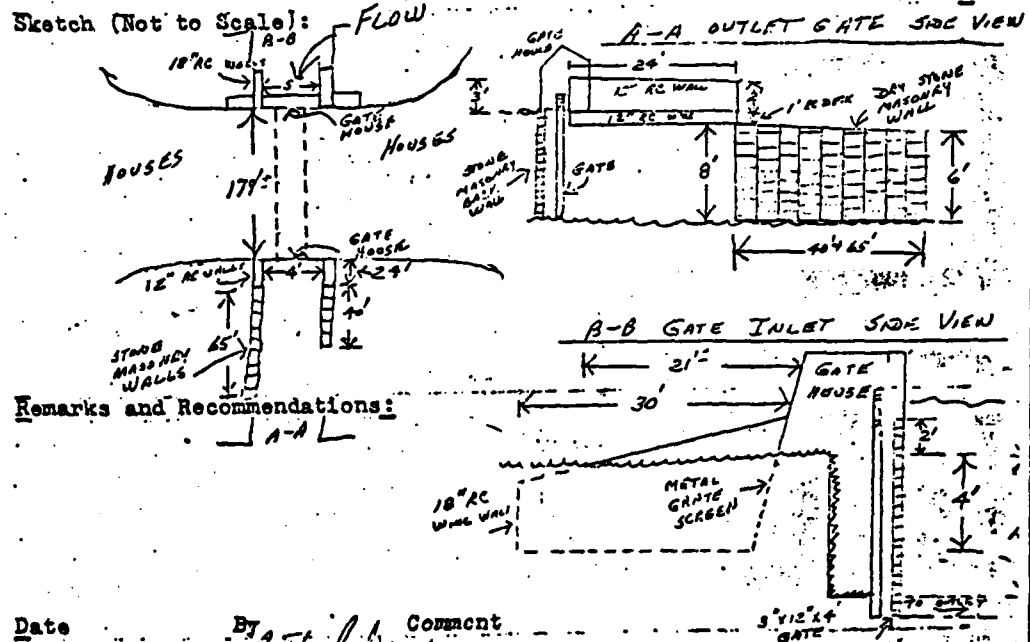
Location & Access: 1ST DRIVEWAY ON RIGHT ON HARRIS
FROM JCT OF W. MAIN ST & HARRIS AVE.
 USGS Quad. Worce. South Lat. 42-10-15 Long. 71-46-30
 Drain. Ar. 407 Sq. Mi.; Ponds: no.; Res. @ dam: no.
 Character of D.A.: no.

(11) 3-14-186-16
 Dam No. 30-16
 Town: MILLBURY
 Stream: SINLETHRY RIVER
 Pond: SINLETHRY POND
 Date: 2/17/72
 By: T. J. McKeon
 CONDITION RATING
 Structural: Good
 Hydraulic: Good
 General: Good
 PRIORITY: NONE

Estimated
 Discharge
 Capacity:

General Description of Dam and Discharge Control: EARTH-DIKE TO EAST
OF GATE HOUSE. DAM IS 180' IN WIDTH
BETWEEN GATE HOUSES. 3" X 12" X 4" GATE ON INTAKE. TIMBERS ON OUTLET GATE
ROTTED OUT & BROKEN. 30' X 30' DEPRESSION BEHIND INTAKE GATE HOUSE.

Sketch (Not to Scale):



Remarks and Recommendations:

Date

2/7/72

By

T. J. McKeon
 J. Pociello
 E. M. Leach

Comment

Dam No. 3-14-186-16

APPENDIX C

SELECTED PHOTOGRAPHS OF PROJECT

LOCATION PLAN

Page No.

Location of Photographs

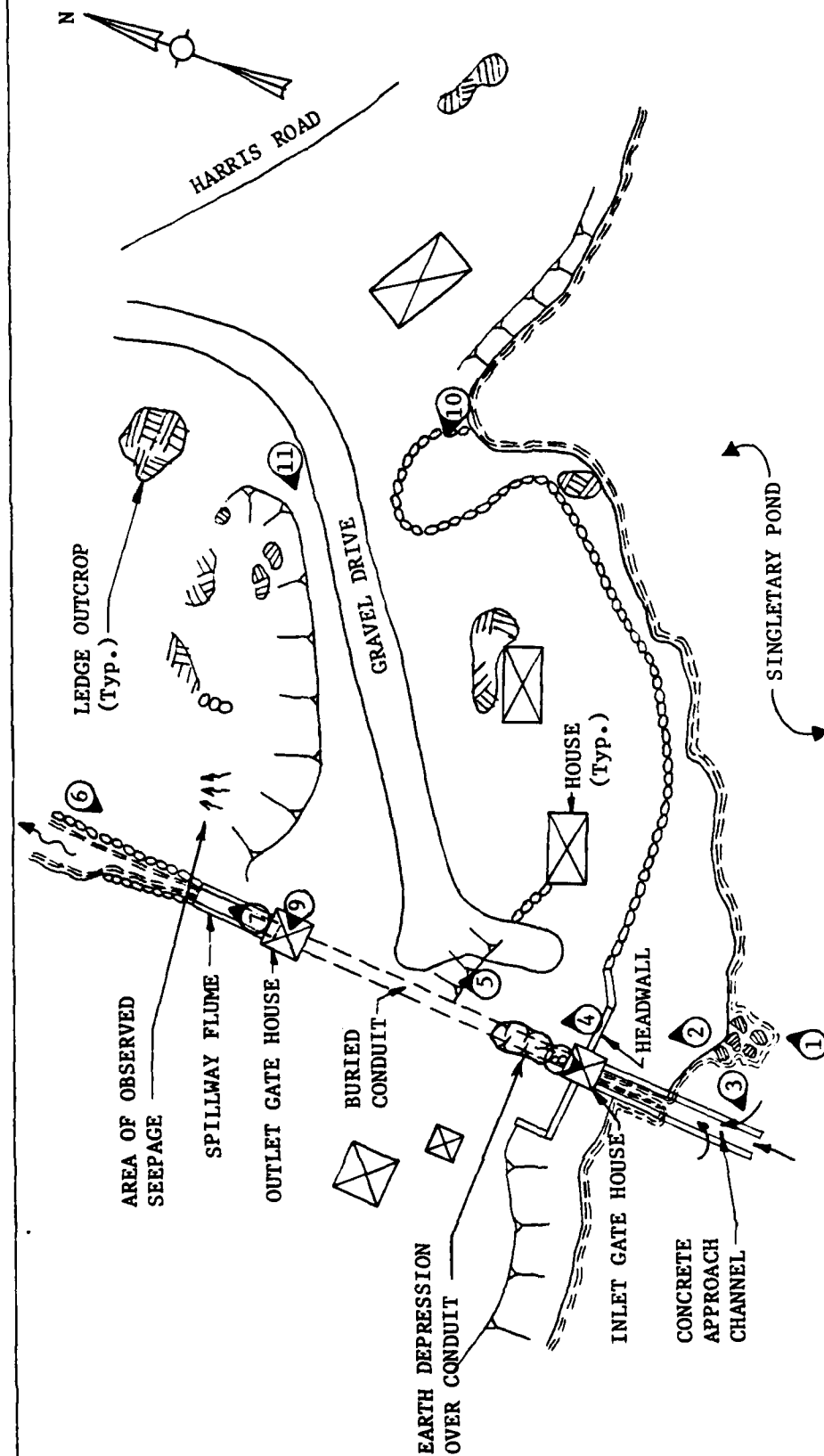
C-1

PHOTOGRAPHS

No. Title

Page No.

