CONNECTICUT RIVER BASIN
MANCHESTER, CONNECTICUT

GLOBE HOLLOW RESERVOIR DAM

CT. 00012

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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

JUNE 1979

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

Globe Hollow Reservoir Dam is a zoned earth embankment about 620 ft. long, with a mazimum height of about 40 ft. and a crest width of about 15 ft. It has a central masonry core wall. The spillway is located at the right abutment of the dam. It consists of a paved stone approach channel; a 35 ft. wide concrete ogee crested weir with provisions for 14 in. high flashboards; and concrete training walls extending 6 ft. above the spillway crest to the top of the dam. The spillway outlets into a pond located at the toe and to the right of the dam, used as a Municipal recreational swimming pool. The gate tower and wet well shaft is located on the crest of the dam near its mid-span.

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PHASE I INSPECTION REPORT
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PHASE I INSPECTION REPORT

Identification No.:	CT 00012
Name of Dam:	Globe Hollow Reservoir Dam
Town:	Manchester
County and State:	Hartford County, Connecticut
Stream:	Hop Brook
Date of Inspection:	9 April and 10 May 1979

BRIEF ASSESSMENT

Globe Hollow Reservoir Dam is a zoned earth embankment about 620 ft. long, with a maximum height of about 40 ft. and a crest width of about 15 ft. It has a central masonry core wall. The spillway is located at the right abutment of the dam. It consists of a paved stone approach channel; a 35 ft. wide concrete ogee crested weir with provisions for 14 in. high flashboards; and concrete training walls extending 6 ft. above the spillway crest to the top of dam. The spillway outlets into a pond located at the toe and to the right of the dam, used as a Municipal recreational swimming pool. The gate tower and wet well shaft is located on the crest of the dam near its mid-span. It has two 24 in. dia. inlet and two 24 in. dia. outlet pipes all of which are controlled by 24 in. gate valves from the gate house. The inlet pipes are located at elevations 235 MSL and 250 MSL. One outlet pipe is used as a blowoff pipe for the reservoir. The other outlet pipe can either be used as a blowoff pipe or as a feeder to the water distribution system for the City of Manchester.

Globe Hollow Reservoir is utilized as a water storage facility by the City of Manchester. It is about 2,800 ft. long and has a surface area of about 38 acres at spillway crest level. The drainage area is about 2.24 sq. mi. (1,432 acres) and the maximum storage to top of dam is 842 acre-ft.. In accordance with size and capacity criteria, the dam is classified as intermediate in size. Because a breach of the dam may damage two homes, a secondary highway and an interchange between a U.S. Highway and a State Highway, as well as the recreational facility at the foot of the dam, with the possibility of the loss of more than a few lives and extensive economic losses, it has been classified as having a high hazard potential.

The dam is judged to be in generally good condition. Minor seepage is evident at the downstream toe of the dam. There is some cracking of the concrete in the discharge channel, but overall the dam has few deficiencies. The spillway discharge channel has been partly blocked by a structure which diverts water to the downstream pond. The low walls of the discharge channel would likely be overtopped during high spillway discharges.

Based upon an intermediate size and high hazard classification, in accordance with the "Recommended Guidelines for Safety Inspection of Dams", the recommended test flood is the full PMF. The test flood inflow is 6,250 cfs. The routed test flood outflow of 5,875 cfs would overtop the dam by 1.4 ft. While the spillway is adequate to pass an outflow corresponding to about 36 percent of the routed test flood outflow without overtopping the dam, the spillway chute walls would be overtopped.

Within two years after receipt of this Phase I Inspection Report, the owner, the City of Manchester, should retain the services of a registered professional engineer to make further investigations, and should implement his recommendations. These studies should cover: (1) whether modifications to the dam and/or spillway are required to improve the ability of the facility to handle high inflows, (2) whether spillway discharge channel modifications are required to forestall possible overtopping of the walls, and (3) possible elimination of use of flashboards, or modifications to facilitate their quick removal.

The owner should also implement the following operating and maintenance measures: (1) remove flashboards and discontinue their use until completion of studies in (1) above; (2) repair cracks in the concrete outlet headwall; (3) repair cracks in spillway discharge channel walls and bottom slab; (4) monitor seepage quantity and clarity from toe drains at least once a year; (5) develop a formal surveillance and flood warning plan; and (6) institute procedures for a biennial periodic technical inspection of the dam and apputenenant works.

Peter B. Dyson
Project Manager

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

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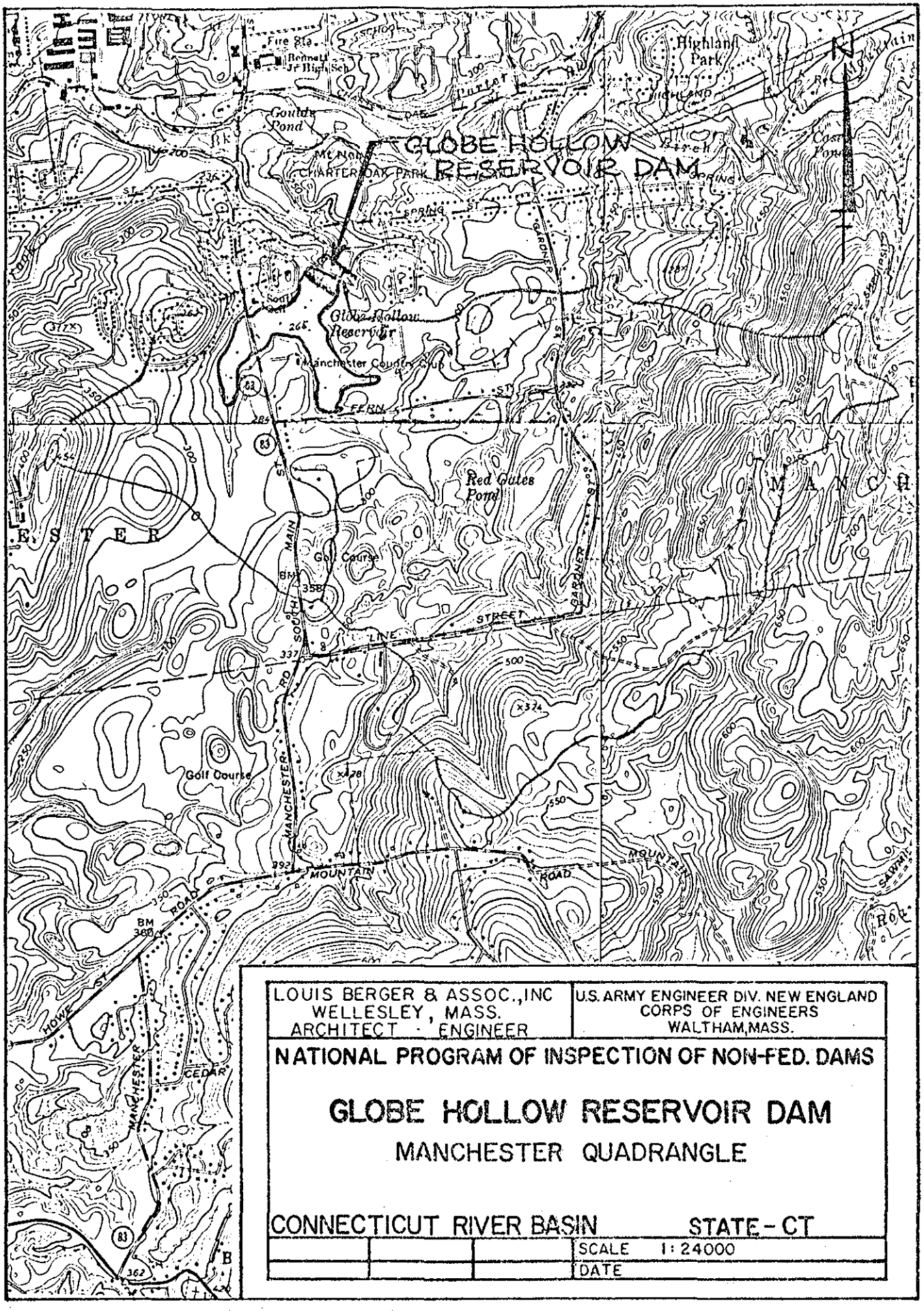
Overview of Dam from Left Abutment



LOUIS BERGER & ASSOC., INC WELLESLEY, MASS. ARCHITECT · ENGINEER	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

GLOBE HOLLOW RESERVOIR DAM

MANCHESTER QUADRANGLE

CONNECTICUT RIVER BASIN STATE - CT

			SCALE 1:24000
			DATE

PHASE I INSPECTION REPORT

GLOBE HOLLOW RESERVOIR DAM CT 00012

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. Louis Berger & Associates, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Connecticut. Authorization and notice to proceed was issued to Louis Berger & Associates, Inc. under a letter of 19 March 1979 from John P. Chandler, Colonel, Corps of Engineers. Contract No. DACW33-79-C-0051 has been assigned by the Corps of Engineers for this work.

b. Purpose.

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

(2) Encourage and 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. Globe Hollow Reservoir Dam is located in the City of Manchester, Hartford County, Connecticut. The dam is reached via South Main Street (State Highway 83) and Spring Street. The dam is situated near the headwaters of the Hop Brook which flows from Globe Hollow Reservoir to the South Fork River. The South Fork River is a tributary of the Hockanum River which joins the Connecticut River about 8 miles downstream near Hartford, Connecticut. The normal storage level of the reservoir is 265 MSL, while the confluence of Hop Brook and the South Fork River about 2.5 miles downstream is about 105 MSL. The dam is shown on U.S.G.S. Quadrangle, Manchester, Connecticut, with coordinates approximately at N41°45'23", W72°30'58".

b. Description of Dam and Appurtenances

(1) Description of Dam. Globe Hollow Reservoir Dam is a 40 ft. high and about 620 ft. long, zoned earth embankment having a central masonry core. The upstream slope is 2 horizontal to 1 vertical and the downstream slope is 2-1/4 horizontal to 1 vertical. The crest of the dam is 15 ft. wide. The masonry core is founded on bedrock through the middle portion of the dam and on natural soil in each abutment area. In the abutment areas a wooden sheet pile wall has been installed through the natural soil from the bottom of the core wall to the top of rock. The masonry core wall is offset 7-1/2 ft. upstream from the centerline of the dam making it coincident with the crest of the upstream slope. The upstream portion of the embankment consists of an impervious material overlain by a coarse gravel layer which is faced with hand-placed riprap. The downstream portion of the embankment is more pervious and consists mostly of sand, several layers of gravel, small stone and then gravel again. Sod has been placed on the donwstream slope. The toe of the center portion of the dam is faced with riprap on the downstream side. There is a 6 in. dia. open-joint toe drain pipe located on either side of the downstream riprapped face which outlets onto the riprap.

(2) Spillway. The spillway for Globe Hollow Reservoir Dam is located near the right abutment. It is a 35 ft. wide, concrete, ogee crested weir with provision for 14 in. flashboards. The downstream concrete chute and discharge channel is about 190 ft. long and outlets onto a 30 ft. by 30 ft. riprap splash pad. Just below the ogee crest, the chute bends towards the center of the dam and converges from a 35 ft. width to a width of 10 ft.. About one third of the way down the chute, a rectangular weir has been constructed across the spillway with an opening about 35 in. high and 44 in. wide. Adjacent to the weir there is a pipe inlet for diverting part of the flow from the spillway to a pond located at the toe and to the right of the dam, used as a Municipal swimming pool.

(3) Outlets. The outlet for this project is located on the left side of the dam, where a wet well and gate house contain controls for regulating the flow in two 24 in. dia. inlet pipes and two 24 in. dia. outlet pipes. The intake pipes are at elevations 235 MSL and 250 MSL. Both outlet pipes are located on the floor of the wet well at elevation 234.5 MSL and can serve as blowoff pipes. One outlet pipe leads directly to the headwall, located at the toe of the dam, and is controlled by a 24 in. gate and valve in the gate house. The other outlet pipe has a "Y-STEM" in it located between the gate house and the headwall, and flows from this pipe can be directed either into the Manchester water distribution system or diverted through the outlet headwall. This line has a 24 in. gate and valve controlled from the gate house and another valve located just downstream of the "Y" for controlling flows to the blowoff outlet. There are also trashracks located in the wet well and gate house.

c. Size Classification. The Globe Hollow Reservoir Dam is about 40 ft. high, impounding a storage of about 545 acre-ft. to spillway crest level and about 842 acre-ft. to top of dam. In accordance with size and capacity criteria promulgated in the Recommended Guidelines for the Safety Inspection of Dams, the project is categorized in the intermediate classification.

d. Hazard Classification. A breach failure of the dam at Globe Hollow Reservoir would release water down Hop Brook. Immediately downstream of the dam a small retention dam forms a pond used for recreational activities. A structural failure of the Globe Hollow Reservoir Dam would result in extensive damage to this recreational facility. The flood wave would inundate the entire area and overtop the small retention dam which would then probably fail. Approximately 800 ft. downstream of Globe Hollow Dam, the Hop Brook passes under Spring Street. It is estimated that a flood stage of up to 20 ft. could be reached in this area. It is therefore anticipated that the roadway would be washed out and that two houses would be damaged by the high waters, with the possible loss of more than a few lives. At a point about 1,200 ft. futher downstream Hop Brook passes through a culvert under the interchange of U.S. Route 6 and South Main Street (State Highway 83). Though considerable erosion and damage to the ramps and culvert may be anticipated, the interchange should serve to retain the flood flows, thus protecting the downstream roadways and structures from damage. Consequently Globe Hollow Reservoir Dam has been classified as having high hazard potential in accordance with the Recommended Guidelines for the Safety Inspection of Dams.

e. Ownership. The dam is owned by the City of Manchester, Connecticut.

f. Operator. Mr. Frank T. Jodiatis, P.E., Administrator, Water and Sewer Department, City of Manchester, 105 N. Main Street, Manchester, Ct. Telephone: (203) 647-3113.

g. Purpose of Dam. The Globe Hollow Reservoir Dam is operated in conjunction with Porter Reservoir, Howard Reservoir, and other water storage facilities to supply municipal water to the City of Manchester.

h. Design and Construction History. The construction plans for Globe Hollow Reservoir Dam were prepared in 1906 by Coffin and Thorpe, 45 Cornhill Street, Boston, Mass. and by Desmond Fitzgerald, Consulting Engineer, also of Boston. It is not known for certain by whom the dam was constructed. However, discussions with local officials indicate that the original owners of the dam, Cheney Brothers of South Manchester, may well have constructed the dam.

i. Normal Operating Procedure. There are no written operating procedures. Water is released from the reservoir through a 24 in. dia. pipe directly into the City of Manchester's water treatment facilities and thence into the water distribution system. Operation of the outlet gate is not a day-to-day procedure. There is a valve on the 24 in. dia. line for diverting flows to a blowoff outlet during an emergency situation. There is also a second 24 in. dia. blowoff.

1.3 Pertinent Data

a. Drainage Area. The drainage area contributing to Globe Hollow Reservoir is situated near the headwaters of Hop Brook. The drainage area encompasses a total of 2.24 sq. mi. (1,432 acres) of which 38 acres are occupied by the reservoir. The longest circuitous stream course contributing to the reservoir

is about 12, 000 ft. long, with an elevation difference of about 435 ft. or at a slope of about 191 ft. per mile. The drainage area has a length of about 1.8 miles and a maximum width of about 1.9 miles, with an average width of about 1.3 miles. The basin is partly forested with several open fields and the terrain is best described as hilly. It is sparsely populated in the upper reaches and heavily populated in the lower reaches.

b. Discharge at Damsite

(1) Outlet Works Conduit. Discharges at Globe Hollow Reservoir are provided for by two 24 in. dia. pipes. One of the pipes is used either as a direct feed to the city distribution system or as a blowoff pipe discharging into the Hop Brook at the toe of the dam. The other pipe functions as a blowoff pipe only. Both pipes lead from the bottom of a wet well shaft where control gates and valves for both the outlet and inlet pipes are located. The invert elevation of the outlet pipes at the gate house is 234.5 MSL. When both outlet pipes function as blowoff pipes, the capacity of the pipes is about 130 cfs with the water surface at test flood elevation and about 126 cfs with the water surface at top of dam.

(2) Maximum Known Flood at Damsite. No records are available of flood inflows into Globe Hollow Reservoir, nor of spillway releases and surcharge heads during such inflows.

(3) Ungated Spillway Capacity at Top of Dam. The spillway at the reservoir is an ungated ogee weir with provision for flashboards. The total spillway capacity at top of dam elevation 271.0 MSL is 2,120 cfs, assuming that flashboards are not installed. When flashboards are installed the total spillway capacity at top of dam is 1,215 cfs.

(4) Ungated Spillway Capacity at Test Flood Elevation. The ungated spillway capacity is about 2,900 cfs at test flood elevation 272.4 MSL, assuming that flashboards are not installed.

(5) Gated Spillway Capacity at Normal Pool Elevation. Not applicable.

(6) Gated Spillway Capacity at Test Flood Elevation. Not applicable.

(7) Total Spillway Capacity at Test Flood Elevation. The total spillway capacity at the test flood elevation is the same as (4) above, 2,900 cfs at elevation 272.4 MSL, assuming that flashboards are not installed.

(8) Total Project Discharge at Test Flood Elevation. The spillway is inadequate to handle the test flood and the dam would be overtopped by about 1.4 ft. at elevation 272.4. The total discharge through the spillway and over the dam would be about 5,875 cfs., assuming that flashboards are not installed.

c. Elevations (Ft. above MSL)

(1) Streamed at centerline of dam - 231 (+)

(2) Maximum tailwater - Not available

(3) Upstream invert of outlet pipe - 234.5

(4) Recreational Pool - Not applicable

(5) Full flood control pool - Not applicable

(6) Ungated spillway crest - 265.0 (without flashboards)
266.2 (with flashboards)

(7) Design surcharge (original design) - Unknown

(8) Top of dam - 271.0

(9) Test flood design surcharge - 272.4

d. Reservoir

(1) Length of maximum pool - 2,800 ft.

(2) Length of recreation pool - Not applicable

(3) Length of flood control pool - Not applicable

e. Storage (acre-ft.)

(1) Recreation pool - Not applicable

(2) Flood control pool - Not applicable

(3) Spillway crest pool El. 265.0 - 545

(4) Top of dam El. 271 - 842

(5) Test flood pool El. 272.4 - 935

f. Reservoir Surface (acres)

(1) Recreation pool - Not applicable

(2) Flood control pool - Not applicable

(3) Spillway crest El. 265.0 - 38.0

(4) Top of dam El. 271.0 - 61.0

(5) Test flood pool El. 272.4 - 67.0

g. Dam

(1) Type - Zoned earthfill embankment

(2) Length - 620 ft.

(3) Height - 40 ft.

(4) Top width - 15 ft.

(5) Side slopes - Upstream 2 horizontal to 1 vertical
Downstream 2¼ horizontal to 1 vertical

(6) Zoning - Upstream - impervious material, overlain by gravel, then broken stone and then riprap.
Downstream - pervious material, sand, gravel, stones, overlain with sod.

(7) Impervious core - Masonry core wall

(8) Cutoff - Below and adjacent to the core wall, a 6 in. wood sheet pile wall driven to varying depths at the left and right abutments, which is carried to bedrock.

(9) Grout curtain - Unknown

(10) Other - Not applicable

h. Diversion and Regulating Tunnel - None

i. Spillway

(1) Type - Ungated ogee weir with provision for 14 in. flashboards

(2) Length of weir - 35 ft.

(3) Crest elevation - 265.0 MSL

(4) Gates - None

(5) Upstream channel - 6 ft. concrete training walls with riprap on right side.

(6) Downstream channel - 2 ft. high concrete training walls and concrete floor converging from a 35 ft. wide chute to a 10 ft. wide chute about 70 ft. below weir. At this point a diversion weir has been constructed across the chute for purposes of regulating flow to a recreation pond at the toe of the dam. The main spillway chute outlets onto a 30 ft. by 30 ft riprap pad.

(7) General - Not applicable

j. Regulating Outlets

(1) Invert - 234.5 MSL

(2) Size - two 24 in. dia. inlet pipes
- two 24 in. dia. outlet pipes

(3) Description - Cast iron pipes, one pipe leads either to treatment plant and distribution system or to blowoff headwall regulated by a "Y" and valve just upstream of outlet headwall, the other line leads directly to outlet headwall.

(4) Control Mechanism - 24 in. gate valves in line in wet well at gate house, with control hoists for all four pipes.

(5) Other - Not applicable

SECTION 2 - ENGINEERING DATA

2.1 Design Data

The Globe Hollow Reservoir Dam and appurtenances were designed by Coffin and Thorpe, Designing Engineers, and Desmond Fitzgerald, Consulting Engineer, of Boston, Massachusetts. The construction plans were prepared in 1906 and are on file at the City of Manchester, Water and Sewer Department offices. The drawings show complete details of the designs and layouts, half-scale copies are included in Appendix B.

2.2 Construction Data

No records or correspondence regarding construction have been found.

2.3 Operation Data

The dam is operated by the City of Manchester, Water and Sewer Department. There appear to be no formal records other than reservoir levels.

2.4 Evaluation of Data

a. Availability. Since little engineering data is available, it is not possible to make an assessment of the safety of the dam. The basis of the information presented in this report is principally the visual observations of the inspection team.

b. Adequacy. The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past performance history and sound engineering judgement.

c. Validity. The validity of such engineering data as has been acquired is considered acceptable and is not challenged.

SECTION 3 - VISUAL INSPECTION

3.1 Findings

a. General. The visual inspection of Globe Hollow Reservoir Dam took place on 9 April and 10 May 1979. The reservoir was at about elevation 265.2 MSL. The dam was judged to be in generally good condition, except for concrete in the spillway structure, which is in fair condition. There was no evidence of any major problems, but a number of items require attention (see Section 7).

b. Dam. Globe Hollow Reservoir Dam is an earthfill embankment about 40 ft. high, 620 ft. long and has a crest width of about 15 ft. The horizontal and vertical alignment of the embankment is good. The upstream slope is about 2 horizontal to 1 vertical and the downstream slope is about 2-1/4 horizontal to 1 vertical.

The upstream slope is faced with hand-placed rock riprap which extends to within 1.5 ft. of the dam crest. The riprap is in generally good condition with no evidence of sags or bulges. The downstream toe of the embankment contains a drainage zone of coarse riprap which also appears to be in good condition. At each end of this riprap there are 6 in. dia. cast iron drain pipes extending from the toe of the dam. It was estimated that the discharge from the left pipe was about 0.05 gpm, while the right pipe had essentially no discharge, with just a few drops coming out of it. There was some minor seepage along the toe of the embankment, about 30 ft. right of the right toe drain pipe, where the dam intersects natural ground, estimated to be less than 1 to 2 gpm. There was one small rodent hole about 4 in. dia. and 18 in. deep located approximately 50 ft. right of the right toe drain outlet pipe, at the intersection of the toe drain with natural ground. (See Photo Nos. 1 and 2, Appendix C).

c. Appurtenant Structures. The spillway channel at the right abutment of the dam has a 35 ft. wide ogee crested weir with concrete training walls extending 6 ft. above the spillway crest to elevation 271 MSL. Old wooden flashboards were fixed to the left half of the weir. In general the spillway concrete is in fair condition. The discharge channel is about 190 ft. long and generally appears to be in fair condition. The channel training walls are about 2 ft. high, except in the vicinity of the bend, where the right wall has been raised locally at some time after original construction, presumably to forestall overtopping. (See Photo Nos. 5 and 6, Appendix C). At the right training wall of the channel approximately 40 ft. downstream of the crest, some minor deterioration of the concrete has occurred. There are some settlement cracks in the floor of the discharge channel which generally follow the construction joints. (See Photo Nos. 3,4,5 and 6, Appendix C).

A rectangular weir is located about 75 ft. downstream of the ogee crest with an opening of about 35 in. high and 44 in. wide. This weir is a fairly recent

modification to the spillway chute for purposes of diverting water via a pipe located to the right of the weir to the recreational pool located at the toe and to the right of the dam.

The gate house over a wet well in the center of the dam contains controls for regulating flows in four 24 in. dia. pipes (2 inlet and 2 outlet). Controls for four 24 in. valves and gates are located in the gate house. The gate house is in generally good condition with some minor deterioration of the concrete. Trashracks are provided in the wet well. Manchester City official indicated that all controls were operative and in good condition. (See Photo Nos. 7 and 8, Appendix C). One 24 in. dia. outlet pipe leads directly to the outlet headwall, the other outlet pipe can either distribute water to the treatment plant or to the outlet headwall. There is a crack in the outlet headwall concrete to the right of the right pipe. Seepage estimated at less than 0.1 gpm was issuing from the right cast iron pipe.

d. Reservoir Area. The shoreline of the reservoir upstream of the dam appeared stable. No evidence of slides or other problems were noted. Globe Hollow reservoir is divided into two reservoirs by the South Main Street roadway embankment which traverses across the western part of the reservoir. A 6 ft. by 6 ft. arched culvert, 60 ft. long passes under the roadway. About 36 ft. of the culvert is of masonry construction and about 24 ft. is constructed of concrete. The water surface elevation of the western reservoir is about 5 ft. higher than the eastern reservoir.

e. Downstream channel. Hop Brook flows from Globe Hollow Reservoir through a residential area to its confluence with South Fork River about 2.5 miles downstream of the dam. Immediately below the dam there is a recreational swimming pool owned by the city. Water in the pool is retained by a small dam just upstream of Spring Street. About 1,200 ft. beyond Spring Street, Hop Brook passes under the interchange of U.S. Route 6 and South Main Street (State Highway 83). Beyond the interchange the brook has been rechanneled along the north side of U.S. Route 6. There are two houses, a local roadway and a major interchange that would be inundated by high flows in the reach between the dam and its confluence with the South Fork.