- | | | |
|-----|---|-----|
| 1. | Telephoto Overview of Upstream Face of Dam and Intake Gate House | iv |
| 2. | Intake Channel and Upstream Face of Intake Gate House | C-2 |
| 3. | Stop Log Guides at Upstream End of Intake Channel | C-2 |
| 4. | Reed Growth in Depression over Pipe Line between Intake and Outlet Gatehouses | C-3 |
| 5. | Looking Downstream Towards Outlet Gatehouse | C-3 |
| 6. | View Looking Upstream Towards Outlet Gatehouse | C-4 |
| 7. | View from Outlet Gatehouse Looking Downstream | C-4 |
| 8. | Gate Operator in Intake Gatehouse | C-5 |
| 9. | Gate Operator in Downstream Gatehouse | C-5 |
| 10. | Indentation in Shore Line to Access Road to Dam | C-6 |
| 11. | Low Area on Opposite Side of Access Road to Dam From Shore Line Indentation | C-6 |



NATIONAL INSPECTION PROGRAM
OF NON-FEDERAL DAMS

LOCATION OF PHOTOGRAPHS

SINGLETARY POND DAM
MILLBURY, MASSACHUSETTS

Note: ① Denotes direction of view
and photograph number.



2. INTAKE CHANNEL AND UPSTREAM FACE OF INTAKE GATE HOUSE.



3. STOP LOG GUIDES AT UPSTREAM END OF INTAKE CHANNEL.



4. REED GROWTH IN DEPRESSION OVER PIPE LINE BETWEEN INTAKE AND OUTLET GATEHOUSES. VIEW IS FROM INTAKE GATE HOUSE LOOKING DOWNSTREAM.



5. LOOKING DOWNSTREAM TOWARDS OUTLET GATEHOUSE.



6. VIEW LOOKING UPSTREAM TOWARDS
OUTLET GATE HOUSE.



7. VIEW FROM OUTLET GATE HOUSE
LOOKING DOWNSTREAM.



8. GATE OPERATOR IN INTAKE GATE HOUSE.



9. GATE OPERATOR IN DOWNSTREAM GATE HOUSE.



10. INDENTATION IN SHORE LINE TO ACCESS ROAD TO DAM.



11. LOW AREA ON OPPOSITE SIDE OF ACCESS ROAD TO DAM FROM SHORE LINE INDENTATION.

APPENDIX D

OUTLINE OF DRAINAGE AREA AND
HYDRAULIC COMPUTATIONS

Page No.

OUTLINE OF DRAINAGE AREA

Drainage Area Map

D-1

COMPUTATIONS

Elevation; Surface Area; Storage Volume; Size
Classification; Hazard Potential Classification;

Test Flood

D-2

PMF; Outlet Works

D-3

Stage-Discharge Relationship; Spillway Detail

D-4

Spillway (continued)

D-5, 6

Discharge; Storage Capacity at Various W.S.

Elevations

D-7

Test Flood Analysis

D-8

Rate of Storage Curve for Adams Pond

D-9

Adams Pond Outflow Hydrograph

D-10

Test Flood Analysis (continued)