3.2 Evaluation

The visual inspection has adequately revealed key characteristics of the dam as they may relate to its stability and integrity. The dam and appurtenant works are judged to be in generally good condition. The concrete in the spillway structure, particularly in the discharge channel walls, is only in fair condition. The diversion structure in the discharge channel, which feeds water to the downstream swimming pool, is an obstruction to high flows which could cause the low side training walls to be overtopped. The dam embankment and riprap slope protection appear to be in good condition and adequately maintained. All outlet controls are reported to be operative.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures

Globe Hollow Reservoir and Dam are operated by personnel of the City of Manchester, Water and Sewer Department. Reservoir operation entails mainly the release of stored water from the reservoir to the City's water treatment and distribution system facilities. Day-to-day regulation of the outlet valve is not required. However, the reservoir is visited at least once a day by reservoir patrolmen. No documented operating procedures were disclosed.

4.2 Maintenance of Dam

Globe Hollow Reservoir Dam is maintained by the City of Manchester. Maintenance consists mainly of periodic cutting of brush growth on the crest of the dam and the slopes of the embankment. No documented maintenance instructions were disclosed.

4.3 Maintenance of Operating Facilities

No written maintenance procedures were disclosed. The gate and valve operating mechanisms require periodic maintenance to keep them operative.

4.4 Description of Any Warning System in Effect

No warning system is in effect at Globe Hollow Reservoir.

4.5 Evaluation

Although little is known about the construction of the facility, it has simple operating devices and, though undocumented, operating and maintenance procedures appear to be adequate. Maintenance involves periodic growth removal from the embankment and surveillance regarding seeps, slope damage, animal burrows etc. The outlet operating devices require checking and, repairs should be made as needed. The trashracks should be cleaned as necessary. A formal warning system should be developed.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. General. Globe Hollow Reservoir is an earthfill embankment, impounding a normal storage of about 545 acre-ft., with provision for an additional 297 acre-ft. of capacity in its surcharge space to the top of the dam. It is basically a low spillage - low surcharge facility used for water supply purposes. The 35 ft. wide spillway, which consists of a modified ogee weir with provision for flashboards, is capable of discharging 2,120 cfs with surcharge to the top of the dam. The downstream training walls are only about 2 ft. high and would probably be overtopped during periods of high flow. This could lead to a washout of the spillway and to erosion of the toe of the dam embankment.

The general topographic characteristic of the 2.24 sq. mi. (1,432 acres) drainage area is hilly with elevations ranging from 265 MSL at the spillway crest to elevation 720 MSL in the upper regions. Ground cover is a mixture of forested areas and residential developments, with a golf course and country club adjacent to the reservoir.

b. Design Data. There is no design data available for this dam.

c. Experience Data. No records are available in regard to past operation of the reservoir, nor of surcharge encroachments and flows through the spillway. The maximum past inflows are unknown.

d. Visual Observations. There is no visible evidence either along the reservoir or in the downstream channel to indicate high water levels or signs of major spillway outflows. No one contacted could recollect any such occurrences.

e. Test Flood Analysis. Reservoir area and capacity curves and tables, for use in flood routings, are shown on Sheet D-1 and Fig. 1, Sheet D-2, Appendix D. For determining surface areas and surcharge capacities, planimetered areas were taken from contours delineated on USGS 2,000 ft. per in. quadrangle sheets.

The test flood chosen to evaluate the hydraulic and hydrologic capacity of Globe Hollow Reservoir Dam was selected in accordance with the criteria presented in the Recommended Guidelines for Safety Inspection of Dams. Since this dam is classified as intermediate in size with a significant hazard potential, the range of test floods is ½ PMF to PMF. Because an interchange between a U.S. Highway and State Highway would be affected, the full PMF test flood was selected.

Precipitation data were obtained from Hydrometeorological Report No. 33, which for the Connecticut area approximates 24.0 in. of 6 hour point rainfall over a 10 square mile area. This value was then reduced by 20 percent to allow for basin size, shape and fit factors. The 6 hour rainfall was distributed into one hour incremental periods as suggested in COE Publication EC 1110-2-1411.

A triangular incremental unitgraph was assumed for the inflow hydrographs, using a computed lag time value of 2.0 hours to derive a time-to-peak for the triangular hydrograph of 2.0 hours (see computations on Sheets D-3 and D-6, Appendix D). A PMF inflow hydrograph is shown on Fig. 2, Sheet D-7, Appendix D, indicating a peak inflow of about 6,250 cfs or a CSM of about 2,790.

Discharge tables and curves for the spillway and for over the top of the dam are shown on Sheets D-8 and D-9 and Fig. 3 Sheet D-10, Appendix D. Because of their small capacity, the effect of the outlet pipes was neglected. The spillway capacity at top of dam, elevation 271.0 MSL, is 2,120 cfs, assuming that flashboards are not installed. When both 24 in. outlet pipes function as blowoff pipes their combined capacity is 130 cfs with the water surface at test flood elevation and about 126 cfs with the water surface at top of dam.

Flood routings were performed for both ½ and full PMF. Results of these routings are shown on Sheets D-11 and D-12 and are summarized as follows:

Flood Magnitude	Max. Routed Outflow cfs	Max. Res. El. ft. MSL	Max. Head Over Dam ft.
½ PMF	2,400	271.2	0.2
PMF (Test Flood)	5,875	272.4	1.4

From the above table, it can be seen that the project will not pass the routed test flood outflow without overtopping the dam by 1.4 ft. The project, however, can handle 36% of the routed test flood outflow without overtopping the dam.

It should be noted that, while the spillway opening could theoretically handle about 36% of the routed test flood outflow, it is doubtful whether the discharge channel could handle such a flow. The 2 ft. high training walls lining the spillway chute would probably be overtopped during high flows, especially in the vicinity of the swimming pool diversion weir. Overtopping of these walls could result in erosion of the downstream toe of the dam, a washout of the spillway and chute, and possible undermining of the dam embankment.

It should also be noted that Globe Hollow Reservoir is separated into two reservoirs by the South Main Street roadway embankment. A 6 ft. by 6 ft. arched culvert with a drop inlet control passes under the roadway. The water surface elevation of the western reservoir is about 5 ft. higher than the eastern reservoir. The normal storage capacity of the western reservoir

is estimated at about 70 acre-ft. with a drainage area of 0.36 sq. mi. or about 16 percent of the total drainage area. A preliminary analysis of this culvert control was made. A rating curve for the culvert was developed assuming different stages in the two reservoirs. (see Appendix D, Fig. 5, Sheet D-19). From this rating curve it was estimated that an average inflow of 150 cfs might be expected from the western reservoir during the test flood. A test flood inflow hydrograph was developed for the eastern reservoir drainage area with a constant inflow of 150 cfs from the western reservoir. This analysis reduced the routed test flood outflow by about 14 percent, or 920 cfs, but still resulted in the dam being overtopped. However, for a ½ PMF event the water surface would crest at about the top of the dam.

Drawdown of the reservoir is possible through two 24 in. dia. pipes.

F. Dam Failure Analysis. As discussed above, the dam would be overtopped by the routed test flood outflow. Also, a breach owing to structural failure of the dam by piping or sloughing is a possibility. A breach from overtopping was assumed with the water level at the top of dam. The "rule of thumb" criteria suggested in the NED March 1978 Guidance Report was used for the breach analysis. With a breach width of 40 percent of the dam length at mid-height, or 136 feet, an outflow of about 57,850 cfs would be realized. (See Sheets D-13 thru D-18, Appendix D).

Immediately downstream of the Globe Hollow Reservoir Dam there is a small dam and retention pond used for recreational activities. Structural failure of the main dam embankment would result in extensive damage to this recreational facility, inundating the entire area and probably causing the small retention dam to fail.

Approximately 800 ft. downstream, the Hop Brook passes under Spring Street. Stage discharge computations indicate flood depths of up to 20 ft. at this crossing. This stage would be about 16 ft. higher than the brook's stage just prior to failure of the dam and would wash out the roadway and flood two adjacent dwellings by about a 7 ft. to 10 ft. depth.

Further downstream or a point about 1,200 ft. from the Spring Street crossing, the Hop Brook intersects with the southeast cloverleaf of the U.S. Route 6/ South Main Street interchange, where the brook is culverted through the interchange to the west side of South Main Street. Though considerable erosion and damage to the ramps and culvert may result, the interchange would serve to retain the flood outflow, protecting downstream roadways and structures from damage. (See Fig. 6, Sheet D-22, Appendix D).

SECTION 6 - STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. The field investigation revealed no significant displacements or distress that would warrant the preparation of stability computations based on assumed soil properties and engineering factors.

b. Design and Construction Data. No plans or calculations of value to a stability assessment are available for the dam.

c. Operating Records. There are no records which indicate the manner in which the dam has been operated.

d. Post Construction Changes. There are no records of any post construction changes made to the dam over the course of its history. However, a weir and intake pipe have been constructed in the spillway chute to control flow into the lower recreational reservoir.

e. Seismic Stability. The dam is located in seismic Zone No. 1 and in accordance with recommended Phase I Guidelines does not warrant seismic analysis.

SECTION 7
ASSESSMENT, RECOMMENDATIONS & REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. On the basis of the Phase I visual examination, Globe Hollow Reservoir Dam appears to be in generally good condition at the present time. The principal areas for concern are the inadequacy of the spillway and the potential for the spillway discharge channel to wash out from overtopping during high flood outflows, threatening the integrity of the dam.

b. Adequacy of Information. The lack of in-depth engineering data does not permit a definitive review. Therefore, the adequacy of the dam cannot be assessed from a standpoint of reviewing design and construction data. This assessment is based primarily on the visual inspection, past performance, and sound engineering judgement.

c. Urgency. The recommendations and remedial measures enumerated below should be implemented by the owner within two years after receipt of this Phase I Inspection Report.

d. Need for Additional Investigations. Additional investigations are required as recommended in Para. 7.2.

7.2 Recommendations

It is recommended that the owner retain the services of a competent registered professional engineer to make investigations and studies of the following, and if proved necessary, to design appropriate remedial works:

(1) Conduct a thorough study of the hydrology of the drainage basin and further evaluate the spillway adequacy and potential for overtopping of the dam.

(2) Review flow conditions in the spillway discharge channel, particularly in the vicinity of the recreational pool diversion weir, and determine whether modifications are required to forestall possible overtopping of the walls.

(3) Review the use of flashboards on the spillway crest and determine the feasibility of either eliminating their use altogether, or modifying them to facilitate quick removal in anticipation of a storm.

7.3 Remedial Measures

a. Operation and Maintenance Procedures.

(1) Pending completion of the review of the use of flashboards recommended in Section 7.2, remove flashboards installed on half the spillway weir, because of apparent spillway inadequacy and the potential for overtopping of the dam, and leave them removed.

(2) Repair cracks in the concrete outlet headwall.

(3) Repair cracks in spillway discharge channel training walls and bottom slab.

(4) Monitor seepage quantity and clarity from toe drains at least once a year.

(5) Backfill rodent holes and monitor the embankment for new burrows.

(6) Develop a formal surveillance and flood warning plan.

(7) Institute procedures for a biennial periodic technical inspection of the dam and appurtenant works.

7.4 Alternatives

There are no practical alternatives to the above recommendations.

APPENDIX A

INSPECTION CHECKLIST

VISUAL INSPECTION CHECKLIST
PARTY ORGANIZATION

PROJECT Globe Hollow Reservoir Dam

DATE 9 April & 10 May 1979

TIME 9:00 AM

WEATHER Rain (4/9) - Sunny (5/10)

W.S. ELEV. 265.2 U.S. N/A DN.S.

PARTY:

1. Peter B. Dyson
2. Pasquale E. Corsetti
3. Roger F. Berry
4. Carl J. Hoffman
5. William S. Zoino
6. Frank T. Jodiatis
7. Robert Young
8. Walter Senkow
9.
10.

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Hydrologic	Roger F. Berry	
2.	Hydraulics/Structures	Carl J. Hoffman	
3.	Soils and Geology	William S. Zoino	
4.	General Features	Peter B. Dyson	
5.	General Features	Pasquale E. Corsetti	
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECKLIST

PROJECT Globe Hollow Reservoir Dam DATE 9 April & 10 May 1979

PROJECT FEATURE Embankment NAME W. Zoino

DISCIPLINE Soils/Structures NAME C. Hoffman

AREA EVALUATED	CONDITIONS
DAM: EMBANKMENT	
Crest Elevation	271.0 MSL
Current Pool Elevation	265.2 MSL
Maximum Impoundment to Date	Unknown
Surface Cracks	None
Pavement Condition	None
Movement or Settlement of Crest	None
Lateral Movement	None
Vertical Alignment	Good
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	Minor erosion of D/S slope right of right spillway training wall
Indications of Movement of Structural Items on Slopes	None
Trespassing on Slopes	Minor at right spillway training wall D/S slope
Sloughing or Erosion of Slopes or Abutments	None
Rock Slope Protection - Riprap Failures	Good Condition
Unusual Movement or Cracking at or near Toes	None
Unusual Embankment or Downstream Seepage	Toe drain pipes less than 0.1 GPM each.
Piping or Boils	None
Foundation Drainage Features	Two 6 in. dia. pipes both functioning
Toe Drains	Same as above
Instrumentation System	None

PERIODIC INSPECTION CHECKLIST

PROJECT Globe Hollow Reservoir Dam DATE 9 April & 10 May 1979

PROJECT FEATURE Gate House NAME C. Hoffman

DISCIPLINE Structures NAME

AREA EVALUATED	CONDITIONS
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural	
General Condition	Fair
Condition of Joints	Fair - minor deterioration
Spalling	Yes - minor
Visible Reinforcing	None visible
Rusting or Staning of Concrete	Minor
Any Seepage or Efflorescence	None visible
Joint Alignment	Good
Unusual Seepage or Leaks in Gate Chamber	N/A
Cracks	Minor surface cracks
Rusting or Corrosion of Steel	N/A
b. Mechanical and Electrical	N/A
Air Vents	
Float Wells	
Crane Hoist	
Elevator	
Hydraulic System	
Service Gates	
Emergency Gates	
Lighting Protection System	
Emergency Power System	
Wiring and Lighting System in Gate Chamber	

PERIODIC INSPECTION CHECKLIST

PROJECT Globe Hollow Reservoir Dam DATE 9 April & 10 May 1979

PROJECT FEATURE Outlet Conduit NAME C. Hoffman

DISCIPLINE Structures NAME

AREA EVALUATED	CONDITIONS
OUTLET WORKS - TRANSITION AND CONDUIT	
General Condition of Concrete	2 - Cast Iron Pipes
Rust or Staining on Concrete	N/A
Spalling	N/A
Erosion or Cavitation	N/A
Cracking	Cracking on Headwall only
Alignment of Monoliths	N/A
Alignment of Joints	N/A
Numbering of Monoliths	N/A

PERIODIC INSPECTION CHECKLIST

PROJECT Globe Hollow Reservoir Dam DATE 9 April & 10 May 1979

PROJECT FEATURE Spillway NAME C. Hoffman

DISCIPLINE Hydraulics/Structures NAME

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	
General Condition	fair
Loose Rock Overhanging Channel	No
Trees Overhanging Channel	Yes
Floor of Approach Channel	Sloped paving
b. Weir and Training Walls	
General Condition of Concrete	Fair
Rust or Staining	Yes
Spalling	Yes
Any Visible Reinforcing	No
Any Seepage or Efflorescence	Yes
Drain Holes	None
c. Discharge Channel	
General Condition	fair
Loose Rock Overhanging Channel	No
Trees Overhanging Channel	No
Floor of Channel	Concrete pavement, minor settlement cracks
Other Obstructions	

PERIODIC INSPECTION CHECKLIST

PROJECT Globe Hollow Reservoir Dam DATE 9 April & 10 May 1979

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITIONS
- Dike Embankment	NA
- Outlet Works - Intake Channel and Intake Structure	NA
- Outlet Works - Outlet Structure and Outlet Channel	NA
- Service Bridge	NA

APPENDIX B

ENGINEERING DATA

Globe Hollow Reservoir

Cheney Dam, South Manchester, Conn.

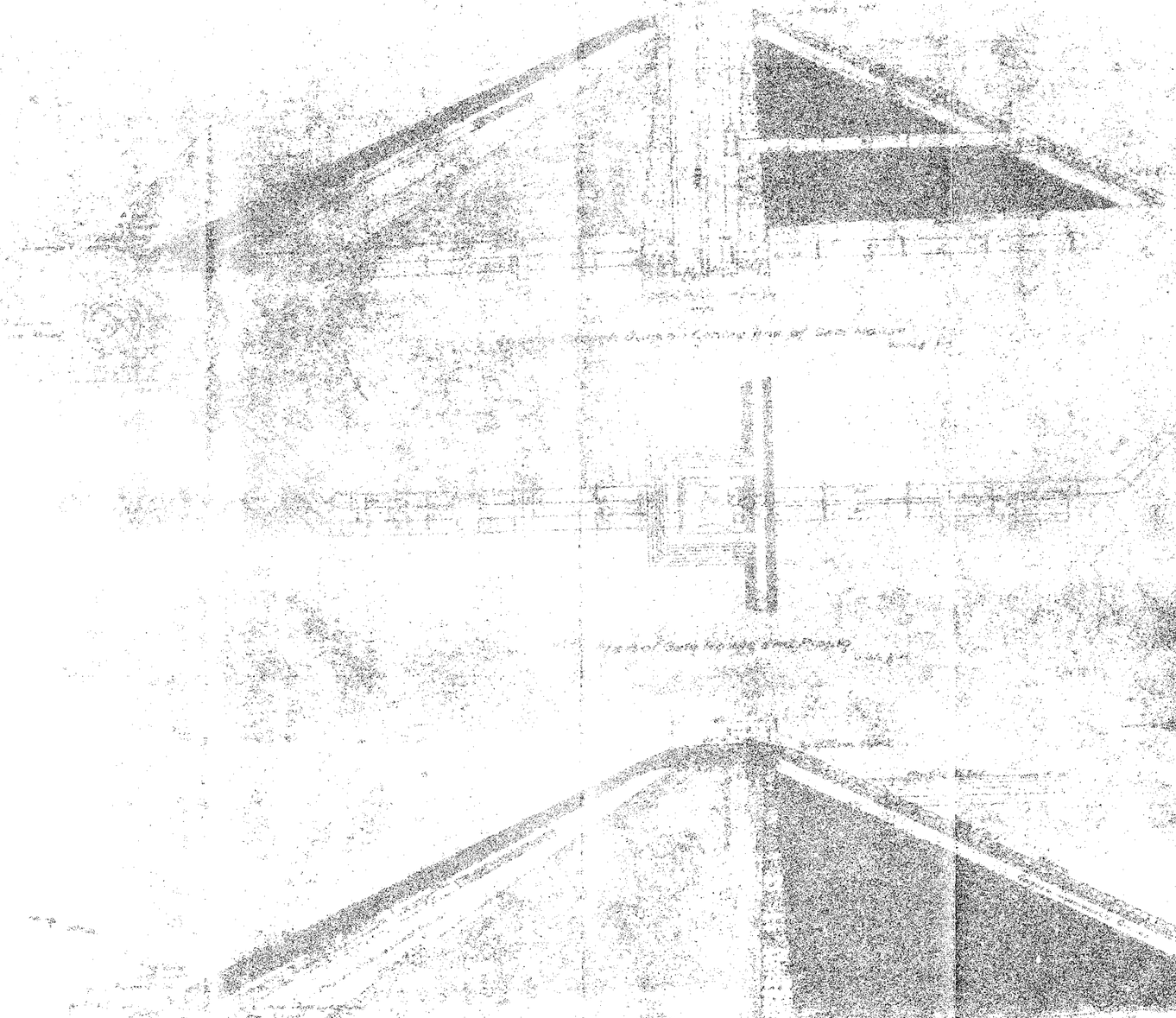
DRAWINGS OF DAM

Scale: 1" = 20' Nov. 1906

GLOBE HOLLOW RESERVOIR

Cheney Bros. South Manchester, Conn.

DRAWINGS OF DAM

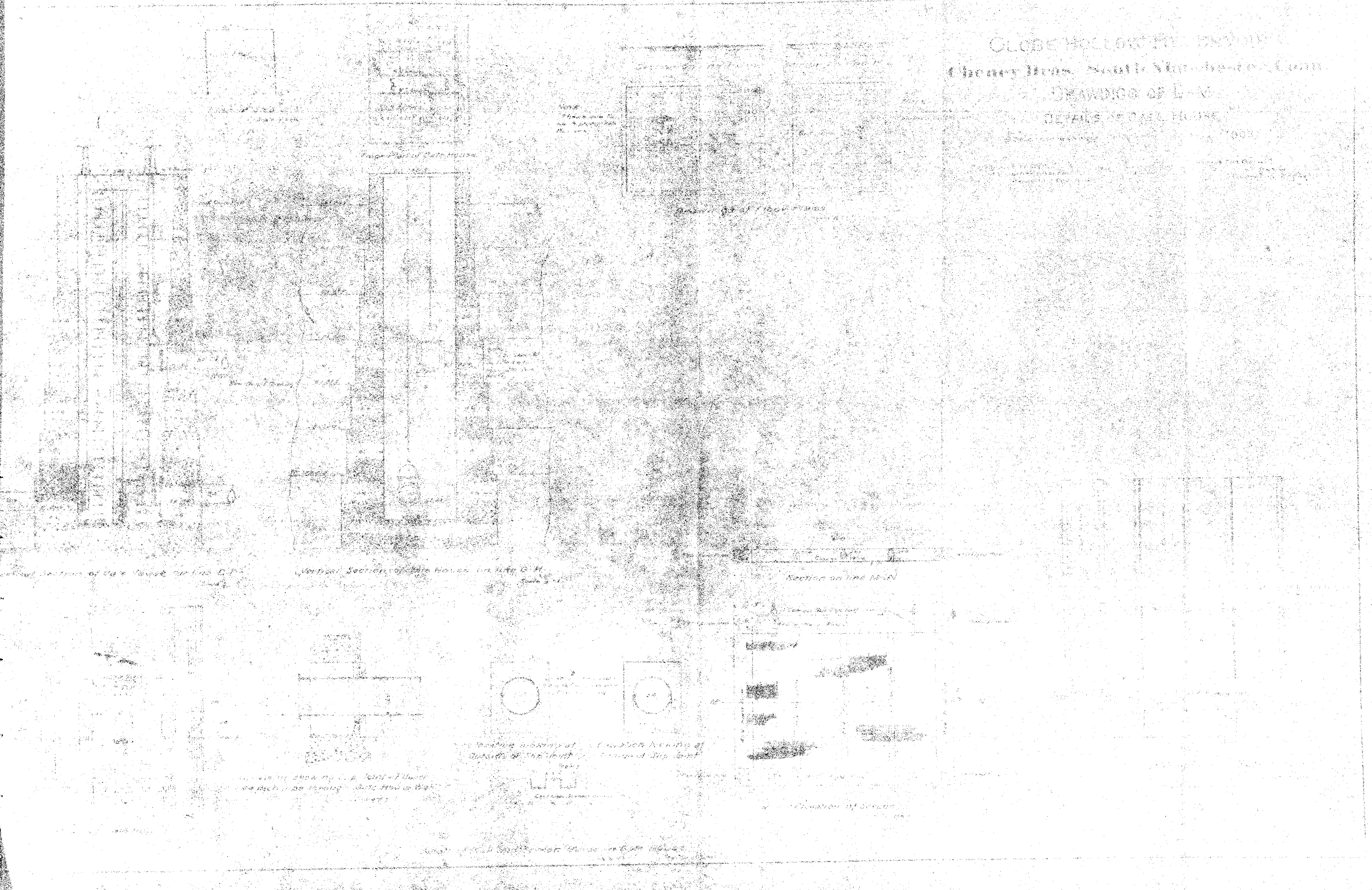


GLOBE HOLLOW RESERVOIR

Owner: Boro. South Manchester, Conn.

DRAWINGS OF DAM

Section on Wall


Cheney Bros. South Manchester, Conn.
Details of Gate House
Vertical Section of Gate House on line G-H
Section on line M-N