D-11

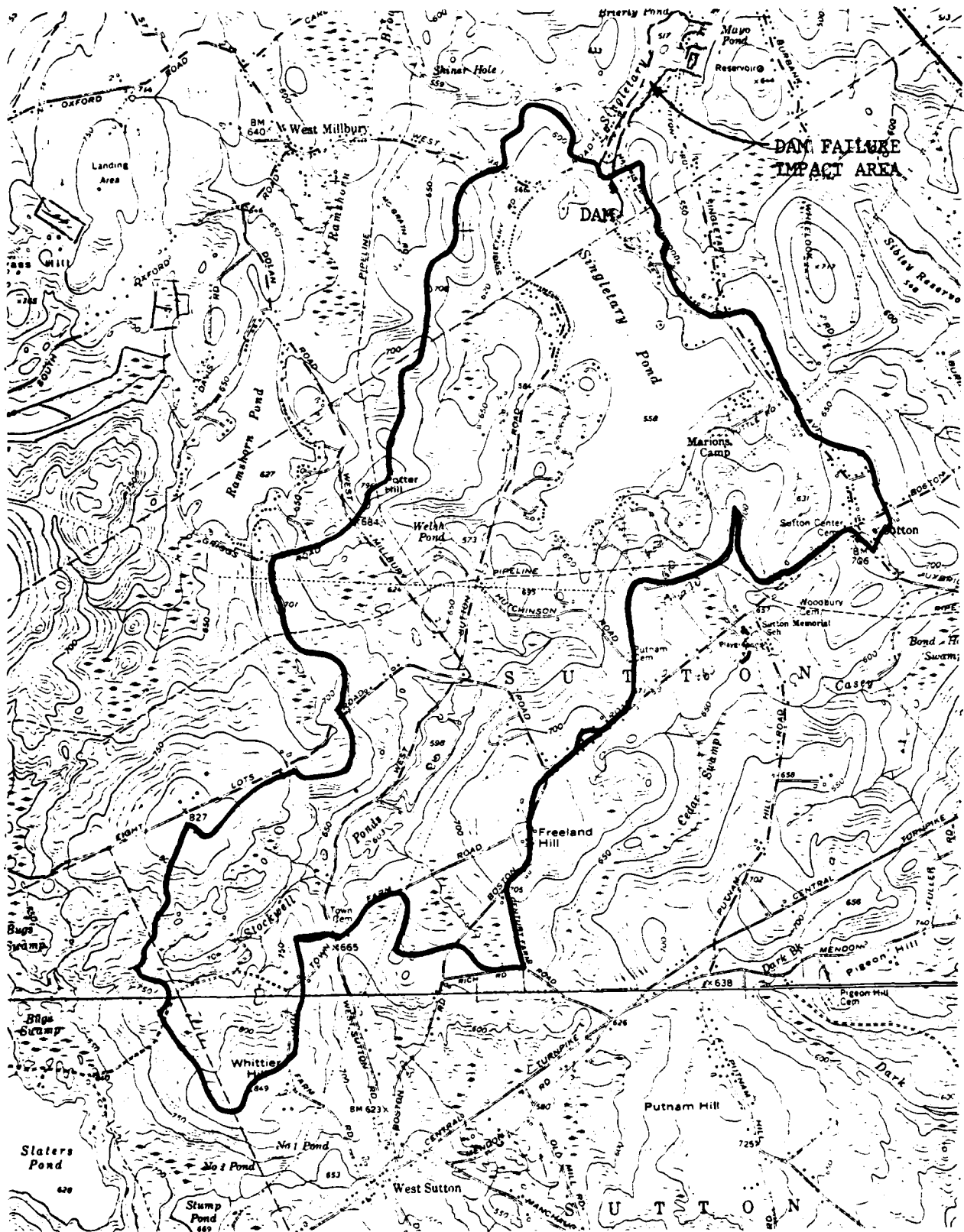
Tailwater Analysis

D-12

Dam Failure Analysis

D-13 - 16

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CAMP DRESSER & McKEE Inc.
 Consulting Engineers
 Boston, Mass.



SINGLETARY POND DAM
DRAINAGE AREA MAP
 SCALE: 1" = 2660'

CAMP DRESSER & MCKEE
Environmental Engineers
Boston, Mass

CLIENT USPS CE BUREAU
PROJECT DAM INSP
DETAIL SINGLE-KEY ROAD

JOB NO. 380-S-CH
DATE CHECKED 2-5-79
CHECKED BY Briller

PAGE 1 of 11
DATE 1-25-79
COMPUTED BY JED

ELEVATIONS

All elevations are based on field survey by
Harry R. Feldman, Inc. for HUD/FIA Flood Insurance
Study of Town of Millbury and field measurements
made by Inspection Party.
Spillway crest (w/ flashboards) = 557.0
Top of Headwall @ Ups Gate House = 560.75
Top of Spillway Culvert Inlet = 561.0
Ups Gate House Inlet El. = 547.2

SURFACE AREAS (from USGS Quad: WORCESTER SOUTH, MA, 1960)

D.A. = 2562 ac. = 4.0 sq. mi.

Surface Area @ Kils. El. 557.0 = 335 ac. = 0.52 sq. mi.

" " " El. 560.0 = 367 ac. = 0.58 sq. mi.

" " " El. 570.0 = 440 ac. = 0.69 sq. mi.

STORAGE VOLUMES

At Normal Pool Elev. 557.0 = $335 \text{ ac.} \times 12 \text{ ft} \times \frac{1}{3} = 1340 \text{ ac.-ft.}$

At El. 560.75 = $(335 + 367) / 2 \times 3.75 + 1340 = 1320 + 1340 = 2660$

SIZE CLASSIFICATION

Hydraulic Ht. $\leq 40 \text{ ft.} \rightarrow$ small

Storage @ top of dam = 2,660 ac.-ft. $\rightarrow$ INTERMEDIATE

HAZARD CLASSIFICATION

Dam failure analysis (pages 1 of 4 thru 4 of 4) indicates
that a failure would result in shallow depth-high velocity
flooding of a portion of West 11th St. and
approx. 4 homes and 1 factory. The potential for
loss of life is significant (0 to 10) and economic losses
would not be high. $\therefore$ Hazard is SIGNIFICANT

TEST FLOOD

Intermediate Size & Significant Hazard:

TEST FLOOD RANGE $\rightarrow$ $\frac{1}{2}$ PMF. to PMF

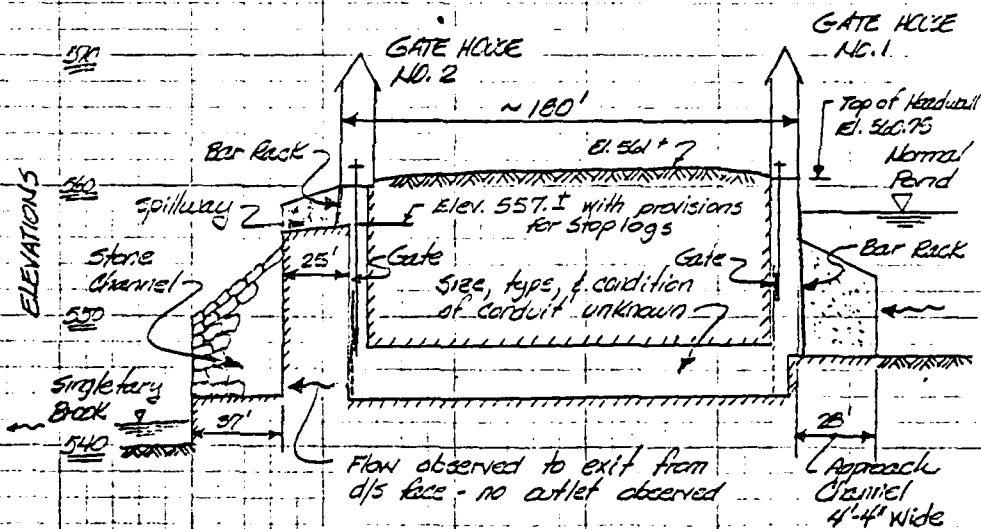
PMF DETERMINATION

Terrain consists of moderately rolling, side slopes into a valley which has a mild slope of $\sim 1\%$. Therefore use 85% of Rolling Terrain CSM value from CCE Curves for Estimating Probable Max. Floods.

$$\therefore \text{CSM} = 1400 \text{ cfs/sq. mi.} \times 85\% = 1195 \text{ CSM, say } 1200 \text{ CSM}$$

$$\text{then PMF Int'lvl} = 1200 \text{ cfs/sq. mi.} \times 4.0 \text{ sq. mi.} = 4,800 \text{ cfs}$$

OUTLET WORKS: The following sketch is based on field survey & field inspection. Details within & between gate houses are assumed as interiors were inaccessible.