LOCATION OF CONN. 83

PHOTOGRAMMETRY

FIVE FEET

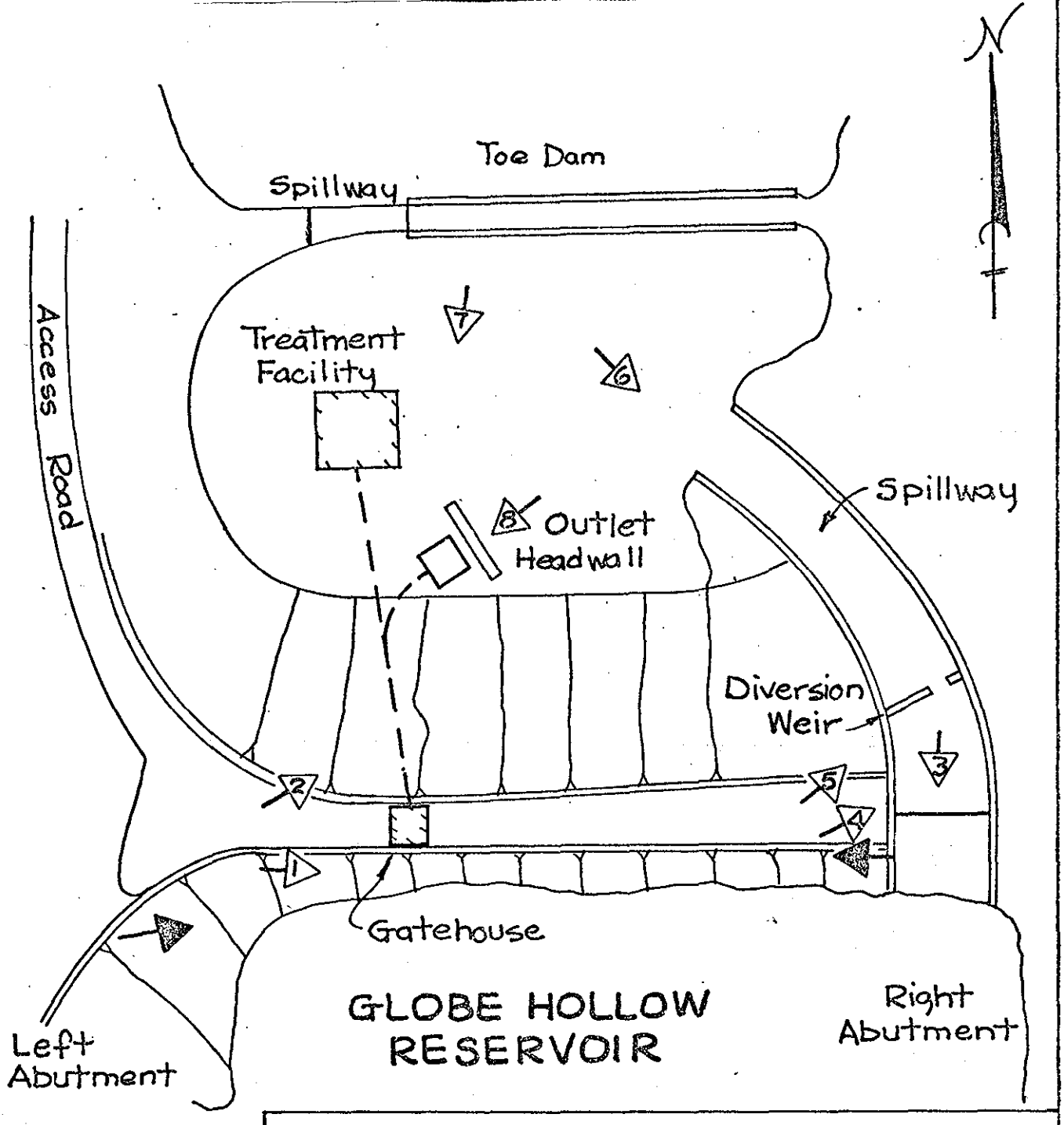
SHEET 2 OF

RELOCATION OF CONN

PHOTOGRAMMETRY

APPENDIX C

PHOTOGRAPHS



Appendix 'C' Photos

Overview Photos

LOUIS BERGER & ASSOC., INC WELLESLEY, MASS. ARCHITECT · ENGINEER	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

GLOBE HOLLOW RESERVOIR DAM

SKETCH PLAN SHOWING LOCATION & ORIENTATION OF PHOTOS

STATE - CT.

			SCALE
			DATE

GLOBE HOLLOW RESERVOIR DAM

1. Upstream slope of dam.

2. Downstream slope of dam.

3. Spillway crest and deteriorated flashboards viewed from downstream chute.

4. Deterioration of right downstream training wall.

5. Diversion weir in downstream spillway chute.

6. Downstream end of spillway chute.

7. View of gate house on crest of dam and outlet headwall.

8. Outlet headwall at downstream toe of dam.

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

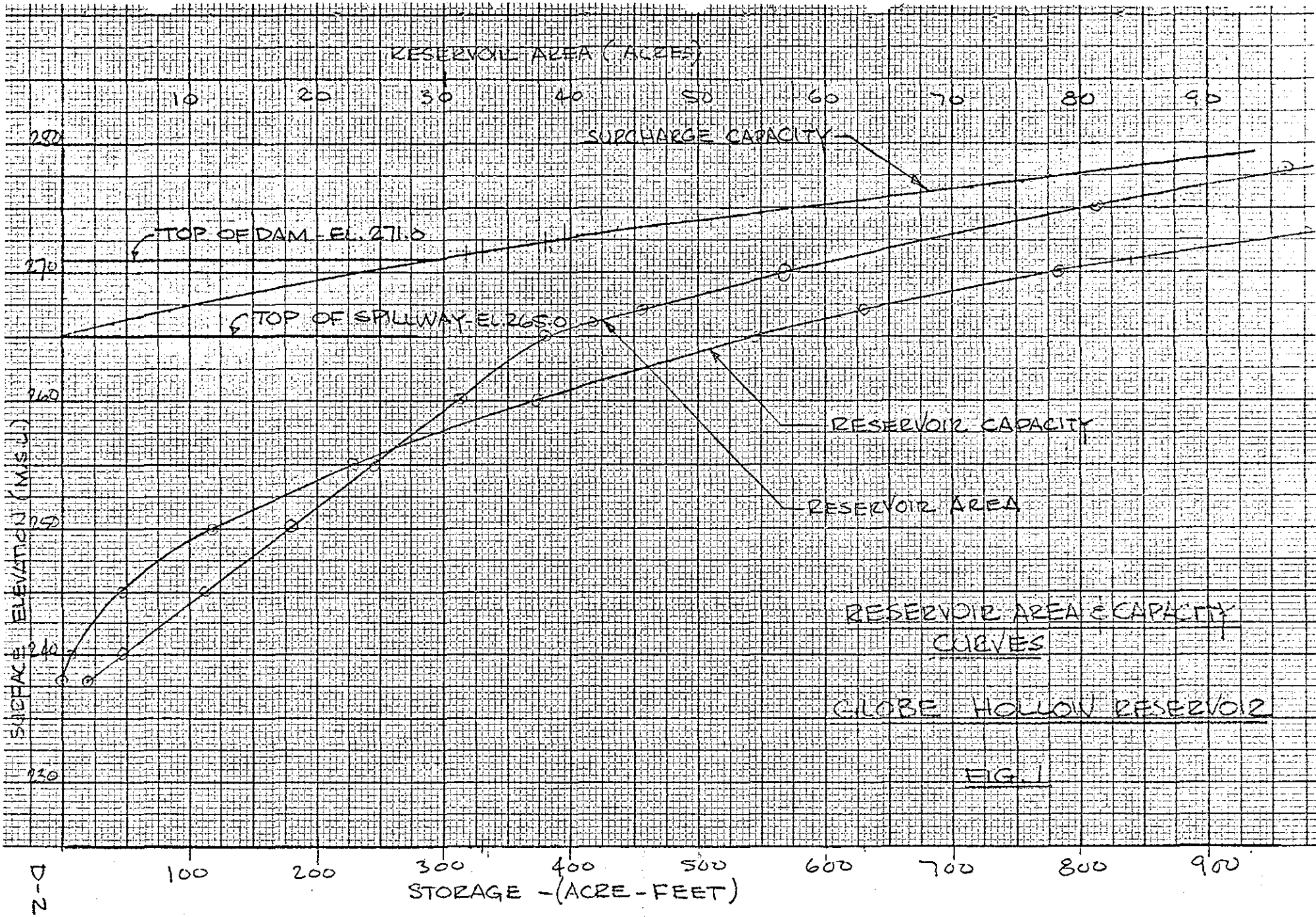
BY [illegible] DATE 4.24.79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. 1 OF

CHKD. BY DATE INSPECTION OF DAMS PROJECT

SUBJECT GLOBE HOLLOW

CAPACITY ANALYSIS

ELEV MSL	AREA (AC)	AV. AREA (AC)	HT (FT)	INCR. STO (AC-FT)	CUM. STO (AC-FT)	SURCHARGE STO (AC-FT)	REMARKS
235	SAY 0.	—	—	—	—	—	24" ϕ
240	2.6	1.3	5	6.6	6.6		
245	11.3	8.0	5	40.0	46.6		
250	18.0	14.6	5	73.0	119.6		
255	24.6	22.0	5	110.0	229.6		
260	31.3	28.6	5	143.0	372.6		
265	38 AC	34.6	5	173.0	545.6	0	SPILLWAY
266	41.8	39.9	1	39.9	585.5	39.9	
267	45.6	43.7	1	43.7	629.2	83.6	
268	49.4	47.5	1	47.5	676.7	131.1	
269	53.2	51.3	1	51.3	728.0	182.4	
270	56.9(PL)	55.0	1	55.0	783.0	237.4	
271	61.8	59.3	1	59.3	842.3	296.7	TOP OF DAM
272	66.7	64.2	1	64.2	906.5	360.9	
273	71.6	69.1	1	69.1	975.6	430.0	
274	76.5	74.0	1	74.0	1049.6	504.0	
275	81.4	79.0	1	79.0	1128.6	583.0	
276	86.3	83.8	1	83.8	1212.4	666.8	
277	91.2	88.7	1	88.7	1301.1	755.5	
278	96.1	93.6	1	93.6	1394.7	849.1	
279	101.0	98.6	1	98.6	1493.3	947.7	
280	105.6 (PL)	103.3	1	103.3	1596.6	1051.0	



RESERVOIR AREA & CAPACITY CURVES

GLOBE HOLLOW RESERVOIR

FIG. 1

BY JKH DATE 3/29/79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. 1 OF
CHKD. BY RCM DATE 4/10/79 INSPECTION OF DAMS - CONN & RI PROJECT
SUBJECT GLOBE HOLLOW RESERVOIR - DRAINAGE AREA, #1, CT

FIND: ENTIRE AREA ABOVE RESERVOIR

PLANIMETER No 3651-
INDEX @ 899
10 = 1 sq in

Sheet		Ave Reading (sq in)
Manchester	Conn.	3.75
Marbough	Conn.	2.86
Rockville	Conn.	1.74
Glastonbury	Conn.	7.25
		15.60

$(1")^2 = (2{,}000')^2 = 4{,}000{,}000$ sq ft/sq in

$$\text{AREA} = \frac{15.60 \text{ sq in} \times 4{,}000{,}000 \text{ sq ft/sq in}}{43{,}560 \text{ sq ft/ACRE}} = \boxed{1{,}432.5 \text{ ACRES}}$$

$$1{,}432.5 \text{ Acres} \div 640 \text{ Acres/sq mi} = \boxed{2.24 \text{ sq mi}}$$

BY RCM DATE 4-11-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. 1 OF

CHKD. BY DATE INSPECTION OF DAMS PROJECT

SUBJECT GLOBE HOLLOW DAM - MANCHESTER CONN.

DRAINAGE AREA - 1,432.5 AC = 2.24 SQ. MI.

RESERVOIR AREA = $\frac{PL = 0.41 \text{ in} \times 4{,}000{,}000 \text{ S.F./in}}{(43{,}560)(640)} = \frac{37.6 \text{ SAC}}{640}$

= 0.059 SQ. MI. = 2.6 % of DA.

RESERVOIR CAPACITY AT NORMAL STORAGE: 170 MG
(OBTAINED FROM CITY OF MANCHESTER) (= 520 AC-FT)

SPILLWAY CREST EL. = 265 (USC&GS)

RESERVOIR LENGTH = 2800' ±
" WIDTH = VARIES - 400' - 800'

DRAINAGE AREA
TRIBUTARIES TO RESERVOIR

	L	H	S
1.	10,580'	575 - 265 = 310'	310 ÷ 10,580 = 0.0295 1/1
2.	9,800'	575 - " = 310'	310 ÷ 9800 = 0.0316
3.	12,000'	700' - " = 435'	435 ÷ 12000 = 0.0362
4.	11,500	720' - " = 455'	455 ÷ 11,580 = 0.0396
	4 | 43,800		4 | 0.1369

L_{AV} = 10,950 = 2.07 MI.

S_{AV} = 0.0342 1/1
= 180.7 FT/MI.

LAG TIME FOR U.H.

$LAG = K\left(\frac{L L_{CA}}{\sqrt{S}}\right)^{0.33}$ $L_{CA} = L/2$ $K = 3.75$ CURVE "B" (2.5 → 5.0) MIXED TERRAIN

PG. 66 - DESIGN OF SMALL DAMS

$= 3.75\left(\frac{2.07\left(\frac{2.07}{2}\right)}{\sqrt{180}}\right)^{0.33}$

$= 3.75\left(\frac{2.14}{13.42}\right)^{0.33} = 3.75(.5456) = 2.05$ SAY 2 HRS

D - 4

CHECK VELOCITY

$$V = \frac{10{,}950'}{3600 \times 2.0} = 1.52 \text{ Ft/Sec}$$

CHECK "DESIGN SMALL DAMS" - PG. 70

FOR $S_{AV} = 0.0342 = 3.4\%$ $V_{AV} = 3.0$ FPS. TP-PW-S

" " $V_{AV} = 1 \rightarrow 2$ FPS TEXAS

$\therefore V_C = 1.52$ FPS O.K.

CALC T_p. (TIME TO PEAK)

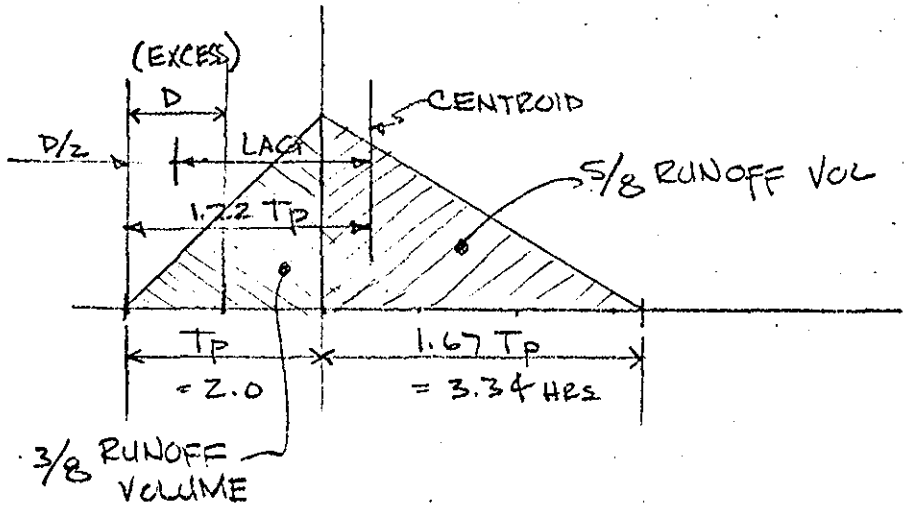
$$T_p = \frac{LAG}{1.22} + \frac{D}{2 \times 1.22} = 0.82 LAG + 0.42 D \text{ (HRS)}$$

D = INCREMENTAL TIME PERIOD — USE 1 HR

$$T_p = 0.82(2.0) + 0.42(1) = 1.64 + .42 = 2.06$$

USE $T_p = 2$ HRS

UNIT HYDROGRAPH



$$Q_{p(1")} \text{ (CFS AT PEAK)} = \frac{484 A Q}{T_p} \qquad \text{PG. 69-DSD}$$

$$= \underset{D\text{-}S}{484} \frac{(2.24)(1.0)}{2} = \underline{542 \text{ CFS}}$$

RAINFALL

PMF = 0.8 (FIT FACTOR) = 19.2" FOR 6 HRS FOR CONN.

19.2" − FILTRATION LOSS (0.4) = 18.8"

FLOOD HYDROGRAPH FOR PMF $Q_{P(1")} = 542$ CFS

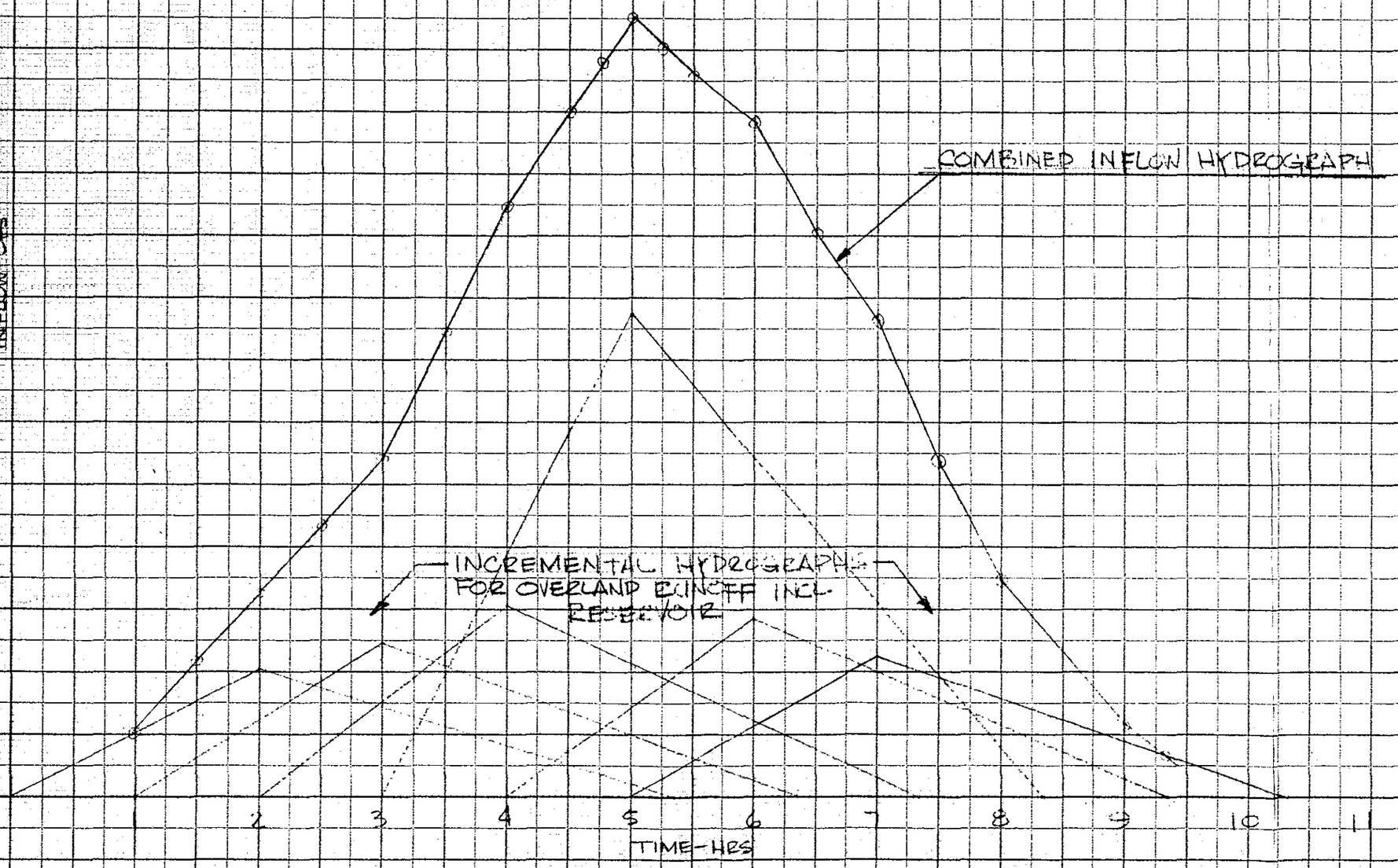
TIME (HRS)	RAINFALL % *	RAINFALL IN	Qp (CFS)	BEGIN TIME (HR)	PEAK TIME (HR)	END TIME (HR)
0						
1	10	1.88	1019	0.0	2.0	5.34
2	12	2.26	1225	1.0	3.0	6.34
3	15	2.82	1528	2.0	4.0	7.34
4	38	7.14	3870	3.0	5.0	8.34
5	14	2.63	1425	4.0	6.0	9.34
6	11	2.07	1122	5.0	7.0	10.34
		18.8	10,189			

* DISTRIBUTION OF MAXIMUM 6 HR SPS OR PMP IN PERCENT OF 6 HR AMOUNT.

EM 1110-2-1411 (ACOE)

GLOBE HOLLOW RESERVOIR
INFLOW FLOOD HYDROGRAPH
FULL P.M.F.

FIG. 2

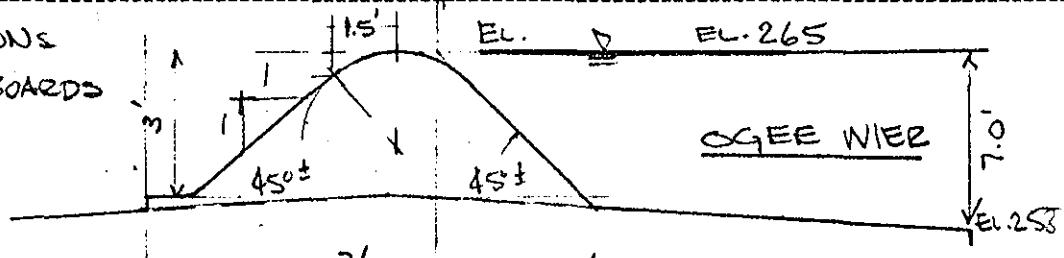


BY RLM DATE 4/26/79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. 1 OF...

CHKD. BY...DATE... GLOBE HOLLOW PROJECT...

SUBJECT DISCHARGE ANALYSIS

NOTE: PROVISIONS FOR 14" FLASHBOARDS



ASSUME $H_o = 3'$, $C = 4'$ $\quad q = CH^{3/2} = 20.8$ CFS/FT

GIVEN: $P = 7'$ $\quad \therefore P + H_o = 10'$ $\quad V$ (APPROACH VEL.) $= \frac{20.8}{10} = 2.1$ FPS

$X = 1$

$Y = 0.5$

$$h_a = \frac{V^2}{2g} = \frac{(2.1)^2}{64.4} = \underline{0.068}$$

$$\frac{h_a}{H_o} = \frac{0.068}{3} = \underline{0.023}$$

FROM FIG. 247 - DSD — $n = 1.77$ $K = 0.54$ $X = 1.5$

45° UPSTREAM $Y = 0.5$

$$\frac{Y}{H_o} = K\left(\frac{X}{H_o}\right)^n$$

$$\frac{0.5}{H_o} = 0.54\left(\frac{1.5}{H_o}\right)^{1.77}$$

$$\frac{0.5}{0.54} = H_o\left(\frac{1.5}{H_o}\right)^{1.77} = \frac{H_o(1.5)^{1.77}}{(H_o)^{1.77}}$$

$$0.93 = \frac{(1.5)^{1.77}}{H_o^{0.77}} = \frac{2.05}{H_o^{0.77}}$$

$$H_o^{0.77} = \frac{2.05}{0.93} = 2.20$$

$H = 2.9$ SAY $H_o = 3.0$ ✓

∴ DESIGN HEAD = 3.0 FT. EL 265 + 3.0' = 268.0 MSL

$\frac{P}{H_o} = \frac{7}{3} = 2.33$ FIG 249 DSD → $C_o = 3.87$

FIG 251 $\frac{C_{INCL}}{C_{VERT.}} = 0.994$ ∴ $C_o = 3.85$

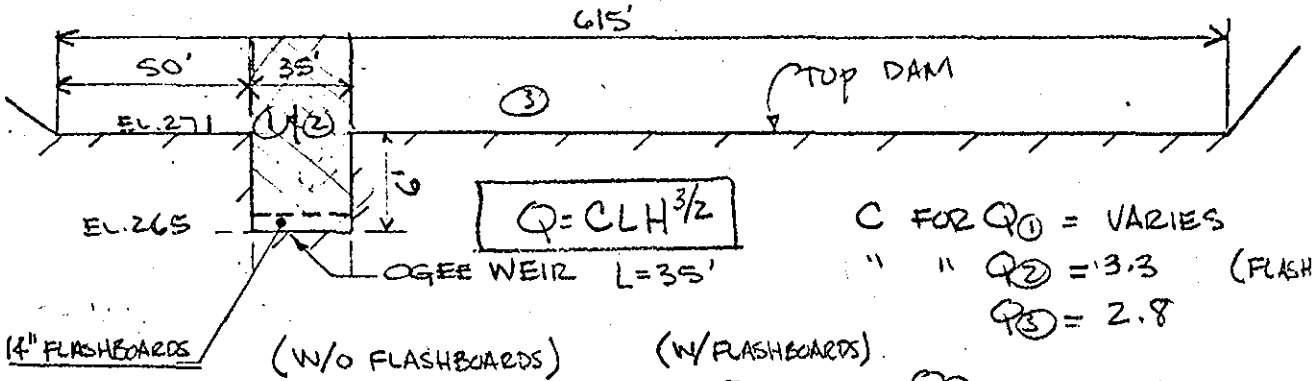
BY RLM DATE 4/24/79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. 2 OF

CHKD. BY DATE INSP. OF DAMS PROJECT

SUBJECT GLOBE HOLLOW – DISCHARGE ANALYSIS

DISCHARGE ANALYSIS

$L_2 = 615 - 35 = 580'$



$Q = CLH^{3/2}$

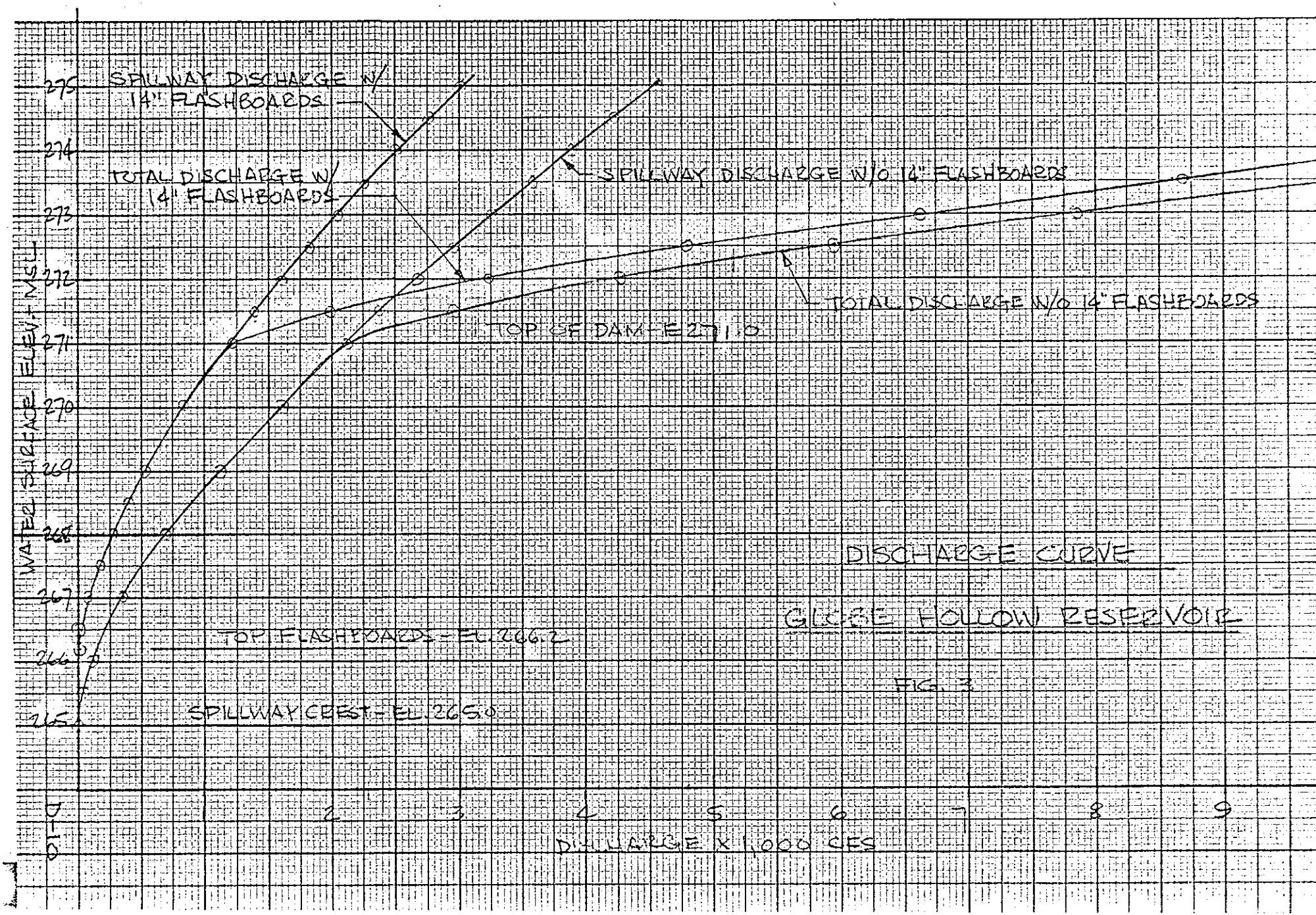
C FOR $Q_①$ = VARIES

" " $Q_②$ = 3.3 (FLASHBOARDS)