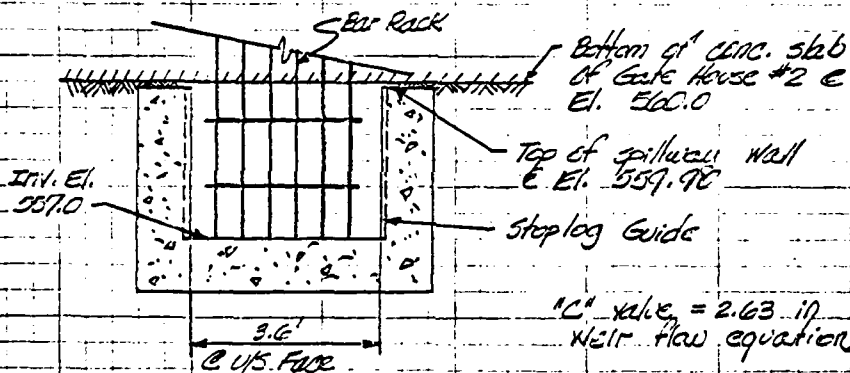


Normal pond level is controlled by stoplogs in gate house #2. Flow discharges over stoplogs and down spillway which is a 4 ft. wide (arg.) by 3 ft. high x 25 ft. long concrete channel. Crest elev. w/o stoplogs is about 557.0. At the end of the 25 ft. long spillway the discharge drops approx. 13 ft. into a stone channel which is 37 ft. long by 4 ft. wide at the ups end and 7'-3" wide at the d/s end. At the end of this

channel the discharge drops another 2 ft.
into Singlethry Brook

At the time of inspection both gates 1 & 2
were open (exact open unknown) and the
pond was being lowered for the winter.
No discharge was occurring over the
spillway. All flow was exiting from the
downstream face of the spillway through
an unobserved outlet and into the 27 ft.
long stone channel.

STAGE - DISCHARGE RELATIONSHIPS



SPILLWAY DETAIL

A. Assume Gate
No. 2 closed

W.S. El. in Gate House #2	Flow (cfs)	(1)* EGL within Gate House	(2)* Head Loss from Gate House #2	(3)* Pond W.S. El.	(* See page 4)
557.0	0	557.00	0	557.0	
558.0	10	558.00	0.1	558.1	
559.0	27	559.02	0.7	559.7	
560.0	50	560.04	2.43	562.4	

- (1) Riser section within Gate House #2 is 13.25 ft. high and is approx. 5' x 6'.

$$A = 5 \times 6 = 30 \text{ sq. ft.}$$

$$V = Q/A = Q/30$$

FLOW (cfs)	Velocity (fps)	$V^2/2g$	EGL = $V^2/2g + W.S.$
10	0.33	0.0	558.00
27	1.0	0.02	559.02
50	1.67	0.04	560.04

- (2) Conduit size, type, & condition from Gate House 1 to 2 is unknown. Gate #1 is approx. 1' x 4'. Assume velocity from 1 to 2 is function of 1' x 4' = 4 sq. ft. area. Assume head loss from 1 to 2, including entrance loss @ 1 and exit loss @ 2 equals one vel. head.

FLOW (cfs)	Velocity (fps)	$V^2/2g = h_v$	$h_L = h_v$
10	2.5	0.1	0.1
27	6.75	0.7	0.7
50	12.5	2.43	2.43

- (3) Pond level equals EGL @ Gate House #2 plus head loss from 1 to 2 minus velocity head in approach channel.

FLOW (cfs)	EGL @ Pond	Approx. W.S.	Vel. in approach	Pond = EGL - $V^2/2g$ W.S.
10	558.10	558.0	0.21	558.1
27	559.72	559.5	0.50	559.7
50	562.47	562.0	0.77	562.4

B. Assume Gate
No. 2 Open

It is assumed that the discharge capacity of the outlet works would be greater than normal flow over spillway for corresponding pond levels if gate #2 were open.

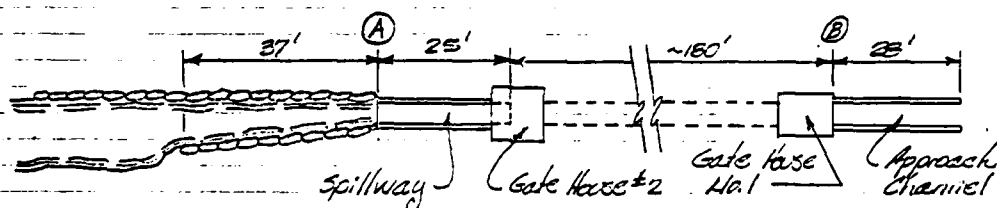
CLIENT CCE
 PROJECT SINGLETARY R.N.
 DETAIL SINGLETARY R.N.

 JOB NO. 380-S-04
 DATE CHECKED 2-5-79
 CHECKED BY Miller

 PAGE 5 of 11
 DATE 1-26-79
 COMPUTED BY MD

Exact determination of the stage-discharge relationships with the gate open are not possible since:

- (1) size and configuration of inlet at gate house #1 are unknown
- (2) size, type, & condition of conduit from #1 to #2 is unknown
- (3) outlet from gate house #2 beneath spillway is unknown. It may be that no conduit exists as such. At the time of inspection, it appeared that the flow discharged thru the rock wall with no defined outlet.



Assumed stage-discharge relationship with gate #2 open will be based on conditions at the time of inspection:

$$W.S. El. @ A = 548.5$$

$$W.S. El. @ B = 554.7$$

$$Vel. in approach channel = 10 ft. / 12 sec. = 0.83 fps$$

$$Q = 4.33' \times 7.25' \times 0.83 f/s = 26 cfs$$

$$Assume h_f (between A \& B) = K Q^{1.85} [Hazen-Williams]$$

For observed conditions:

$$h_f = 554.7 - 548.5 = 6.2$$

$$Then 6.2 = K (26)^{1.85}$$

$$K = 6.2 / (26)^{1.85} = 0.015$$

Assume velocity at A is constant with increasing flows. Then depth @ A = $Q / V \times W = Q / 1.44 \times 4.0 = Q / 5.76$

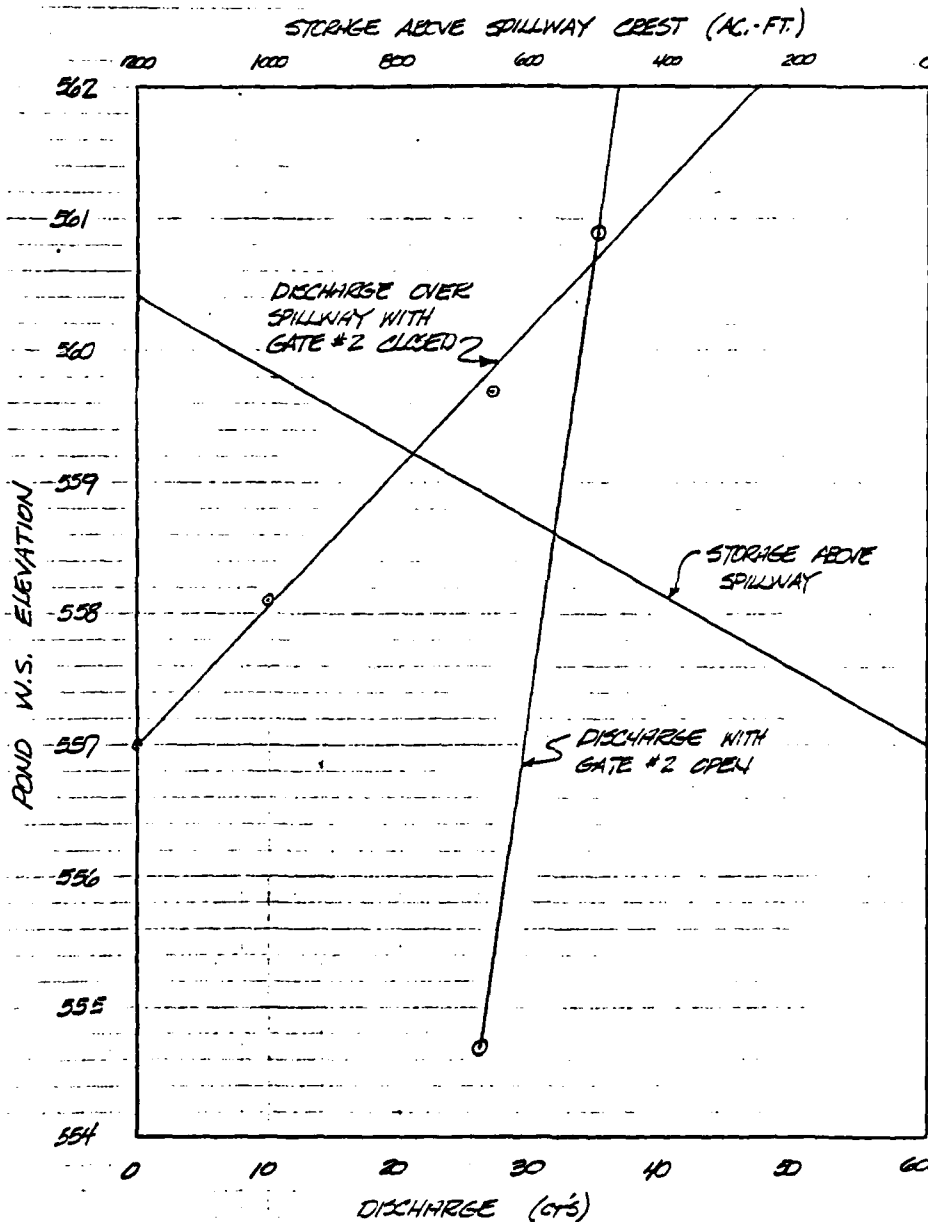
Flow (cfs)	Depth @ A (ft.)	W.S. Elev. @ A	h_f between A & B (ft.)	W.S. Elev. @ B
26	4.5	548.5	6.2	554.7
33	6.1	550.1	10.6	560.9
45	7.6	551.8	17.2	569.0

CAMP DRESSER & MOORE INC

CLIENT COE
 PROJECT SINGLETHRY REND
 DETAIL SINGLETHRY REND

JOB NO 380-S-CH
 DATE CHECKED 2-3-77
 CHECKED BY CH/LL

PAGE 6 of 11
 DATE 1-26-77
 COMPUTED BY JED



TEST FLOOD ANALYSIS

A. Route $\frac{1}{2}$ PMF through Adams, Arnold, & Town Farm Ponds which are upstream of Singletary Pond

DA. above Arnold Pond outlet = 123.57 mi

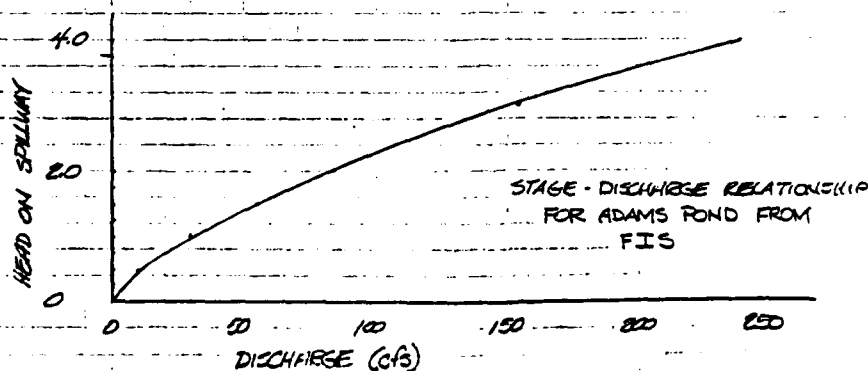
$\frac{1}{2}$ PMF Inflow = $2250 \text{ cfs/mi}^2 \times 85\% \times 123 \text{ mi}^2 \times \frac{1}{2} = 1180 \text{ cfs}$

Develop inflow hydrograph by multiply ordinates of 100-yr hydrograph developed in Flood Insurance Study by ratio of $\frac{1}{2}$ PMF peak inflow to 100-yr peak inflow

Time (hrs)	$\frac{1}{2}$ PMF Observed Inflow (cfs)	Avg. Inflow	(1) Head on Spillway	(2) Outflow (cfs)
0	0	366	0.55	22
1	732	954	1.96	83
2	1150	1039	3.45	192
3	897	667	4.20	256
4	434	331	4.33	282
5	225	172	4.20	256
6	118	88	3.95	235
7	58	47	3.68	210
8	36	0	3.34	181
9			3.05	156
10			2.80	139
11			2.57	122
12			2.34	106
13			2.14	93
14			1.94	80
15	0	0		

Column (1) derived from storage curve on next page

Column (2) from Discharge Curve below



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CLIENT COE

JOB NO 380-5-124

PAGE 8 of 11

PROJECT SINGLETHRY RD

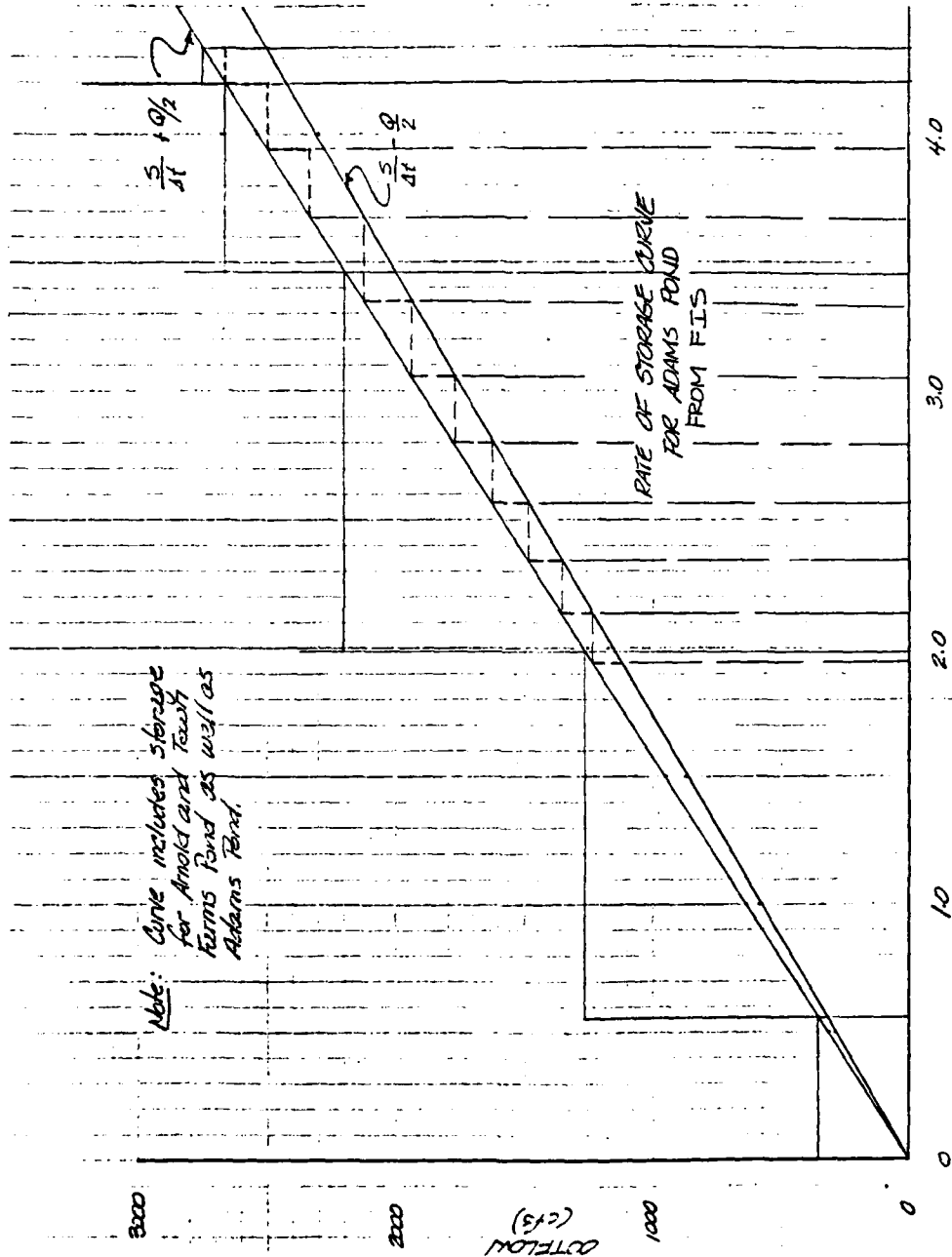
DATE CHECKED 2-5-79

DATE 1-26-79

DETAIL SINGLETHRY RD

CHECKED BY CFW

COMPUTED BY JED

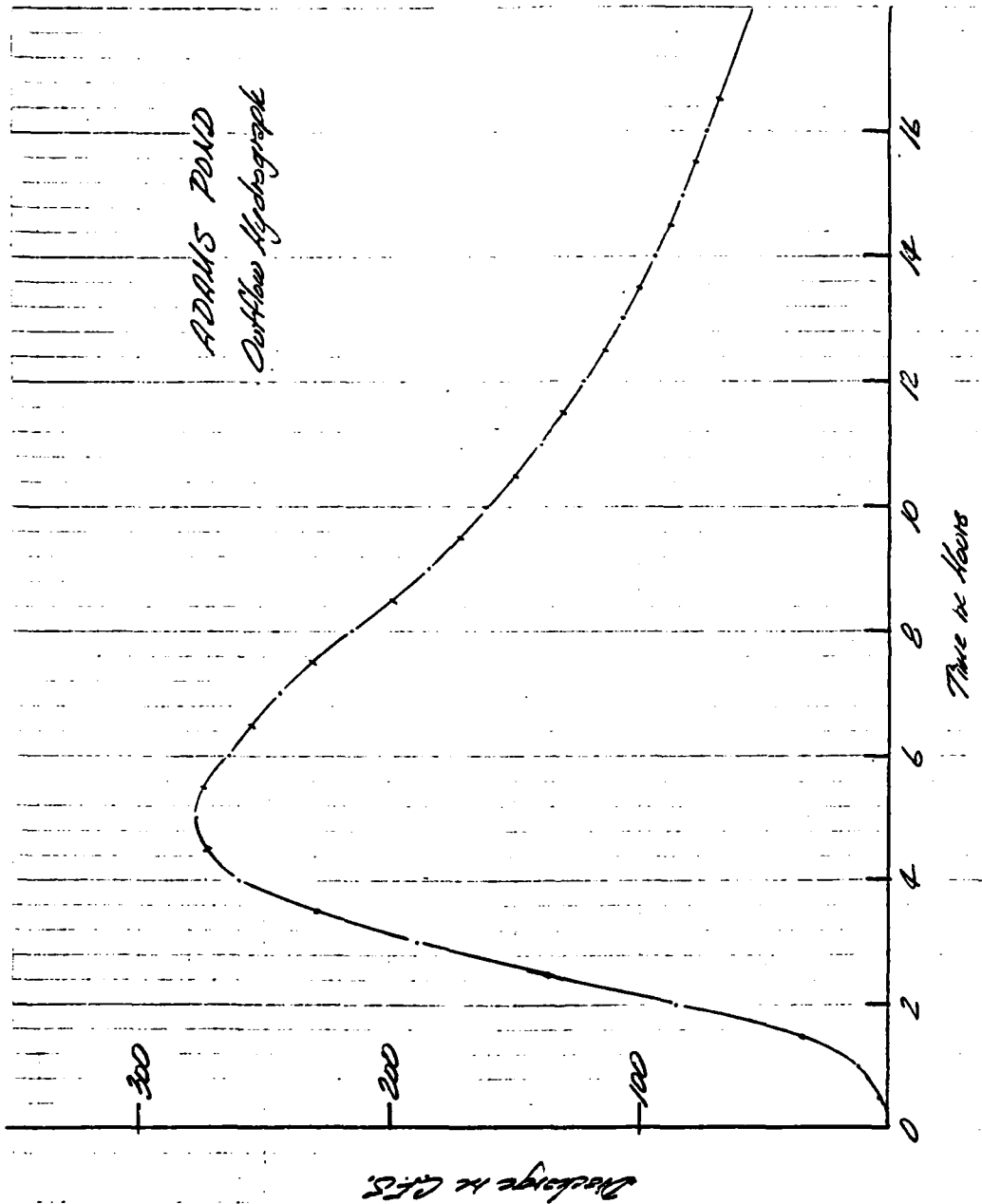


CAMP DRESSER & MCKEE
Environmental Engineers
Boston, Mass.

CLIENT City of Engineers-Dev Corp.
PROJECT Supplementary Pond
DETAIL Supplementary Pond

JOB NO. 380-5-04
DATE CHECKED 2-7-79
CHECKED BY JED

PAGE 9 of 11
DATE Feb 11/1979
COMPUTED BY Order



CLIENT CCE
 PROJECT SINGLETRARY RD
 DETAIL SINGLETRARY RD
JOB NO 30-5-04DATE CHECKED 2-5-79PAGE 10 of 11DATE 1-26-79CHECKED BY Miller COMPUTED BY JED

- B. Combine outflow hydrograph from Adams Pond with inflow hydrograph from intervening terrain to Singletrary Rd.

Intervening D.A. = 2.77 sq. mi.

$$1/2 \text{ PMF Inflow} = 2025 \text{ cfs/mi}^2 \times 85\% \times 2.77 \text{ mi}^2 \times 1/2 = 2,380 \text{ cfs}$$

Use FIS hydrograph shape for inflow hydrograph to Singletrary Rd. Use 1/2 hr. lag for Adams P. contribution to Singletrary Rd.

Time (hrs)	SINGLETRARY Observed Inflow (cfs)	Unlabeled Adams Rd Outflow (cfs)	Lag = 0.5 hrs Adams Rd Outflow (cfs)	TOTAL INFLOW (cfs)	AVG. INFLOW (cfs)	HEAD ON SINGLETRARY OUTLET	SINGLETRARY OUTFLOW (cfs)
0	0	0	0	0	0		
1	452	22	11	463	232		
2	1757	83	53	1790	1127		
3	2380	192	138	2518	2154		
4	1952	256	224	2176	2247		
5	1095	282	269	1364	1770		
6	595	256	269	864	1114		
7	333	235	246	579	723		
8	190	210	223	413	496		
9	119	151	196	315	364		
10	72	158	170	242	279		
11	24	139	149	173	208		
12		122	131	131	152		
13		106	114	114	123		
14		93	100	100	107		
15		80	87	87	94		
		72	77	77	82		

Routing not required - see below

$$\Sigma = 11,372 \text{ cfs-hrs}$$

$$11,372 \text{ ft}^3/\text{sec} \cdot \text{hr} \times 3600 \text{ sec/hr} \times 1 \text{ acre}/43,560 \text{ ft}^2 = 940 \text{ ac-ft}$$

$$\begin{aligned} \text{let avg. outflow} &= 30 \text{ cfs for 15 hrs with gate \#2 open} \\ &= 30 \text{ ft}^3/\text{sec} \times 15 \text{ hrs} \times 3600 \text{ sec/hr} \times 1 \text{ acre}/43,560 \text{ ft}^2 \\ &= 37.2 \text{ ac-ft} \end{aligned}$$

$$\text{Then total volume to be stored} = 940 - 37.2 = 903 \text{ ac-ft}$$

Since a storage volume of 903 ac-ft corresponds to a pond level of 559.5, the dam will not be overtopped.

If gate Gate #2 is closed, ag. discharge
over spillway is

$$20 \text{ cfs} \times 15 \text{ hrs.} \times 3600 / 43,560 = 25 \text{ ac-ft.}$$

$$\text{Volume to be stored} = 933 - 25 = 908 \text{ ac-ft.}$$

From Storage-Volume Curve, Pond level = 559.6
and dam is not overtopped.

TALKWATER ANALYSIS

Peak outflow occurs with Gate #2 open and Pond
at max. level of 559.5; $Q_p = 34 \text{ cfs}$

Downstream control is at Harris Rd. culvert which
is a 5' N x 3.2' H stone culvert. If water is
at crown of culvert, $\text{Vel.} = 45 \text{ cfs} / 5 \times 3.2 = 3 \text{ fps}$.
 $\therefore$ W/S. would be at or below crown.

No tailwater will exist at outlet works -
free discharge from 37' long stone channel.

DAM FAILURE ANALYSIS

The width of dam between the upstream (#1) and downstream (#2) gatehouses is approx. 160 ft. Top of headwall at gate house #1 is elev. 560.75. Low ground to the left of the headwall is at elev. 560.9. Top of 7'-6" long section of head which is at 90° to left end of front headwall is at elev. 559.75 and is the low point of the dam in the vicinity of gate house #1. Ground elev. behind the headwall to the right of gate house #1 slopes from 560.1 to 561.6.

The portion of this dam located approx. 150 ft. to the right of gate house #1 is believed to have once been a spillway which is now filled in and is used as a gravel driveway. The min. width of this embankment is 21 ft. Top elev. is 561.0 and bottom of pond upstream is approx. elev. 557.0 underlain by ledge.

If the pond were to rise and overtop the dam, the 7'-6" long segment of the gate house #1 headwall at elev. 559.75 would be overtopped before the spillway embankment at elev. 561.0. However, the ground between the two gate houses rises to elev. 561.2 so that the water would not flow until after the spillway embankment was overtopped by 0.2 ft.

One other flow path over the dam exists which starts at the headwall adjacent to the right side of gate house #1 and runs approx. 80 ft. over flat ground to the gravel driveway. Ground elev. is 560.1 but the pond stage would have to be at 560.75 to first overtop the headwall.

Assume dam failure occurs at the spillway embankment since it will be overtopped at nearly the same pond stage as will the main dam, but has a much narrower width (21 ft. vs. 160+).

The length of spillway embankment, which is 21 ft. wide, is approx. 25 ft. The width widens rapidly at both ends of the 25 ft. section. Assume that the 25 ft. long section fails initially and that a portion of the under sections at both ends are eroded such that the breach width is 50 ft.

$$Q_p = \frac{8}{27} (W_b) (g)^{1/2} (Y_o)^{3/2} ; \text{ where } Y_o = 561.0 - 557.0 = 4 \text{ ft.}$$

$$= \frac{8}{27} (50) (32.2)^{1/2} (4)^{3/2} = 670 \text{ cfs}$$

Reach #1: Dam to Harris Rd.

Harris Rd. culvert is 5' W x 3.2' H; crown is 2.2' below top of road which is @ elev. 546.4

Assume pressure & weir flow @ 670 cfs.

$$\text{then } Q_T = (Q_w = C_1 L H^{3/2}) + (Q_p = C_2 A (2g h)^{1/2})$$

where $C_1 = 2.8$, $L = \text{varies with W.S. Elev.}$, $H = \text{ft. above 546.4}$
 $C_2 = 0.8$, $A = 5 \times 3.2 = 16 \text{ ft}^2$, $h = \text{ft. above 544.2}$

W.S. @ El. 547.0

$$Q_T = (2.8)(165)(0.6)^{3/2} + (0.8)(16)(64.4 \times 2.8)^{1/2}$$

$$= 215 + 172 = 387 \text{ cfs}$$

W.S. @ El. 547.5

$$Q_T = (2.8)(200)(1.1)^{3/2} + (0.8)(16)(64.4 \times 3.3)^{1/2}$$

$$= 710 + 190 = 900 \text{ cfs}$$

$$\text{then stage @ 670 cfs: } (670 - 387) / (900 - 387) \times 0.5 + 547.0$$

$$= 0.3 + 547.0 = 547.3$$

There is no significant storage between dam and Harris Rd. $\therefore Q_{p2} = Q_{p1}$

There is no development @ or below elev. 550.0

Reach No. 2: Harris Rd. to West Main St.

Culvert is 60" R.C. pipe. Inv. El. 539.5, length = 71 ft.
Top of Rd. Elev. 547.5 over & of pipe.
Low point in road El. 546.8 approx. 50 ft. to the right of & of pipe.

Slope of pipe = 0.008, Slope of EGL ~ 0.004

W.S. @ El. 544.5 (crown of pipe)

$$Q_1 = \frac{1.47}{.013} (\pi \times 2.5^2) \left(\frac{5}{4}\right)^{3/2} (0.004)^{1/2} = 1060 \text{ cfs}$$

W.S. @ El. 546.5 (top of Rd.)

$$Q_P = (0.8)(\pi \times 2.5^2) (64.4 \times 2.3)^{1/2} = 191 \text{ cfs}$$

W.S. @ El. 548.0

$$Q_T = (2.6)(150) \left(\frac{1.2}{2}\right)^{3/2} + (0.8)(\pi \times 2.5^2) (64.4 \times 3.5)^{1/2} \\ = 195 + 235 = 430 \text{ cfs}$$

W.S. @ El. 548.5

$$Q_T = (2.6)(190) \left(\frac{1.7}{2}\right)^{3/2} + (0.8)(\pi \times 2.5^2) (64.4 \times 4)^{1/2} \\ = 416 + 252 = 668 \text{ cfs}$$

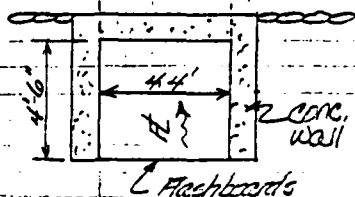
There is one uninhabited structure below elev. 548.5.

NOTE: Since W.S. @ Reach #2 > W.S. @ Reach #1 (548.5 vs 547.3), a backwater condition exists and W.S. @ Reach #1 is 548.5.

No Significant Storage $\therefore Q_{P3} = Q_{P2} = Q_{P1}$

Reach No. 3: West Main St. to Pond Outlet

Outlet is a 4.4' W x 4.0' H x 155' L box conduit @ Inv. El. 537.75. Entrance to box conduit consists of two perpendicular wing walls, 4' 6" long @ El. 547.3 with flashboards in between @ El. 543.9. (see sketch)
Inv. El. @ outlet (155' d/s) is 539.0



Note: Pond levels greater than Elev. 545.4 will overflow onto West Main St.

W.S. El. @ 545.4

$$Q = (3.5)(4.4)(1.5)^{3/2} = 26 \text{ cfs}$$

Excess flow, together with overflow from Reach No. 2 will overflow West Main St., bypass Reach No. 3 outlet and flow overland to Brierly Pond. Shallow depth - high velocity flow will occur over and down West Main St. No apparent hazards as exist. development is on high ground.

Reach No. 4 - Outlet @ Brierly Pond

Some storage reduction will take place in Brierly Pond. Assume outflow = 600 cfs.

Outlet is a 5'W x 6.4'H conc. channel w/ fast boards @ 57.0, Inv. of conc. channel is 511.15

W.S. @ El. 515.0

$$Q = (3.3)(5)(1)^{3/2} = 16.5 \text{ cfs}$$

W.S. @ El. 57.0

$$Q = (3.3)(5)(2)^{3/2} + (2.5)(35)(1/2)^{3/2} = 47 + 21 = 68 \text{ cfs}$$

W.S. @ El. 520.0

$$Q = (3.3)(5)(3)^{3/2} + (2.5)(175)(1.2)^{3/2} = 66 + 575 = 641 \text{ cfs}$$

Then Brierly Pond will rise to about El. 520.0

Portion of West Main St. is at elev. 59.± along east bank of Pond. Water will overflow, causing shallow flooding of road, factory on east side of road, and possibly 1 to 4 homes @ intersection of W. Main St. and Sutton Rd.

Reach No. 5 - Mayo Pond

HLD/FIA FIS prepared for the Town of Millbury indicates that no significant flooding will occur @ Mayo Pond with $Q \leq 600 \text{ cfs}$.

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APPENDIX E
INFORMATION AS CONTAINED IN
THE NATIONAL INVENTORY OF DAMS

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INVENTORY OF DAMS IN THE UNITED STATES

STATE	MA	IDENTITY NUMBER	100-1-ED	CONGR DIST	MA	STATE DIST	03	NAME	SINGLETARY POND DAM	LATITUDE (NORTH)	4210.1	LONGITUDE (WEST)	7146.8	REPORT DATE DAY	00	REPORT DATE MO	00	REPORT DATE YR	1979
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POPULAR NAME	SINGLETARY POND	NAME OF FOUNDMENT	
REGION/DASH		RIVER OR STREAM	
01 0A	SINGLETARY BROOK	MILLHURY	
		NEAREST DOWNSTREAM CITY - TOWN - VILLAGE	
		DIST FROM DAM (MI.)	1
		POPULATION	12100

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FT.)	HYDRAULIC HEAD (FT.)	IMPOUNDING CAPACITIES (ACRES-FT.)	DIST OWN	FED R	PRV/FED	SCS A	VER/DATE
RECTPG	1900	SP	17	21	2660	1340	N	N	N	N

REMARKS

D/S HAS LENGTH	SPILLWAY TYPE	WIDTH (FT.)	MAXIMUM DISCHARGE (CFS)	VOLUME OF DAM (CU)	POWER CAPACITY (MW)	INSTALLED	PROPOSED	NO	LENGTH	WIDTH	DEPTH	LENGTH	WIDTH	DEPTH
2	50	C	11	35										

OWNER	ENGINEERING BY	CONSTRUCTION BY
SINGLETARY CO		

DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NONE	NONE	NONE	NONE

INSPECTION BY	INSPECTION DATE DAY	MO	YR	AUTHORITY FOR INSPECTION
CAMP DRESSER + MCKEE INC	20	SEP	78	PL 92-367

REMARKS