$Q_③$ = 2.8

(W/O FLASHBOARDS) $Q_①$ (W/FLASHBOARDS) $Q_②$ $Q_③$ ΣQ (FLASHBOARDS)

	ELEV.	$He_①$	He/H_o	C/C_o	C	$\Delta Q_①$	$He_②$	$\Delta Q_②$	$He_③$	$\Delta Q_③$	ΣQ W/o	ΣQ W/
SW.	265	0	—	—	—	0	C = 3.3		C = 2.8		0	0
	265.5	0.5	0.17	0.82	3.16	39			L_2 =		39	0
	266.0	1.0	0.33	0.89	3.43	120					120	0
TOP F.B.	266.2	1.2	0.40	0.90	3.46	159	0	—			159	0
	266.5	1.5	0.5	0.92	3.54	228	0.3	19			228	19
	267.0	2.0	0.67	0.95	3.66	362	0.8	83			362	83
	267.5	2.5	0.83	0.98	3.77	522	1.3	171			522	171
	268.0	3.0	1.0	1.0	3.85	700	1.8	279			700	279
	268.5	3.5	1.17	1.02	3.93	901	2.3	403			901	403
	269.0	4.0	1.33	1.04	4.00	1120	2.8	541			1120	541
	269.5	4.5	1.67	1.07	4.12	1377	3.3	692			1377	692
	270.0	5.0	"		"	1612	3.8	856			1612	852
	270.5	5.5				1860	4.3	1342			1860	1342
TOP DAM	271.0	6.0	"		"	2119	4.8	1215	0	—	2119	1215
	271.5	6.5	"		4.12	2390	5.3	1409	0.5	514	2964	1983
	272.0	7.0			4.12	2671	5.8	1613	1.0	1624	4295	3237
	272.5	7.5	"		4.12	2962	6.3	1826	1.5	2983	5945	4809
	273.0	8.0			"	3263	6.9	2049	2.0	4593	7956	6641
	273.5	9.5				3573	7.3	2279	2.5	6419	9992	8697
	274.0	9.0	"			3893	7.8	2516	3.0	8439	12,332	10,955
	274.5	9.5			"	4222	8.3	2762	3.5	10,633	14,855	13,395
	275.0	10.0	"			4560	8.8	3015	4.0	12,992	17,552	16,007
					"							



DISCHARGE CURVE

GLADE HOLLOW RESERVOIR

FIG. 3

BY. RCM DATE 4.27.79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. 1 OF
CHKD. BY DATE DAM INSPECTION—CONN & RI PROJECT
SUBJECT GLOBE HOLLOW - EFFECT OF SURCHARGE ON MPD

A_D = 1,432 AC. = 2.24 SQ.M. HT. DAM = 40' ±
STORAGE = 170 MG = 520 AC-FT (CITY) / 545 AC-FT (CALC'D)
SIZE CLASSIFICATION = INTERMEDIATE
HAZARD " = HIGH

INSPECTION OF PMF (W/O FLASHBOARDS)

1. PMF (FROM INFLOW HYDROGRAPH) = 6,250 CFS

Q_{P_1} = 6,250 CFS

2a. SURCHARGE HT @ 6,250 CFS (FROM DISCHARGE CURVE = EL. 272.6

b. VOL. OF SURCHARGE ($STOR_1$) IN INCHES = 395 AC-FT (FROM SURCHARGE CAPACITY)

$$= \left[\left(395 \text{ AC-FT} \times \frac{43{,}560 \text{ CF}}{\text{AC.}}\right) \div (1{,}432 \text{ AC} \times 43{,}560)\right] \times 12$$

∴ $STOR_1$ = 3.31 INCHES

c.

$$Q_{P_2} = Q_{P_1} \times \left(1 - \frac{STOR_1}{19}\right)$$

$$= 6{,}250\left(1 - \frac{3.31}{19}\right) = 6{,}250\,(0.826) = 5161 \text{ CFS}$$

Q_{P_2} = 5161 CFS

3. a. SURCHARGE HT (Q_{P_2}) = EL. 272.3 (FROM DISCHARGE CURVE)

b. VOLUME OF SURCHARGE ($STOR_2$) IN INCHES = 375 AC-FT

$$STOR_2 = \left[(375 \text{ AC-FT} \times 43{,}560) \div (1432 \times 43560)\right] 12 =$$

= 3.14 INCHES

AVER. STOR = (3.31 + 3.14) ÷ 2 = 3.22 IN.

A.V. STOR. = 3.22 IN.

$\frac{3.22 \text{ IN} \times 1432}{12"/\text{FT}} = 384. \text{ AC-FT}$

STOR EL. FOR 384 AC-FT = 272.4

$Q_{P_3} = 5,875$ CFS (FROM DISCHARGE CURVE)

EL. TOP DAM = 271.0

∴ SPILLWAY INADEQUATE TO HANDLE PMF - OVER TOP DAM BY 1.4'

CHECK 1/2 PMF W/O FLASHBOARDS

$Q_{P_1} = 6,250 \div 2 = 3,125$ CFS

2a. SURCHARGE HT. = 271.6
b. VOLUME OF SURCHARGE = 330. AC-FT

$\text{STOR}_1 = [(330 \times 43,560) \div (1432 \times 43,560)] \times 12 = 2.76$ IN

$Q_{P_2} = Q_{P_1} \times (1 - \frac{2.76}{9.5}) = 3125(1 - \frac{2.76}{9.5}) = 2217$ CFS

3a. SURCHARGE HT Q_{P_2} = 271.1
VOLUME OF SURCHARGE = 300. AC-FT

$\text{STOR}_2 = [(300 \times 43,560) \div (1432 \times 43560)] \times 12 = 2.51$ IN.

AVERAGE STOR = $(2.76 + 2.51) \div 2 = 2.63$ IN.

$\frac{2.63 \text{ IN} \times 1432}{12} = 314. \text{ AC-FT}$

STOR EL. FOR 314 AC-FT = 271.2
$Q_{P_3} = 2,400$ CFS

∴ SPILLWAY INADEQUATE TO HANDLE 1/2 PMF - OVER BY 0.2'

BY RLM DATE 4.27.79 | **LOUIS BERGER & ASSOCIATES INC.** | SHEET NO. 1 OF

CHKD. BY DATE | GLOBE HOLLOW | PROJECT

SUBJECT FAILURE ANALYSIS

STEP NO.1 – RESERVOIR STORAGE AT TIME OF FAILURE
ASSUME WATER SURFACE EL. AT TOP DAM – EL. 271.0

FROM CAPACITY CURVE: STORAGE AT EL 271. = 840 AC-FT

STEP NO.2 – PEAK FAILURE OUTFLOW:

$$Q_{P_1} = 8/27\ W_b \sqrt{g}\ Y_o^{1.5}$$

W_b = BREACH WIDTH = 40% DAM WIDTH AT MID HT.
= 0.4(340) = 136 FT

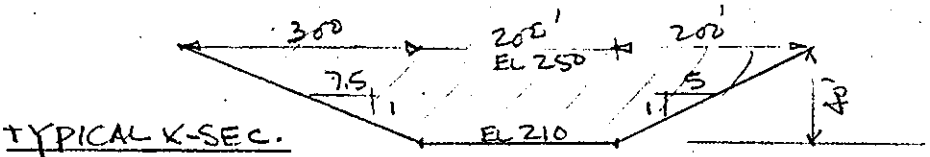
Y_o = TOTAL HT FROM RIVER TO POOL H.T = 40'

$$Q_{P_1} = (8/27)(136)\sqrt{g}\ (40)^{1.5}$$

= 57,847 CFS SAY 57,850 CFS

Q_{P_1} = 57,850 CFS

STEP NO.3 – STAGE DISCHARGE RATING CURVE FOR RIVER REACHES.



TYPICAL K-SEC.
@ 1500 D/S

USING MANING FORMULA: $Q = VA = (A)\left(\frac{1.486}{n} R^{2/3} S^{1/2}\right)$

USE n = 0.14 (HDS No 3 pg 108) $S_{AV.} = \frac{20}{1700} = 0.012$ 1/1

H	A	P	$R^{2/3}$	1.486/n	$S^{1/2}$	Q CFS
5	1156	263	2.68	10.61	0.11	3616
10	2625	327	4.01	"	"	12,285
15	4406	390	5.04	"	"	25,917
20	6500	453	5.91	"	"	44,834
23	7906	491	6.38	"	"	58,869

STEP No. 4 ESTIMATE Q_{P_2} $S = 1050$ AC-FT, $S/2 = 525$ AC-FT

4A $Q_{P_1} = 57,850$ CFS
FROM S-D CURVE: STAGE = 22.8 FT

TRY $L_{REACH_1} = 2800$ FT TO ROAD CROSSING (MAIN ST)

$$A = \frac{(22.8 \times 7.5) \times 22.8}{2} + (22.8 \times 200) + \frac{(22.8 \times 5) \times 22.8}{2}$$

$A = 1949 + 4560 + 1299 = 7808$ SF

$$Vol_1 = \frac{7808 \times 2800}{43560} = 501 \text{ AC-FT} < 525 \quad \text{O.K.}$$

4B $$Q_{P_2\,(TRIAL)} = Q_{P_1}\left(1 - \frac{Vol_1}{S}\right) = 57,850\left(1 - \frac{501}{1050}\right) = 30,247 \text{ CFS}$$

4C $STAGE_2\,(TRIAL) = 16.4'$

$$\tfrac{1}{2}A_2\,(TRIAL) = \frac{(16.4 \times 7.5) \times 16.4}{2} + (200 \times 16.4) + \frac{16.4 \times 5 \times 16.4}{2}$$

$$= 1009 + 3280 + 672 = 4961 \text{ SF}$$

$$Vol_2\,(TRIAL) = \frac{4961 \times 2880}{43,560} = 319 \text{ AC-FT}$$

4D $$\frac{Vol_1 + Vol_2}{2} = \frac{501 + 319}{2} = 410 \text{ AC-FT} = Vol_{AV.}$$

$$Q_{P_2} = Q_{P_1}\left(1 - \frac{Vol_{AV}}{S}\right) = 57,850\left(1 - \frac{410}{1050}\right)$$

$$= 35,260 \text{ CFS}$$

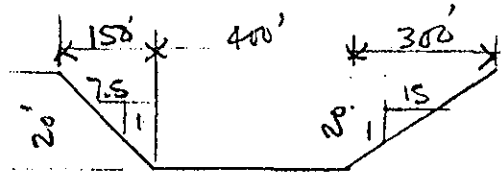
$STAGE_2 = 17.8$ FT

∴ AT 2880' DOWNSTREAM AT MAIN ST. CROSSING — $Q_{P_2} = 35,260$ CFS, $STAGE_2 = 17.8$ FT

$Q_{P_2} = 35,260$ CFS
STAGE$_2$ = 17.8 FT

$S = \frac{20}{3000} = .00667$
$S^{1/2} = 0.0816$

TYP. SEC. 5800' D/S FOR REACH$_2$



H	A	P	$R^{2/3}$	$1.486/n$	$S^{1/2}$		Q (CFS)
5	2281	513	2.71	10.61	0.0816		5,351.
10	5125	626	4.06	"	"		18,014
15	8531	739	5.11	"	"		37,742
20	12,580	852	6.00	"	"		64,933
17	10,051	784	5.48				47,706

USING S-D CURVE FOR REACH NO. 2:

$Q_{P_2} = 35,260$ CFS
STAGE$_2$ = 14.6 FT

STEP NO. 4:

TRY $L_{REACH_2} = 3000'$

$$A_2 = \frac{14.6 \times 7.5 \times 14.6}{2} + 400 \times 14.6 + \frac{14.6 \times 15 \times 14.6}{2}$$

$A_2 = 799 + 5840 + 1599 = 8238$ SF

$$Vol_2 = \frac{8238 \times 3000'}{43560} = 567 > 525$$ TRY 2580 FT

$$Vol_2 = \frac{8238 \times 2580'}{43560} = 472 < 525$$ O.K.

4B $Q_{P_3}(\text{TRIAL}) = Q_{P_2}\left(1 - \frac{Vol_2}{S}\right) = 35{,}260\left(1 - \frac{472}{1050}\right)$

$Q_{P_3\,(\text{TRIAL})} = 19{,}410.\ \text{CFS}$

$\text{STAGE}_3\,(\text{TRIAL}) = 10.4\ \text{FT}$

$A_3\,(\text{TRIAL}) = \frac{10.4 \times 7.5 \times 10.4}{2} + (400 \times 10.4) + \frac{10.4 \times 15 \times 10.4}{2}$

$= 406 + 4160 + 811 = 5377\ \text{SF}$

$Vol_3\,(\text{TRIAL}) = \frac{5377 \times 2500}{43{,}560} = 309\ \text{AC-FT}$

$Vol_{AV.} = \frac{Vol_2 + Vol_3}{2} = 472 + 309 = 390\ \text{AC-FT}$

$Q_{P_3} = Q_{P_2}\left(1 - \frac{Vol_{AV}}{S}\right) = 35{,}260\left(1 - \frac{390}{1050}\right)$

$= 22{,}163\ \text{CFS}$

$\text{STAGE}_3 = 11.2\ \text{FT}$

∴ 2500' D/S FROM MAIN St. – $Q_{P_3} = 22{,}163$ CFS
(5300' D/S " DAM) $\text{STAGE}_3 = 11.2$ FT

$Qp_3 = 22,163$ CFS
$STAGE_3 = 11.2$ FT

TRY $L_{REACH_3} = 2500'$

$$A_3 = \frac{11.2 \times 7.5 \times 11.2}{2} + 400 \times 11.2 + \frac{11.2 \times 15 \times 11.2}{2}$$

$A_3 = 470 + 4480 + 941 = 5891$

$Vol_3 = \frac{5891 \times 2500}{43560} = 338 < 525$ OK.

$$Qp_4(TRIAL) = Qp_3\left(1 - \frac{Vol_3}{S}\right) = 22,163\left(1 - \frac{338}{1050}\right)$$

$= 15,028$ CFS

$STAGE_4(TRIAL) = 9.0$ FT

$A_4(TRIAL) = \frac{9 \times 7.5 \times 9}{2} + 400 \times 9 + \frac{9 \times 15 \times 9}{2} = 4511$ SF

$Vol_4(TRIAL) = \frac{4511 \times 2500}{43560} = 259$ AC-FT

$Vol.AV = \frac{338 + 259}{2} = 298$ AC-FT

$$Qp_4 = Qp_3\left(1 - \frac{Vd.AV}{S}\right) = 22,163\left(1 - \frac{298}{1050}\right)$$

$= 15,873$ CFS

$STAGE_4 = 9.3$ FT

∴ AT 5000' D/S FROM MAIN ST, $Qp_4 = 15,873$ CFS
(7800' D/S FROM DAM $STAGE_4 = 9.3'$

KEUFFEL & ESSER CO. STANDARD @ CROSS SECTION
10 X 10 TO THE HALF INCH

STAGE - FT

25
20
15
10
5

REACH NO 1
REACH NO. 2 & 3

10,000
20,000
30,000
40,000

DISCHARGE - CFS

GLOBE HOLLOW RESERVOIR
STAGE-DISCHARGE RATING CURVE
DOWNSTREAM

FIG. 4

MADE IN U.S.A.

FIG. 5

GLOBE HOLLOW RESERVOIR
SOUTH MAIN STREET CULVERT (HWY #3)
DISCHARGE CAPACITY AT VARIOUS UPSTREAM + DOWNSTREAM POND LEVELS

LOUIS BERGER & ASSOCIATES INC.

Planimeter reading for area west of South Main St equals = 2.54 IN^2 from USGS 1/24,000

Area = 0.3659 MI^2

From sheet D-3 Total D.A. = 2.24 MI^2

Area east of South Main St. = 2.24 - 0.36 = 1.88 MI^2

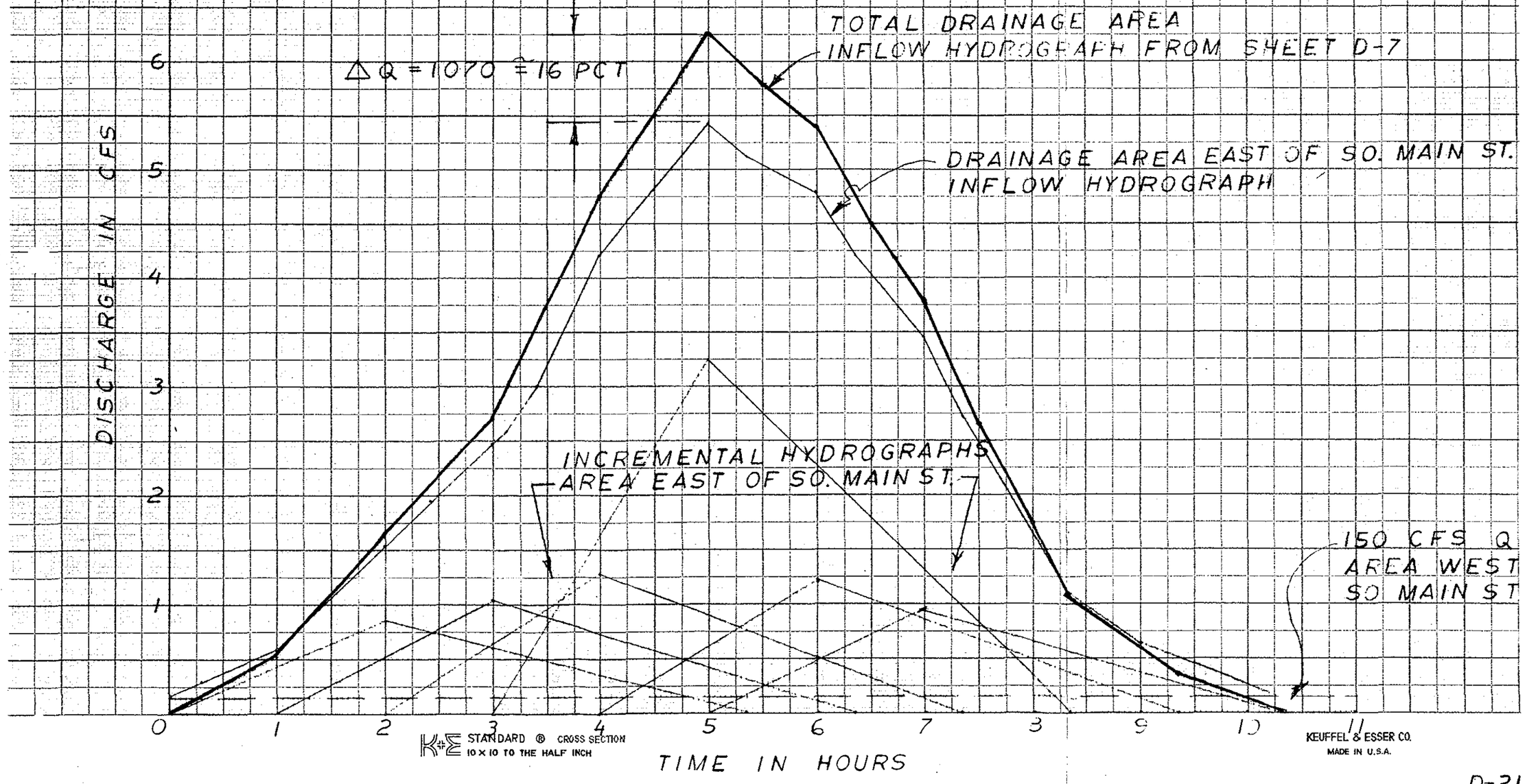
From sheet D-5, $Q_{P(1)}$ = 542 cfs

Modified $Q_{P(1)} = 542 \left(\frac{1.88}{2.24} \right) = 455$ cfs

Using same Tp as on sheet D-5, Modify Hydrograph Data on Sheet D-6

Time Hrs	Rainfall %	Rainfall In	Qp cfs	Begin Time (Hr)	Peak Time (Hr)	End Time (Hr)
0						
1	10	1.88	855	0.0	2.0	5.34
2	12	2.26	1028	1.0	3.0	6.34
3	15	2.82	1283	2.0	4.0	7.34
4	38	7.14	3249	3.0	5.0	8.34
5	14	2.63	1197	4.0	6.0	9.34
6	11	2.07	942	5.0	7.0	10.34

GLOBE HOLLOW RESERVOIR
INFLOW FLOOD HYDROGRAPHS
FULL P.M.F.



K+E STANDARD ® CROSS SECTION
10 × 10 TO THE HALF INCH

KEUFFEL & ESSER CO.
MADE IN U.S.A.

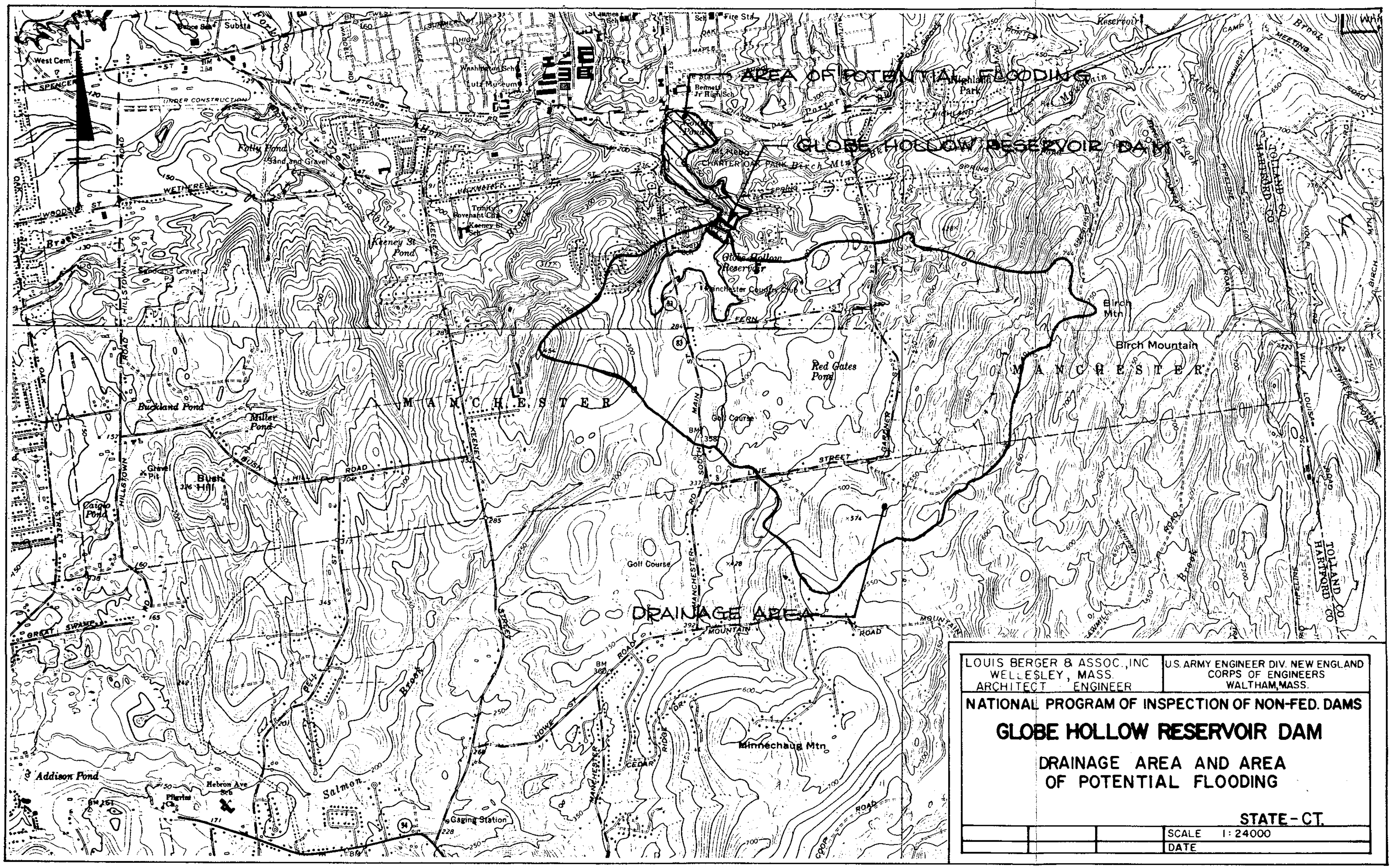


FIGURE 6 SHEET D-22

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS