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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Moodus Reservoir is a homogeneous earth embankment dam. The dam has a maximum height of 17.5 feet and is approximately 275 feet long. The dam consists of a mortared stone spillway 140 feet long by 15 feet in height. Based on the visual inspection the dam is judged to be in good condition. Based on the size and hazard classification the test flood for this dam is in the range of one-half PMF to full PMF.		

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MOODUS RESERVOIR DAM

CT 00350

CONNECTICUT RIVER BASIN
EAST HADDAM, CONNECTICUT

PHASE 1 INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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NATIONAL DAM INSPECTION PROGRAM

PHASE 1 INSPECTION REPORT

Identification No.: CT 00350
Name of Dam: Moodus Reservoir Dam
Town: East Haddam
County and State: Middlesex County, Connecticut
Stream: Moodus River
Date of Inspection: July 5, 1978

BRIEF ASSESSMENT

Moodus Reservoir is a homogeneous earth embankment dam constructed around 1824. The dam has a maximum height of 17.5 feet and is approximately 275 feet long. The dam consists of a mortared stone spillway 140 feet long by 15 feet in height. An earth embankment with a total length of 135 feet is located to the left of the spillway. The overflow spillway discharges into a stone and concrete lined channel leading to an 18 foot by 8 foot bridge opening beneath Falls Bashan Road, which is immediately downstream. This bridge has a wooden deck and a load capacity limited to 5 tons per axle. The earth embankments are approximately 2.5H:1.0V and are grassed on the crest and both slopes. There is also an outlet structure with a discharge opening measuring 7 feet by 3 feet at the left spillway abutment

of the dam which discharges through a separate stone masonry channel beneath Falls Bashan Road.

Due to its age, Moodus Reservoir Dam was neither designed nor constructed by present State-of-the-art methods. Based upon the visual inspection at the site, the lack of engineering data available, and very limited operational or maintenance evidence, the dam is judged to be in good condition. However, there are areas of concern which must be corrected to assure the safety and long-term performance of this dam.

Based on the size and hazard classification of the Corps of Engineers guidelines, the test flood for this dam is in the range of one-half PMF to full PMF. In this case the one-half PMF was adopted as the test flood. It is estimated that a test flood outflow of 6898 cfs (657 csm) will overtop the dam by about 3.7 feet; therefore, the spillway is considered inadequate. With the pool level at the top of the dam, the spillway can discharge 2182 cfs, or 32 percent of the test flood outflow.


It is recommended that the owner immediately engage an engineer experienced in the design of earth dams to evaluate the areas of concern expressed above and formulate a program to analyze the freeboard allowance and spillway capacity with respect to the test flood criteria and institute corrective measures to reduce the overtopping potential and improve the spillway capacity.

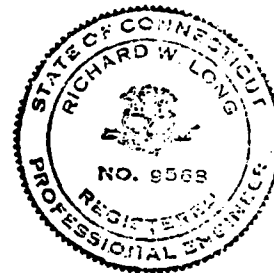
Other specific recommendations and remedial measures that should be implemented by the Owner within 2 years after receipt of this Phase I Inspection Report are described in Section 7.

The alternative to these recommendations would be to partially drain the reservoir and maintain the water surface at a reduced level.

C-E MAGUIRE, INC.

BY:


Richard W. Long, P.E.
Vice President



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

Charles G. Tiersch

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

Fred J. Ravens, Jr.

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

Saul Cooper

SAUL COOPER, Member
Chief, Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

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 aid 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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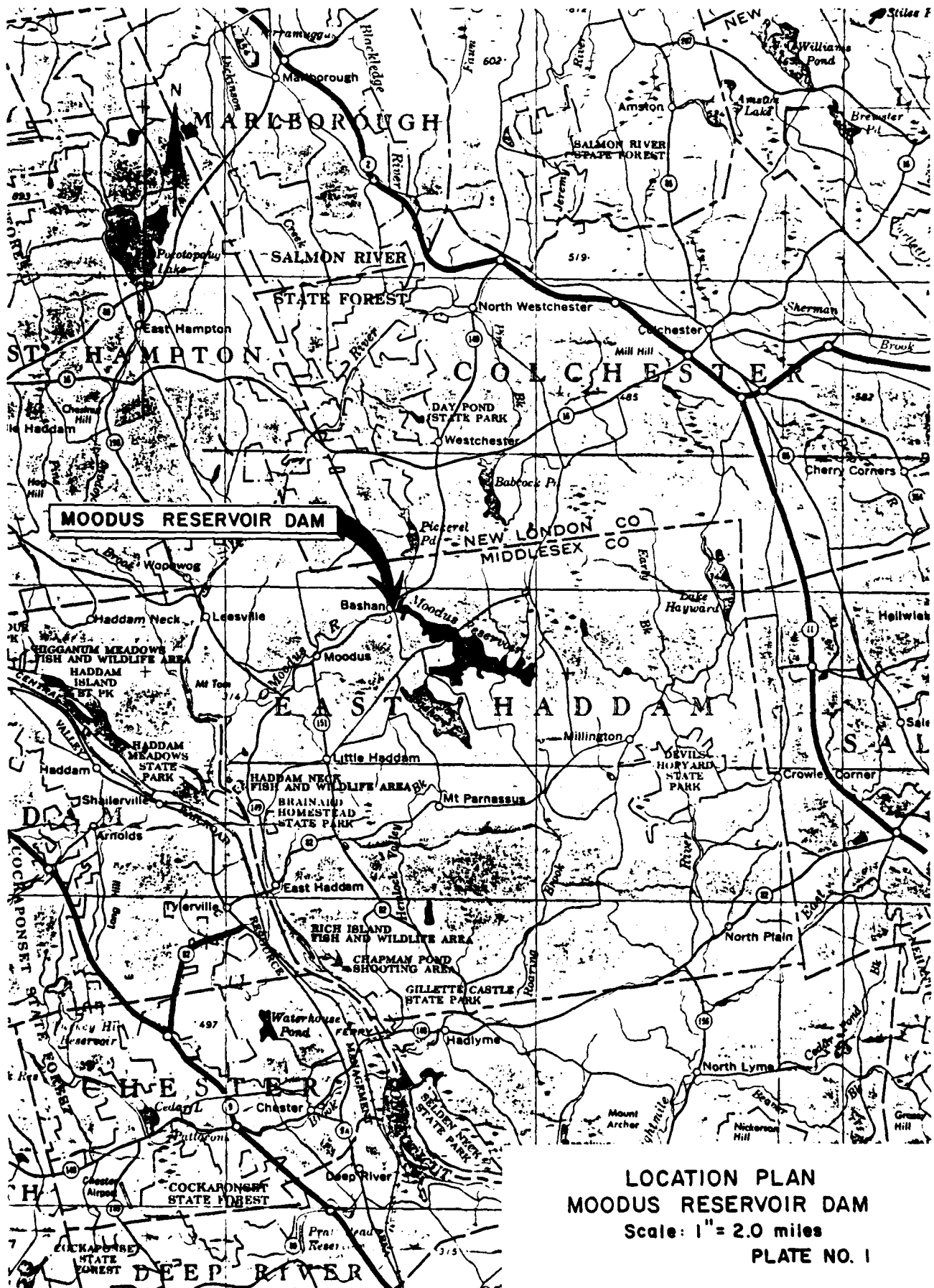
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C-1 MOODUS RESERVOIR - LOOKING UPSTREAM



LOCATION PLAN
 MOODUS RESERVOIR DAM
 Scale: 1" = 2.0 miles
 PLATE NO. 1

PHASE I INSPECTION REPORT
MOODUS RESERVOIR DAM CT 00350

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. C-E Maguire, 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 C-E Maguire, Inc., under a letter of 26 April, 1978, from Ralph T. Garver, Colonel, Corps of Engineers Contract No. DACW33-78-C-0300 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. To update, verify and complete the National Inventory of Dams.

1.2 Description of Project

- a. Location. Moodus Reservoir Dam is located in the Salmon River watershed of the Connecticut River Basin approximately 1.5 miles northeast of the Town of Moodus (North latitude $41^{\circ} - 30.8'$; West longitude $72^{\circ} - 25.6'$) in Middlesex County, Connecticut. Moodus Reservoir Dam is located in the northwest area of Moodus Reservoir and its alignment is parallel to and just upstream from Falls Bashan Road. Pickerel Lake Brook, Molley Brook, Pine Brook and overflow from various reservoirs and swamps like Pickerel Lake; Babcock Pond, Pine Pond, Bashan Lake, Post Pond and Pine Meadow Park Pond, all drain into Moodus Reservoir.
- b. Description of Dam and Appurtenances. The dam consists of a 135 feet long earth embankment (based on visual inspection) and a 140 feet long spillway weir,

resulting in a total crest length of 275.0 feet with an average height of 17.5 feet. The upstream and downstream slopes of the embankment are approximately 2.5H:1V. The crest and the downstream slopes are grassed (see Photo C-2). The upstream slope is stone protected to a depth of a few feet below the waterline.

The spillway, shown in Photo C-3, is the right half of the dam and is an uncontrolled, broadcrested weir. The downstream face is a vertical mortared cut stone wall. The training walls are 3.0 feet high of dry rubble construction. The overflow discharge from the spillway dissipates its energy in a vertical drop to an 11.0-foot wide concrete apron and then flows beneath Falls Bashan Road through a 18-foot by 8-foot rectangular opening indicated in Photos C-4 and C-5. Photo C-4 shows the bridge deck and Photo C-5 the downstream channel. The wooden bridge deck at Falls Bashan Road has an elevation of 351.9, approximately 5.0 feet below the crest of the dam spillway.

There are two intake gates for the outlet works which are housed in a wooden gatehouse structure (see Photo C-4), located on the left abutment of the spillway. The gates are manually operated vertical hoist

gates which allow discharges through a 7-foot by 3-foot rectangular opening (Photo C-6). The outlet works' discharges pass under Falls Bashan Road through a 4.5 foot by 5.0-foot rectangular stone culvert. The upstream face of this culvert appears in Photo C-7 and Photo C-8 shows the downstream face looking upstream through the culvert. These flows then would continue downstream and drop approximately 75 feet to a pond below the dam. As indicated in Photo C-9, this outlet channel is completely blocked downstream from Falls Bashan Road and discharges through the outlet back up and ultimately flow through the bridge opening and down the stream.

- c. Size Classification. The dam is classified as INTER-MEDIATE in size because the impoundment capacity at the top of the dam is 4293 Acre-feet.
- d. Hazard Classification. This dam is classified as a SIGNIFICANT hazard potential structure because it is located in a predominantly rural or agricultural area where failure may damage isolated homes, secondary highways and cause interruption of service of some public utilities. See Appendix D for failure analysis.
- e. Ownership. Early records of ownership were not available, however, the dam and reservoir were operated by

the lower Connecticut River Basin. The total drainage basin area contributing to the Moodus Reservoir Dam is 10.5 square miles and the basin slopes are generally flat to moderate. (See drainage basin map in Appendix D). The watershed is roughly rectangular in shape with its long axis approximately 3.8 miles in length and an average width of 2.8 miles. The terrain of the basin is generally rolling but also includes several large reservoir and swamp storages. Some of the prominent natural reservoirs located in this basin are Pickerel Lake, Babcock Swamp and Post Pond. These large storage areas in the watershed tend to dampen and delay the peak of the surface runoff. The highest elevation in the basin is 595.0 National Geodetic Vertical Datum (NGVD), compared to the spillway crest elevation of 357 NGVD at Moodus Reservoir. A general basin map is enclosed. (See Appendix D).

b. Discharge at Dam Site. There are no discharge records available for this dam. Listed below are other discharge data:

1. Outlet works (conduits) size: 7 feet x 3 feet and downstream Invert Elev. 345.50 Rectangular Stone Masonry;

2. Maximum known flood at dam site - unknown
3. Overflow spillway capacity at maximum pool level
2182 cfs at El. 360.0 (Top of Dam);
4. Gated outlet capacity at normal pool level 365 cfs
at El. 357.0;
5. Gated outlet capacity at maximum pool level 410
cfs at El. 360.0;
6. Total spillway and outlet discharge capacity at
maximum pool level 2592 cfs at El. 360.0.
7. Total discharge at test flood level equals 7350
cfs at El. 363.65.

c. Elevation(ft. above NGVD)

1. Top Dam	360.0
2. Test Flood Pool Elevation	363.65
3. Full flood control pool	not applicable
4. Recreation pool	357.0
5. Spillway crest	357.0
6. Upstream portal invert intake structure	345.5 (est.)
7. Streambed at centerline of dam	344.5 upstream (est.) 342.5 downstream (est.)
8. Recorded Maximum tailwater	Unknown

d. Reservoir Lengths: (feet) (scaled)

1. Length of maximum pool	8000
2. Length of recreation pool	8000

3. Length of flood control pool not applicable

e. Storage: (acre-feet) Total

1. Recreation pool (spillway crest) 2940 @ Elev. 357.0

2. Flood control pool not applicable

3. Test flood elevation 5939 @ Elev. 363.65

4. Top of dam 4293 @ Elev. 360.0

5. Net storage between top of dam and spillway crest is 1353 Acre-Feet which represents 2.42 inches of runoff from the 10.5 square miles of drainage area.

6. One foot of surcharge storage = 0.81 inches of runoff from the drainage area of 10.5 sq. miles.

f. Reservoir Surface: (acres)

1. Top dam 451.0 equals 6.71% of total drainage area

2. Maximum pool 451.0

3. Flood-control pool 451.0

4. Recreation pool 451.0

5. Spillway crest 451.0

g. Dam:

1. Type Earth embankment based on visual inspection.

2. Length 275 feet (including 140 feet spillway)

- | | | |
|----|-----------------|--|
| 3. | Height | 17.5 feet |
| 4. | Top width | 20.0 feet - 35.0 feet at left abutment |
| 5. | Side slopes | 2.5H:1.0V (est.) |
| 6. | Zoning | None known |
| 7. | Impervious core | None known |
| 8. | Cutoff | None known |
| 9. | Grout curtain | None known |

h. Spillway:

- | | | |
|----|-----------------|---|
| 1. | Type | Overflow, broad crested cut stone masonry construction. |
| 2. | Length of weir | 140.0 feet |
| 3. | Crest elevation | 357.0 (NGVD) |
| 4. | Gates | None |
| 5. | U/S Channel | Straight - natural channel |
| 6. | D/S Channel | Bedrock, concrete apron and stones |
| 7. | General | --- |

i. Regulating Outlets: Refer to Paragraph 1.2b "Description of Dam and Appurtenances", Page 3 for description of outlet works.

- | | | |
|----|-------------------|---|
| 1. | Invert | 345.5 downstream |
| 2. | Size | 7.0 feet (width) x 3.0 feet (height) |
| 3. | Description | Rectangular cut stone masonry |
| 4. | Control mechanism | Hand operated vertical hoist-gear mechanism-two gates |
| 5. | Other | --- |

SECTION 2
ENGINEERING DATA

- 2.1 Design: No engineering data is available for this dam. One drawing depicting the transfer of property from the Moodus Reservoir Company to the State of Connecticut is listed in Appendix B-3.
- 2.2 Construction: No record of construction or repairs exist.
- 2.3 Operation: No records of operation for this facility have been maintained.
- 2.4 Evaluation
- a. Availability: There are no plans, specifications or computations available from the Owner, County or State offices regarding the design, construction or subsequent repairs of this dam.
 - 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 judgment.
 - c. Validity: The validity of the limited data must be verified.

SECTION 3

VISUAL INSPECTION

3.1 Findings

- a. General. In general the overall appearance of Moodus Reservoir Dam is good. The cut stone masonry of the downstream face of the spillway is well aligned with no dislodged stones or unusual leakage. The abutment areas had no observable seepage. Some vegetal growth covered each abutment. The gates were operated during the field inspection and are judged to be in good condition. Minor detrimental items that need attention include: surface erosion due to trespass at the left embankment area, vegetal growth and obstructed downstream channels. Two bridge openings exist under Falls Bashan Road. One carries flow from the outlet structure and is judged to be in good structural condition. The outlet channel downstream from Falls Bashan Road however is completely obstructed with debris, trees, brush and trash to the extent that no flow could be observed with the gates open.

The second opening immediately downstream from the spillway consists of a timber deck bridge which has reportedly been destroyed by flooding in the past and

should be analyzed to insure its structural integrity and waterway opening adequacy. It is recommended that the roadway section downstream of the dam should be analyzed for stability against overtopping and erosion. See Photos C-4 through C-9.

- b. Dam. The embankment portion of this dam is a very low and short earth fill extending from the left side of the spillway to the left abutment, a distance of about 135 ft. The maximum head difference across the embankment with the water level in the reservoir at spillway crest, is only 5.0 feet. Over most of the length of the embankment the head difference is less than 2.0 feet above the toe. There was no seepage observed on the downstream side, as would be expected from the fact that the head is low and the dam wide at spillway crest level.

A substantial zone of erosion that occurred some time in the past was found just to the left of the wall on the upstream face of the embankment. A 15 ft. wide (longitudinally along the dam) by 5 ft. deep (transverse to dam) erosion gully was formed and trees up to 6 in. diameter in size have subsequently grown within it. Erosion does not seem to be progressing at present. There is no riprap at this location.

The top surface of the embankment near the gatehouse consists of a silty gravelly sand. In one location the sand has eroded down through the openings in the adjacent stone wall on the upstream face (See Photo C-10). Just to the left of the stairs on the downstream slope, the soil is eroded due to trespass and runoff from the crest (See Photo C-13). In addition, the concrete stairs apparently have settled about an inch relative to the adjacent stone wall.

Two stumps exist on the downstream slope and low shrubs have been allowed to grow.

- c. Appurtenant Structures. The gates were operated and were in good working order at the time of inspection. The left training wall at the spillway had some stones dislodged; and minor seepage was seen emanating from various joints between stones in the spillway face, right training wall of the outlet channel, as well as beneath the concrete spillway apron (See Photos C-11 and C-14).
- d. Reservoir Area. No detrimental features were observed with regard to the reservoir area during the visual

inspection. However, the USGS quadrangle map indicated a restriction created by the East Haddam Colchester Turnpike, which crosses the Moodus Reservoir. This could possibly control flows of low flood frequency leading to the damsite. The water surface elevation in Moodus Reservoir due to the test flood is 363.65 versus the roadway elevation of approximately 360 on the East Haddam-Colchester Turnpike. The test flood will therefore overtop the roadway. Consequently, the restriction created by the bridge opening in this roadway has no significant effect on the test flood discharge or water surface elevation at the spillway crest (Elevation 357). Numerous overhanging trees were noted around the edge of the reservoir just upstream of the dam. Debris and branches from these trees should be monitored to prevent their clogging the bridge opening below the spillway.

- e. Downstream Channel. The downstream channel beyond the Falls Bashan Road bridge was obstructed with miscellaneous debris and fallen trees. The channel also has numerous overhanging trees and extensive growth of brush which potentially could clog the stream. Immediately below the dam a secondary stilling pool is created by the Falls Bashan Road embankment. The water-

way opening in the embankment is rectangular (18 feet long by 8 feet high). Using a test flood of 6898 cfs and the dam failure flow of 7613 cfs, it was found that this bridge opening (144 sq. ft.) is too small to allow passage of a significant portion of the test flood or dam failure flow and therefore the roadway embankment will be overtopped. A further detailed analysis of this problem is required.

3.2 Evaluation

The causes of the erosion on the upstream side of the embankment are not definitely known. The erosion has stopped since 4 to 6 inch diameter trees have grown in this zone. It appears that the absence of riprap at this location permitted the erosion to occur. At adjacent zones the beach slope is so shallow that erosion did not occur. It would be prudent to backfill this eroded zone and armor this area with riprap for protection.

The trees, shrubs and stumps on the embankment could lead to future difficulties by providing pathways for internal erosion. Therefore, this vegetation should be removed annually. The roots should also be removed and replaced with properly-selected and compacted materials.

The crest of the dam near the gatehouse, and the embankment adjacent to the stairs on the downstream slope, are

not protected from erosion. Erosion-control measures, such as seeding with grass, are recommended. The eroded hole just downstream of the upstream face requires repair.

The cause of the movement of the flight of stairs is not known. It may be due to erosion of soil from beneath, either downstream or into voids between the adjacent stonework. Frost action may also have an effect on the apparent movements. Repairs should be made to control any erosion that may be occurring so that the embankment will remain intact.

Other visual observations made during the course of inspection did not indicate any conditions of an immediate and critical nature. Several of the deficiencies observed and discussed earlier require attention and need to be corrected before further deterioration causes a hazardous situation. Recommended measures are discussed in Section 7.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedures

- a. Normal Operating Procedures. Moodus Reservoir is presently used primarily for recreational purposes. Regulation of the water level in the lake is not controlled by any set of regular guidelines. No release of water has been made through the outlet structure in recent years for downstream demands or other reasons. The reservoir is not lowered normally for an impending storm.
- b. Emergency Operating Procedures. No formal procedure exists for emergency situations.

4.2 Maintenance of Dam

Maintenance of the dam has been neglected and has occurred generally only when directed by the State as a result of their inspections.

4.3 Maintenance of Operating Facilities

No record of maintenance or inspection of the operating gates is available. Since the gates are operable and apparently in good working order, it is assumed that the State periodically through their operating personnel check the condition and function of the equipment.

4.4 Description of Any Warning System in Effect

No formal warning system is used. There is no pre-planned effective warning system for the failure of Moodus Reservoir Dam. An emergency action plan must be developed in order that operating personnel can notify authorities for mobilization of State and local emergency forces, organize remedial measures to minimize or prevent complete failures when possible and have an awareness of the locations of standby equipment and materials.

4.5 Evaluation

There is no record of a formal program of inspection or maintenance conducted by the Owner nor is there a definitive contingency plan for emergency situations.

SECTION 5

HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

- a. Design Data. No specific design data is available for this watershed or the dam. In lieu of existing design information, the U.S.G.S. Topographic Maps (scale 1" = 2000') were utilized to develop hydrologic parameters such as drainage areas, reservoir surface areas and rainfall runoff watershed characteristics. Inflow and outflow discharges were developed using the Corps of Engineers' approximate criteria (See Appendix D). Elevation-storage relationships for the reservoir were also approximated. Some of the pertinent hydraulic design data was obtained and/or confirmed by actual field measurements at the time of the visual field inspection. The dam failure discharge was computed as 7613 CFS (See Appendix D) and an approximate profile was developed between Moodus Reservoir and a small pond located approximately 600 feet downstream from the dam. There is a 75.0 foot difference in water surface elevations between this pond and the Moodus Reservoir. Because of the 75.0 foot drop, the flow is assumed to follow Manning's rule of normal flow. Additional design data developed for this investigation is as follows:

MOODUS RESERVOIR DAM

FREQUENCY IN YEARS	24-HOUR TOTAL RAINFALL IN INCHES	24-HOUR* EFFECT- IVE RAIN FALL IN INCHES	MAXIMUM INFLOW IN C.F.S.	MAXIMUM** OUTFLOW IN C.F.S.	SURCHARGE STORAGE IN FEET	SURCHARGE STORAGE ELEVATION
10	5.0	2.6	1458	947	1.72	358.72
50	6.5	4.1	2300	2250	3.20	360.20
100	7.0	4.6	2580	2535	3.65	360.65
1/2PMF = TEST FLOOD	11.9	9.5	8662	6898	6.65	363.65

*Infiltration assumed as 0.1"/hour

**Lake assumed initially full at spillway crest elevation 357.0.
(Top of dam = 360.0)

NOTES:

1. Q_{10} ; Q_{50} ; Q_{100} ; inflow discharges computed by approximate Soil Conservation Service techniques.
2. 1/2 PMF and "test flood" computation based on COE instructions and guidelines.
3. Maximum capacity of spillway without overtopping the top of the dam elevation 360.0 is equal to 2182 C.F.S.
4. All discharges indicated are dependent upon the continued integrity of upstream storage reservoirs.
5. Surcharge storage is allowed to overtop the dam when exceeding the spillway capacity.

- b. Experience Data. No historical data for recorded discharges or water surface elevations is available for this dam or the watershed. Neighbors living close to the dam do not recall any overtopping of the dam although the bridge immediately downstream on Falls Bashan Road has reportedly sustained damage during past high reservoir stage periods.
- c. Visual Observations:
1. The downstream channels for both the spillway and the outlet works are obstructed with vegetation, fill and debris, and their hydraulic capacities reduced. These channels, in their present state, are inadequate to carry the spillway "test flood."
 2. The freeboard above the spillway crest is minimal and only 3.0 feet.
 3. The gatehouse for the control mechanisms of the intake structure needs securing against vandalism.
- d. Overtopping Potential. The spillway is hydraulically inadequate to pass the "test flood" (1/2 PMF) and would overtop the dam approximately 3.65 feet (refer to Table on page 20). The maximum outflow capacity of the spillway is 2182 C.F.S.; sufficient to contain 86% of the 100-year flood event within the spillway training walls with no allowance for freeboard. The spillway

capacity is also 31.6% of the "test flood" outflow discharge (See Appendix D for more details and the Spillway Rating Curve). At the spillway crest elevation of 357.0, the capacity of the outlet structure is 365 CFS. It will require 15 hours to lower the reservoir level the first foot, using the present outlet works assuming 451 Acre-Feet of storage.

The calculated failure discharge of 7613 c.f.s (see Appendix D) will produce an approximate water surface Elevation of 353.0 immediately downstream from the dam. This will raise the water surface approximately 4 ft. over and above the depth existing just prior to failure when the discharge is 2182 c.f.s.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

- a. Visual Observations. None of the visual observations made during the field inspection for this facility indicate any unusual condition regarding the structural stability of this dam. The locations where erosion is presently occurring and where it has occurred in the past should be repaired to avoid potential future difficulties.
- b. Design and Construction Data. There is no design and construction data available for evaluation of structural stability.
- c. Operating Records. There are no operating records available relating to the stability of this embankment.
- d. Post-construction Changes. Based on the visual inspection, it appears that the stone wall on the upstream side of the embankment just to the left of the spillway was reconstructed at some time after the original wall had been built. This repair has an obvious beneficial effect on the stability of the dam. No other post-construction changes are known or evident.

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 AND REMEDIAL MEASURES

7.1 Dam Assessment

- a. Condition. Based on the visual inspection, limited records and analysis available for the site and past operational performance, the dam is judged to be in good condition. However, there are areas of concern which must be corrected in order to assure the long-term performance of this dam. These concerns are as follows:
1. The spillway will not pass the "test flood" (1/2 PMF) without overtopping the dam, and therefore the spillway capacity is inadequate. Due to the large storage potential upstream, the spillway capacity is not judged as being seriously inadequate since upstream storages could be further developed to relieve the Moodus spillway deficiency.
 2. Trees and brush growth on the slopes of the embankment are a potential source of seepage which could endanger the safety of the dam.
 3. Lack of proper inspection, maintenance and emergency monitoring programs.

- b. Adequacy of Information. The lack of information regarding this dam necessitates that the assessment of the condition of the dam be based primarily on the visual inspection.
- c. Urgency. The recommendations and remedial measures described below should be implemented by the Owner within two years after receipt of this Phase I inspection report.
- d. Need for Additional Investigation. There is no evidence that formal engineering analyses were ever performed for this dam. The additional investigations in Section 7.2 and 7.3 should be carried out.

7.2 Recommendations

Engage the services of an engineer experienced in the design and analysis of dams to accomplish the following.

- a. Analyze the freeboard allowance with respect to the test flood criteria and institute corrective measures to provide this allowance. Alternative solutions that may be considered are: raising the embankment, lowering the pool level to increase flood storage, enlarging the outlet works to increase discharges and make regulation of the water surface level more responsive, development an emergency spillway or providing additional upstream storage.

- b. Examine the hydraulics of the stilling basin created between the dam and Falls Bashan Road with respect to the test flood in order to determine the overtopping potential and stability of the road embankment and timber deck bridge.
- c. Perform a topographic survey of the dam and its appurtenances in order to develop drawings that may be used in the above analysis and as a record to the Owner.

7.3 Remedial Measures

- a. Alternatives. As an alternate to the recommendations to upgrade the structure as listed above, the water surface level in the Moodus Reservoir should be lowered and maintained at a level well below the spillway crest. That reduced level should be controlled to provide storage for storm events.
- b. Operating and Maintenance Procedures. While the dam has had some maintenance, it is considered important that the following be accomplished.
 - 1. Develop and commence a regular maintenance inspection schedule for the facility.
 - 2. Incorporate in the above program monitoring of the seepage and examination of the tree stumps on the slopes. Once a procedure has been developed for

the removal of the trees, incorporate this procedure into the regular maintenance program.

3. Develop a system for the recording of data with regard to items such as: water levels, discharges, time and drawdown to assist those responsible for the monitoring of the structure.
4. Continue the technical periodic inspections of this facility on a bi-annual frequency.
5. Prepare an "Emergency Action Plan" to prevent or minimize the impact of failure, listing the expedient action to be taken and authorities to be contacted.
6. Institute immediately an analysis for the short term repairs and/or rehabilitation of the dam embankment in those areas where erosion has occurred including erosion near the gatehouse.
7. Secure the gatehouse properly and effectively against any possible vandalism.
8. Institute corrective measures to provide an adequate foundation for the gatehouse.
9. Establish a program to remove all debris and potential clogging hazards from the reservoir and downstream channels.

10. Repair the concrete of the spillway apron slab.
11. Replace the dislodged stonework at left training wall and repoint it where necessary.
12. Control tree and brush growth on the slopes and crest of the embankment.
13. Monitor seepage through joints in the left training wall at the outlet channel.
14. Due to the potential for overtopping, it is recommended that a definitive plan for surveillance be implemented during periods of unusually heavy rains and a formal warning system be developed for use in the event of an emergency.

APPENDIX A

VISUAL INSPECTION CHECKLIST WITH
COMMENTS

VISUAL INSPECTION CHECK LIST
PARTY ORGANIZATION

PROJECT Moodus Reservoir Dam DATE 5 July 1978

TIME 9:30 AM

WEATHER Clear

W.S.ELEV. _____ U.S. _____ D.S.

PARTY:

- | | |
|---------------------------|---|
| 1. <u>R. Long - CEM</u> | 6. <u>Note: A second inspection was</u> |
| 2. <u>A. Reed - CEM</u> | 7. <u>made on 29 September 1978</u> |
| 3. <u>S. Khanna - CEM</u> | 8. _____ |
| 4. <u>R. Brown - CEM</u> | 9. _____ |
| 5. <u>S. Poulos - GEI</u> | 10. _____ |

PROJECT FEATURE	INSPECTED BY	REMARKS
1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____
4. _____	_____	_____
5. _____	_____	_____
6. _____	_____	_____
7. _____	_____	_____
8. _____	_____	_____
9. _____	_____	_____
10. _____	_____	_____

PERIODIC INSPECTION CHECK LIST

PROJECT Moodus Reservoir Dam DATE 5 July 1978

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
<u>DAM EMBANKMENT</u>	
Crest Elevation	360 NGVD
Current Pool Elevation	357
Maximum Impoundment to Date	
Surface Cracks	None observed
Pavement Condition	None. Grassed
Movement or Settlement of Crest	None observed
Lateral Movement	None observed
Vertical Alignment	None observed
Horizontal Alignment	None observed
Condition at Abutment and at Concrete Structures	Condition Good
Indications of Movement of Structural Items on Slopes	Lt abutment-stairs apparently settled down and away from granite wall
Trespassing on Slopes	Free access
Sloughing or Erosion of Slopes or Abutments	Embankment to left of spillway is gullied on ds side by erosion and trespass. Surface near gatehouse is gravelly sand, ungrassed, subject to erosion.
Rock Slope Protection - Riprap Failures	No riprap. Immediately to left of ups, wall, a 15' wide by 5' deep (transverse) erosion pocket had been formed and now apparently stabilized with tree growth (Maples)
Unusual Movement or Cracking at or near Toes	None observed
Unusual Embankment or Downstream Seepage	None observed

PERIODIC INSPECTION CHECK LIST

PROJECT Moodus Reservoir Dam DATE 5 July 1978

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
<p><u>DAM EMBANKMENT (cont.)</u></p> <p>Piping or Boils</p> <p>Foundation Drainage Features</p> <p>Toe Drains</p> <p>Instrumentation System</p> <p>Vegetation</p>	<p>None observed</p> <p>None apparent</p> <p>None apparent</p> <p>None apparent</p> <p>Two stumps on ds slope 12 in. and 5 in. Maples to 15 in. or ups side at water level. Remainder grassed or sand surface.</p>

PERIODIC INSPECTION CHECK LIST

PROJECT Moodus Reservoir Dam DATE 5 July 1978

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
<u>DIKE EMBANKMENT</u>	Not applicable

PERIODIC INSPECTION CHECK LIST

PROJECT Moodus Reservoir Dam DATE 5 July 1978
 INSPECTOR _____ DISCIPLINE _____
 INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE</u>	
a. Approach Channel Slope Conditions Bottom Conditions Rock Slides or Falls Log Boom Debris Condition of Concrete Lining Drains or Weep Holes	Natural bed, straight Not observable Not observable None None Not observable Not observable Not observable
b. Intake Structure Condition of stone masonry Stop Logs and Slots	Cut masonry 6 ft. wide by 14 ft. deep to water level. Good condition above water, not observable below water.

PERIODIC INSPECTION CHECK LIST

PROJECT Moodus Reservoir Dam DATE 5 July 1978
 INSPECTOR _____ DISCIPLINE _____
 INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - CONTROL TOWER</u>	
<p>a. Concrete and Structural</p> <p> General Condition</p> <p> Condition of Joints</p> <p> Spalling</p> <p> Visible Reinforcing</p> <p> Rusting or Staining of Concrete</p> <p> Any Seepage or Efflorescence</p> <p> Joint Alignment</p> <p> Unusual Seepage or Leaks in Gate Chamber</p> <p> Cracks</p> <p> Rusting or Corrosion of Steel</p> <p>b. Mechanical and Electrical</p> <p> Air Vents</p> <p> Float Wells</p> <p> Crane Hoist</p> <p> Elevator</p> <p> Hydraulic System</p> <p> Service Gates</p>	<p>Fair. Wood frame gatehouse built over gate operating mechanism. Most of the wood frame structure rests on the masonry portion of the dam over the intake structure. One corner of the gatehouse overhangs the reservoir and is propped up with a steel pipe on rod.</p> <p>Two manually operated vertical slide gates 36 inches apart center to center.</p>

PERIODIC INSPECTION CHECK LIST

PROJECT Moodus Reservoir Dam DATE 5 July 1978

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
<p><u>OUTLET WORKS - CONTROL TOWER (cont.)</u></p> <p>b. Mechanical and Electrical (cont.)</p> <p>Emergency Gates</p> <p>Lightning Protection System</p> <p>Emergency Power System</p> <p>Wiring and Lighting System</p>	

PERIODIC INSPECTION CHECK LIST

PROJECT Moodus Reservoir Dam DATE 5 July 1978

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
<p><u>OUTLET WORKS - TRANSITION AND CONDUIT</u></p> <p>General Condition</p>	<p>Unknown - not observable</p>

PERIODIC INSPECTION CHECK LIST

PROJECT Moodus Reservoir Dam DATE 5 July 1978
 INSPECTOR _____ DISCIPLINE _____
 INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL</u>	
General Condition	Good condition at outlet structure
Rust or Staining	Staining noted
Spalling	None observed
Erosion or Cavitation	None observed
Visible Reinforcing	N.A.
Any Seepage or Efflorescence	Slight seepage and efflorescence noted
Condition at Joints	Good, partially mortared
Drain holes	None. Mortar is missing from lower two courses of stone
Channel	Seven ft. by 3 ft. cut stone channel under roadway.
Loose Rock or Trees Overhanging Channel	Overgrown with trees and shrubs, clogged with debris, stone and timber
Condition of Discharge Channel	Poor, Channel has been filled in almost to top with sandy gravel

PERIODIC INSPECTION CHECK LIST

PROJECT Moodus Reservoir Dam DATE 5 July 1978
 INSPECTOR _____ DISCIPLINE _____
 INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
<p><u>OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS</u></p>	
<p>a. Approach Channel</p> <p>General Condition</p> <p>Loose Rock Overhanging Channel</p> <p>Trees Overhanging Channel</p> <p>Floor of Approach Channel</p>	<p>Straight natural bed</p> <p>Good</p> <p>None</p> <p>Weeds, brush and tree - extreme right side of channel. Underwater weeds visible in channel.</p> <p>Natural bed</p>
<p>b. Weir</p> <p>General Condition</p> <p>Rust or Staining</p> <p>Spalling</p> <p>Any Visible Reinforcing</p> <p>Any Seepage or Efflorescence</p> <p>Drain Holes</p>	<p>Vertical fall, broad crested (5 ft.), overflow weir. Upstream sloping.</p> <p>Cut stone masonry good condition</p> <p>Slight staining observed</p> <p>None observed</p> <p>N.A.</p> <p>Considerable leakage through joints.</p> <p>None</p>
<p>b¹. Training Walls</p> <p>General Condition</p> <p>Rusting or staining</p> <p>Spalling</p> <p>Any Visible Reinforcing</p> <p>Any Seepage or Efflorescence</p> <p>Drain Holes</p>	<p>Cut stone masonry. Fair to good condition</p> <p>Left training wall at gatehouse has some surface erosion behind wall.</p> <p>None observed</p> <p>None observed</p> <p>N.A.</p> <p>None observed</p> <p>None observed</p>

PERIODIC INSPECTION CHECK LIST

PROJECT Moodus Reservoir Dam DATE 5 July 1978
 INSPECTOR _____ DISCIPLINE _____
 INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
<p><u>OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS (cont.)</u></p> <p>c. Discharge Channel</p> <p> General Condition</p> <p> Loose Rock Overhanging Channel</p> <p> Trees Overhanging Channel</p> <p> Floor of Channel</p> <p> Other Obstructions</p>	<p>Natural stony bed with brush growth.</p> <p>Concrete apron - fair, channel fair to good.</p> <p>None</p> <p>None immediately at d.s. side of spillway. D.S. of roadway bridge, trees to 8 inch dia. grow profusely.</p> <p>Natural bedrock and cobbles.</p> <p>Bridge.</p>

PERIODIC INSPECTION CHECK LIST

PROJECT Moodus Reservoir Dam DATE 5 July 1978
 INSPECTOR _____ DISCIPLINE _____
 INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
<p><u>OUTLET WORKS - SERVICE BRIDGE</u></p> <p>a. Super Structure</p> <ul style="list-style-type: none"> Bearings Anchor Bolts Bridge Seat Longitudinal Members Under Side of Deck Secondary Bracing Deck Drainage System Railings Expansion Joints Paint <p>b. Abutment & Piers</p> <ul style="list-style-type: none"> General Condition of Concrete Alignment of Abutment Approach to Bridge Condition of Seat & Backwall 	<p>Not applicable</p>

APPENDIX B

1. Listing of Locations for available Design, Construction and Maintenance Records
2. Copies of Past Inspection Reports
3. Plans, Sections, Details

APPENDIX B-1

No Design Construction or Maintenance records could be located.

APPENDIX B-2

Only one inspection report could be located; it includes inspections at various times from 1972 to 1974.

STATE BOARD FOR THE SUPERVISION OF DAMS
INVENTORY DATA

ST-350

NAME OF DAM OR POND Moodus Reservoir

CODE NO. SL 2.0 M 4.1

LOCATION OF STRUCTURE:

Town East Haddam

Name of Stream Moodus River

U.S.G.S. Quad. Moodus Cont. _____ Lat. _____

OWNER:

Address Moodus Reservoir Company State Bk. of Fisheries & Game
East Haddam (Moodus) D.C.P.
_____ Hartford

Pond Used For: Recreation

Dimensions of Pond: Width _____ Length _____ Area 451A

Depth of Water below Spillway Level (downstream) 13' ✓

Total Length of Dam 200' Diameter of Spillway 100' 140ft ✓

Height of Abutments above Spillway 3' ✓

Type of Spillway Construction stone granite Black Capstones

Type of Dike Construction earth

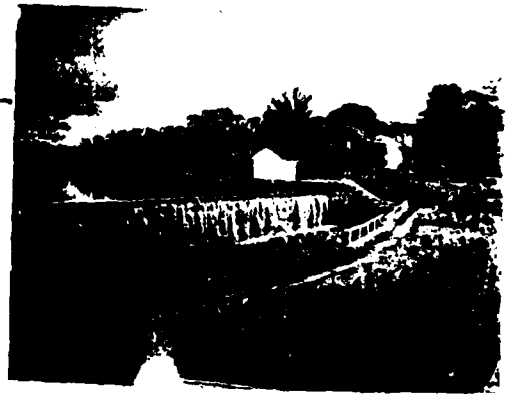
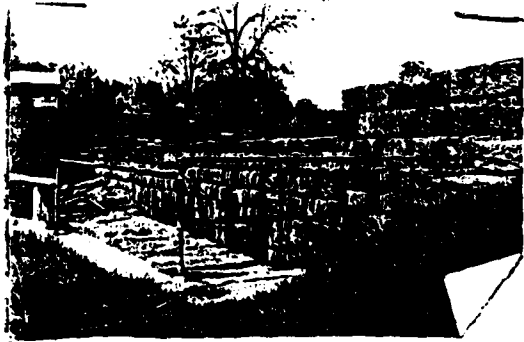
Downstream Conditions _____

Summary of File Data _____

Remarks This is a structure of major importance and should be inspected by the Board Member.

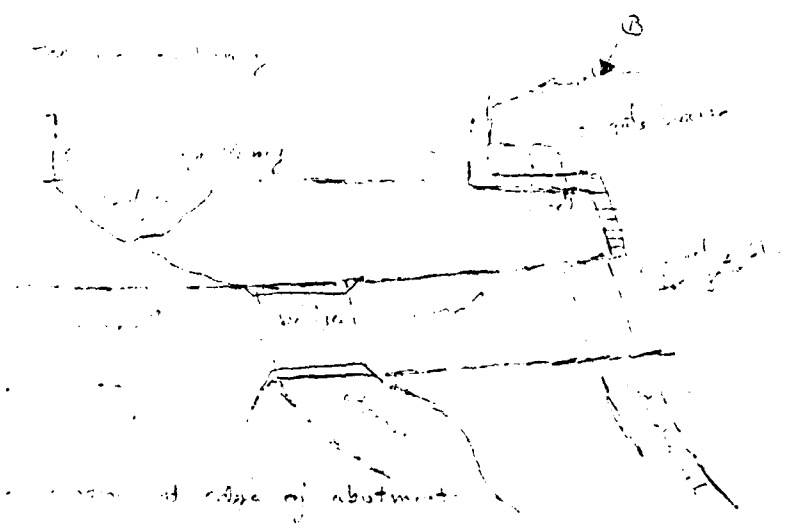
2 1/2 ft x 1 ft x 5 ft black capstone
100

x 8"



6/2 1927 ...
 general condition of dam appears in good condition w/ minor cracks
 in some joints

9/11/23 ...



⊙ must be checked at base of abutment

10-25-27 DAM IN SATISFACTORY CONDITIONS

REGION III

TOWNSHIP East Haddam NAME OF IMPOUNDMENT Moodus Res. (151 acres)

NEAREST STREET LOCATION Rt. 149

U.S.G.S. QUAD. SHOWING LOCATION OF DAM Moodus

NAME OF STREAM Moodus River

POND USED FOR Recreation

TYPE OF SPILLWAY CONSTRUCTION Stone

TYPE OF DIKE CONSTRUCTION Earth

TYPE OF DRAWDOWN CONSTRUCTION Two gate Valves

OPERABLE: YES NO EQUIPMENT NEEDED TO OPERATE Gate House

with equipment inside - locked

EQUIPMENT LOCATED WHERE Gate House

KEYS REQUIRED: YES NO LOCATION OF KEYS: ENTRANCE Gillette Castle

CONTROLS

PERSON TO CONTACT Donald Grant

TELEPHONE # OFFICE 526-2336 HOME 526-2015

DOWNSTREAM CONDITIONS THAT COULD RESTRAIN OPERATION OF GATES

Brownell Manufacturing Co. has small dam Johnsonville village- Johnsonville

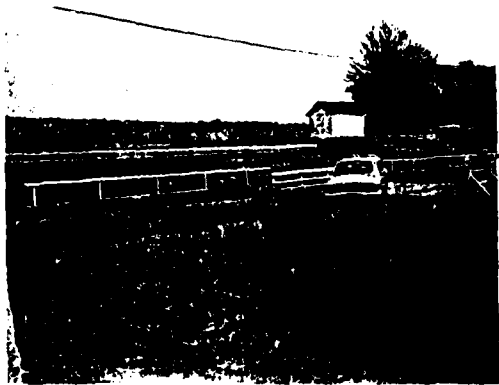
Pond Dam

POTENTIAL BENEFIT OF LOWERING DURING FLOOD WATCH

DESCRIBE DAMAGE THAT WOULD RESULT FROM DAM FAILURE Would quite likely wash out

Johnsonville Pond Dam.

7/22/72



III-11

Dam Inspection Report

Town: Modus

Date of Inspection: July 9, 1974

Name of Impoundment: Modus Reservoir

Remarks: A very sturdy dam in fine condition
no leakage noted at all almost level
also with water flowing over all the cap stones
evenly

A very long spillway section 140 ft by
measurement - 3 ft of free board I didn't
check the draw down situation

Recommendations: The draw down control should
be checked for good operation - splash
pad of concrete has deteriorated to some
extent but in the event of higher water
the spillage would hit a good section
pad up to 1' 6" from face

Owner notified: Phone _____ (date) _____ Letter: _____ (date)

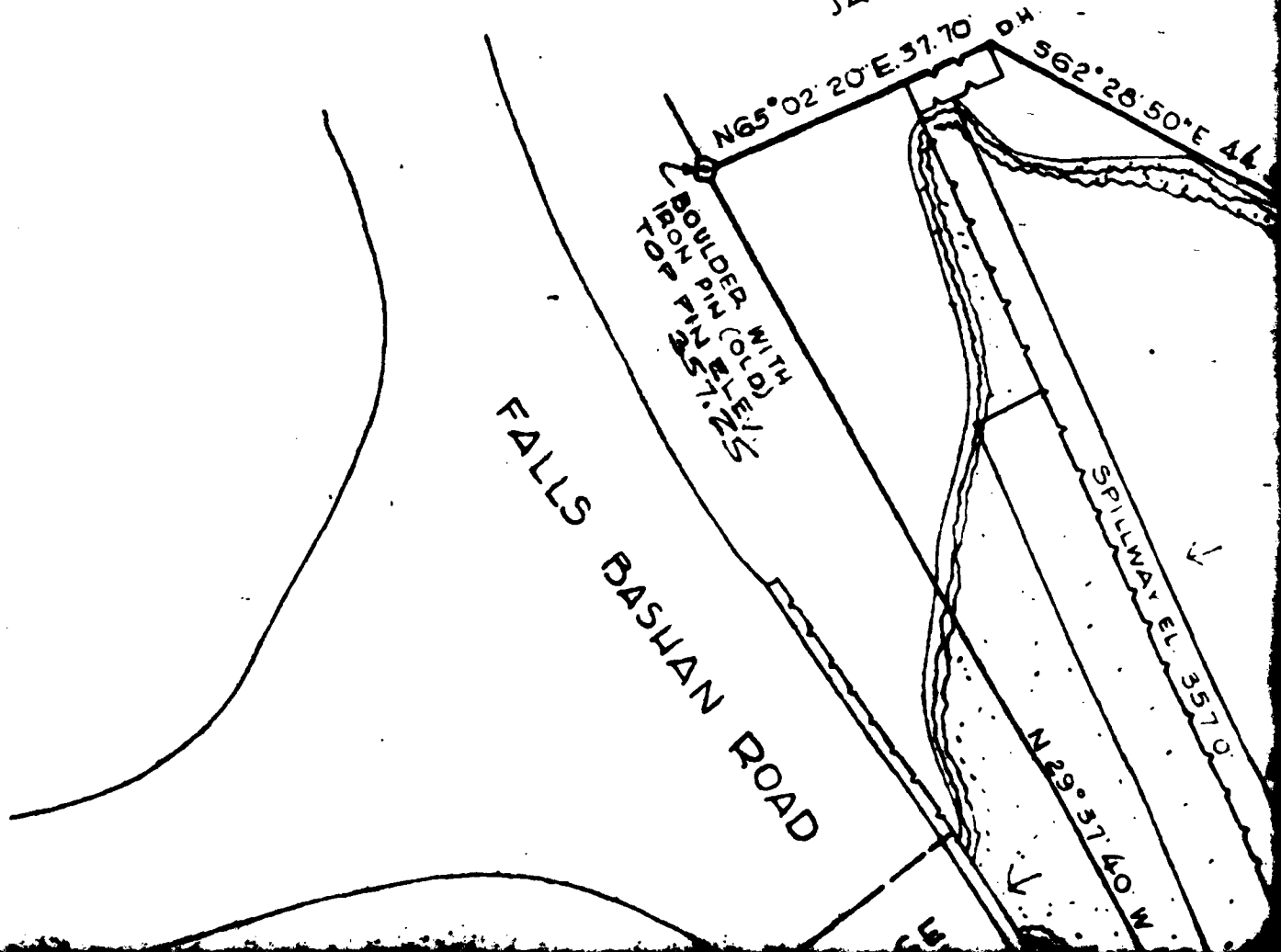
Drainage Area = 10.5 sq. miles Robert E. Somichsen
(Inspector's Signature)

APPENDIX B-3

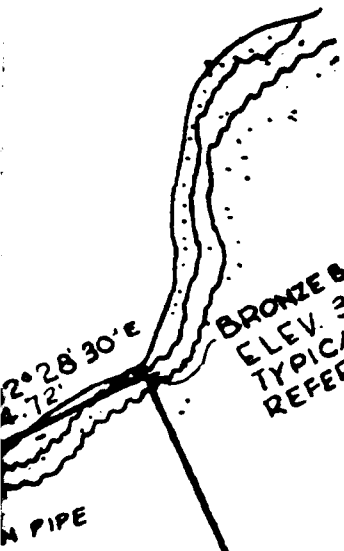
Plan obtained from State of Connecticut DEP showing detail of damsite.

No boring logs or other subsurface information were located.

MYRON R. BERNSTEIN
BK 81 PAGE 97
JAN 28, 1965



2



BRONZE BOLT IN LEDGE
ELEV. 357.0'
TYPICAL DISCRPTION
REFER TO SK. 40 PAGE G43

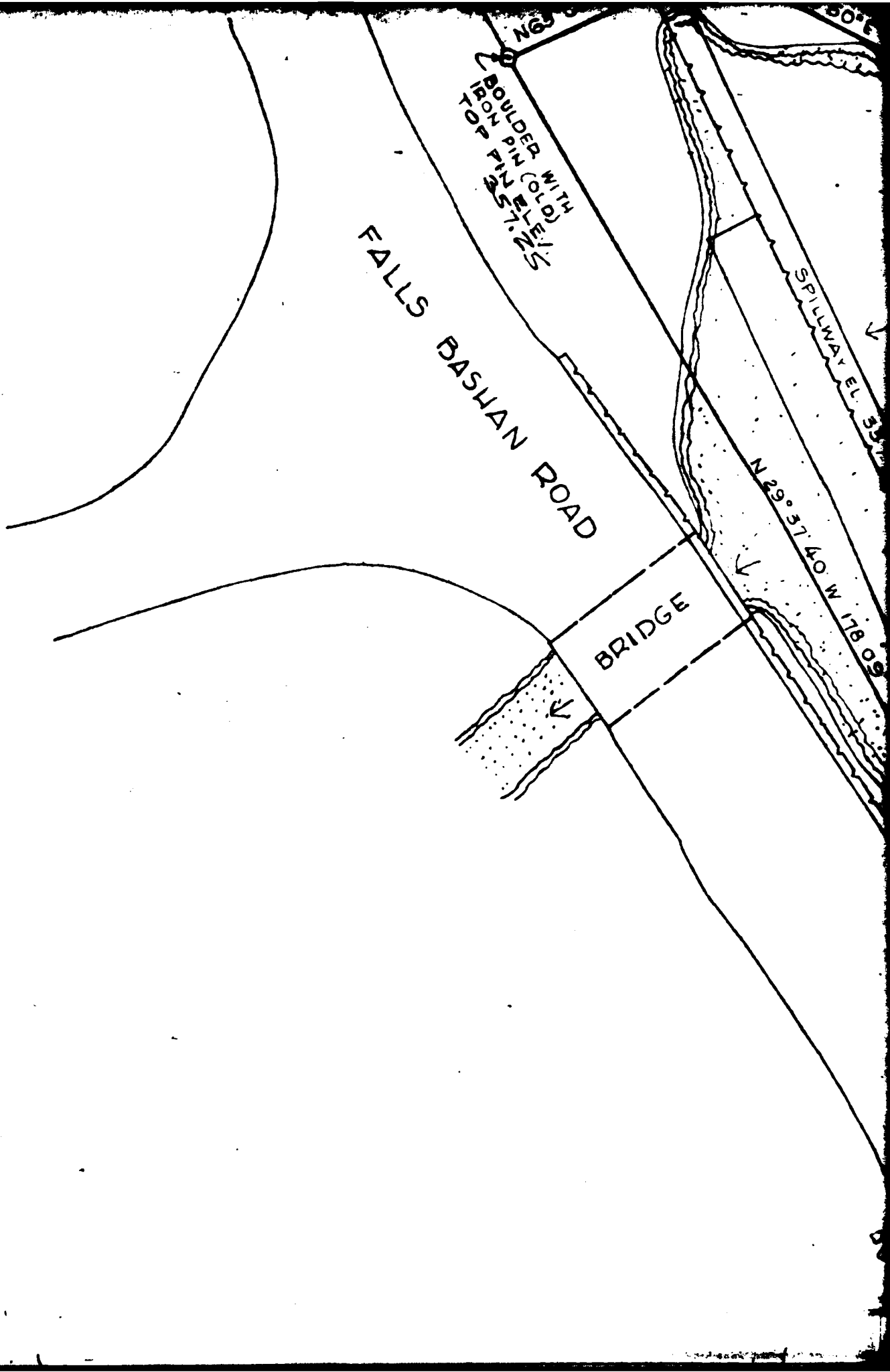
2° 28' 30" E
4.72'

PIPE

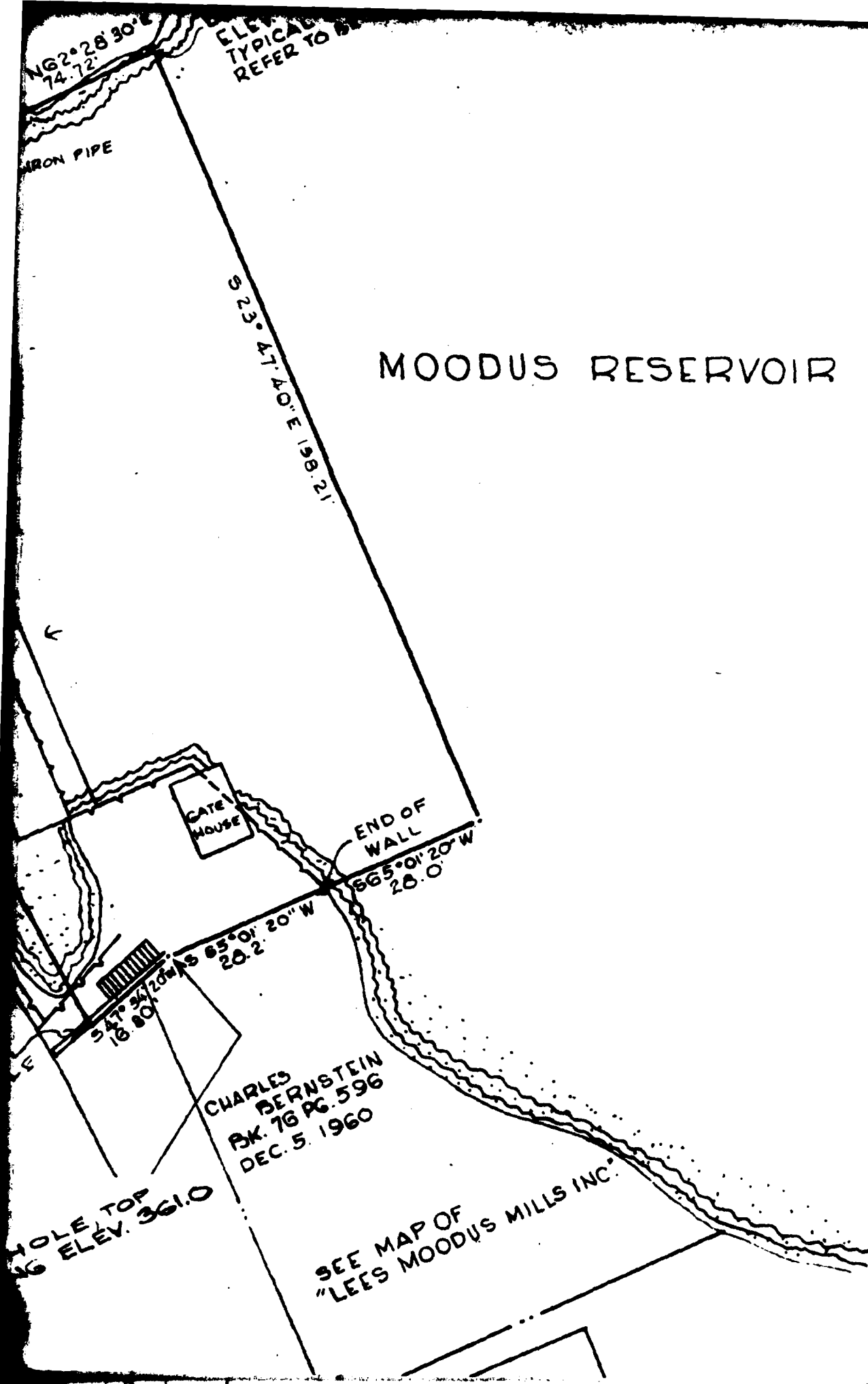
S 23° 47' 40" E 198.21'

MOODUS RESERVOIR

3



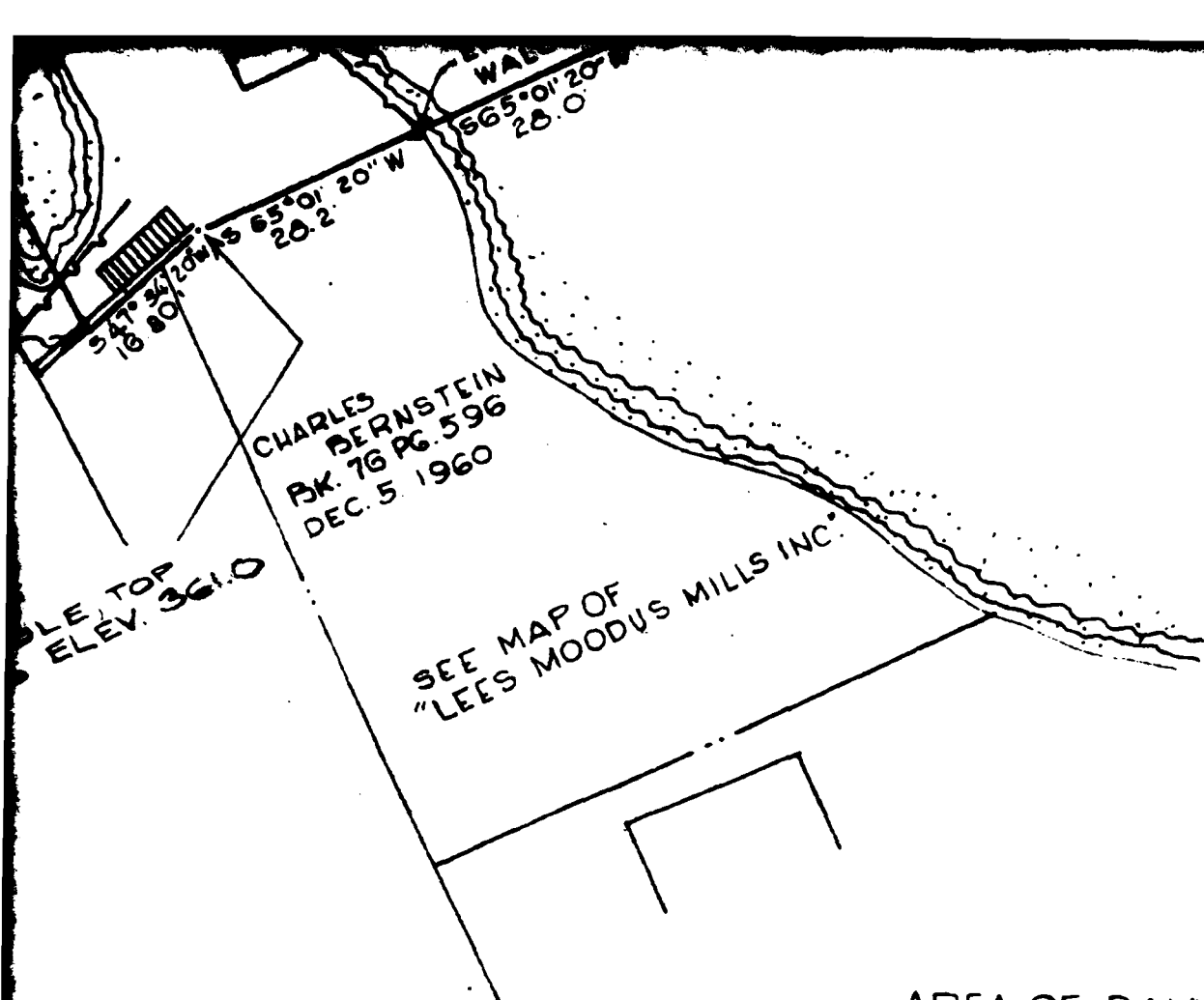
MOODUS RESERVOIR



DA
CA



Shepard B Palmer



CHARLES BERNSTEIN
BK. 76 PG. 596
DEC. 5 1960

LEES TOP
ELEV. 361.0

SEE MAP OF
"LEES MOODUS MILLS INC."

AREA OF DAM SITE
0.29± ACRES

DEED REFERENCE:
MOODUS RESERVOIR CO.
TO STATE OF CONN.
BK 83 PAGE 573
SEPT. 27, 1966
(PARCEL 1)

PLAN MADE FOR
STATE OF CONNECTICUT
DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES
SHOWING DAM SITE AT MOODUS RESERVOIR
IN THE TOWN OF EAST HADDAM CONNECTICUT

SCALE: 1" = 20 FT.

MAY 25, 1967

CHANDLER & PALMER, ENGRS.

NORWICH, CONN.

SHEET # 3 OF 3

APPENDIX C

PHOTOGRAPHS AND PHOTO INDEX PLAN

MYRON R. BEANSTEIN
SKB/ PAGE 97
JAN 28, 1965



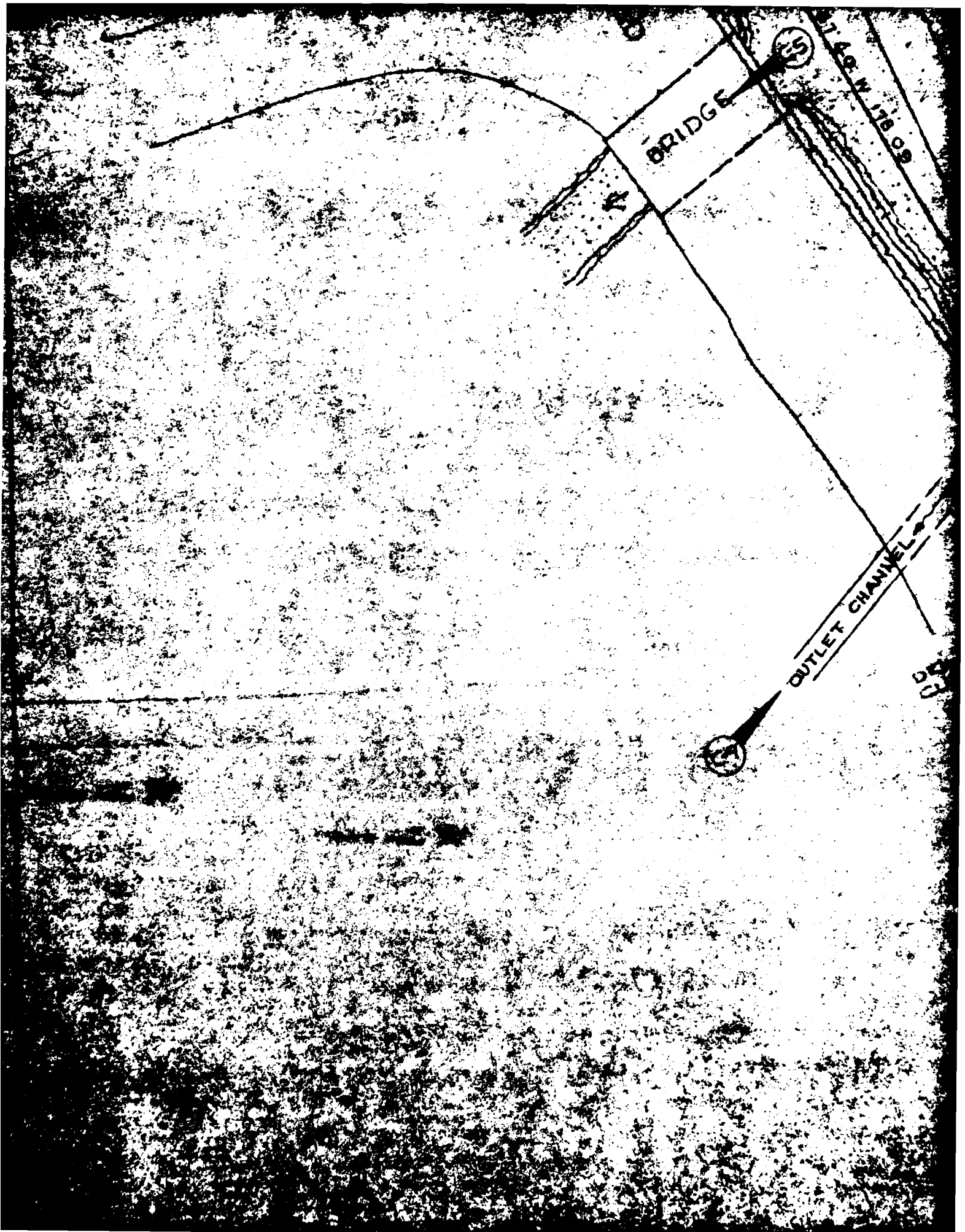
FALLS
BASHAN ROAD

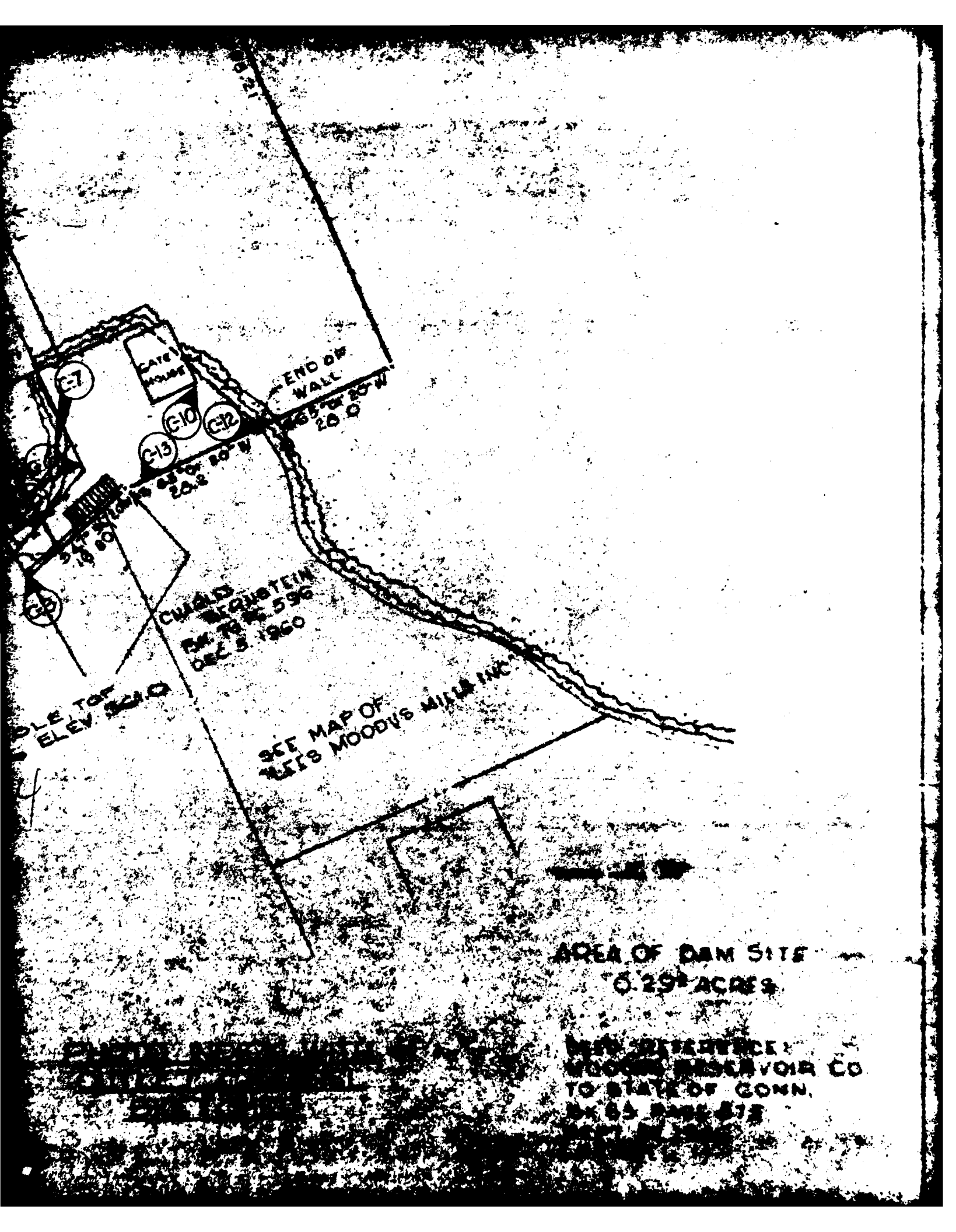
70' 00" 20' 00" 20' 00" 20' 00"
BORDER
WITH
MAY

$166^{\circ}02'20"E$ 37.70' 64
 $962^{\circ}30'50"E$ 44.56'

SPILLWAY

149.87' 49'





GATE HOUSE

END OF WALL

G-7

G-10

G-12

G-13

G-9

TOE TOP
ELEV. 221.0

CHARLES
BERNSTEIN
SM. 79 AC. 596
DEC. 5, 1960

SEE MAP OF
LEIS MOODY'S MILL INC.

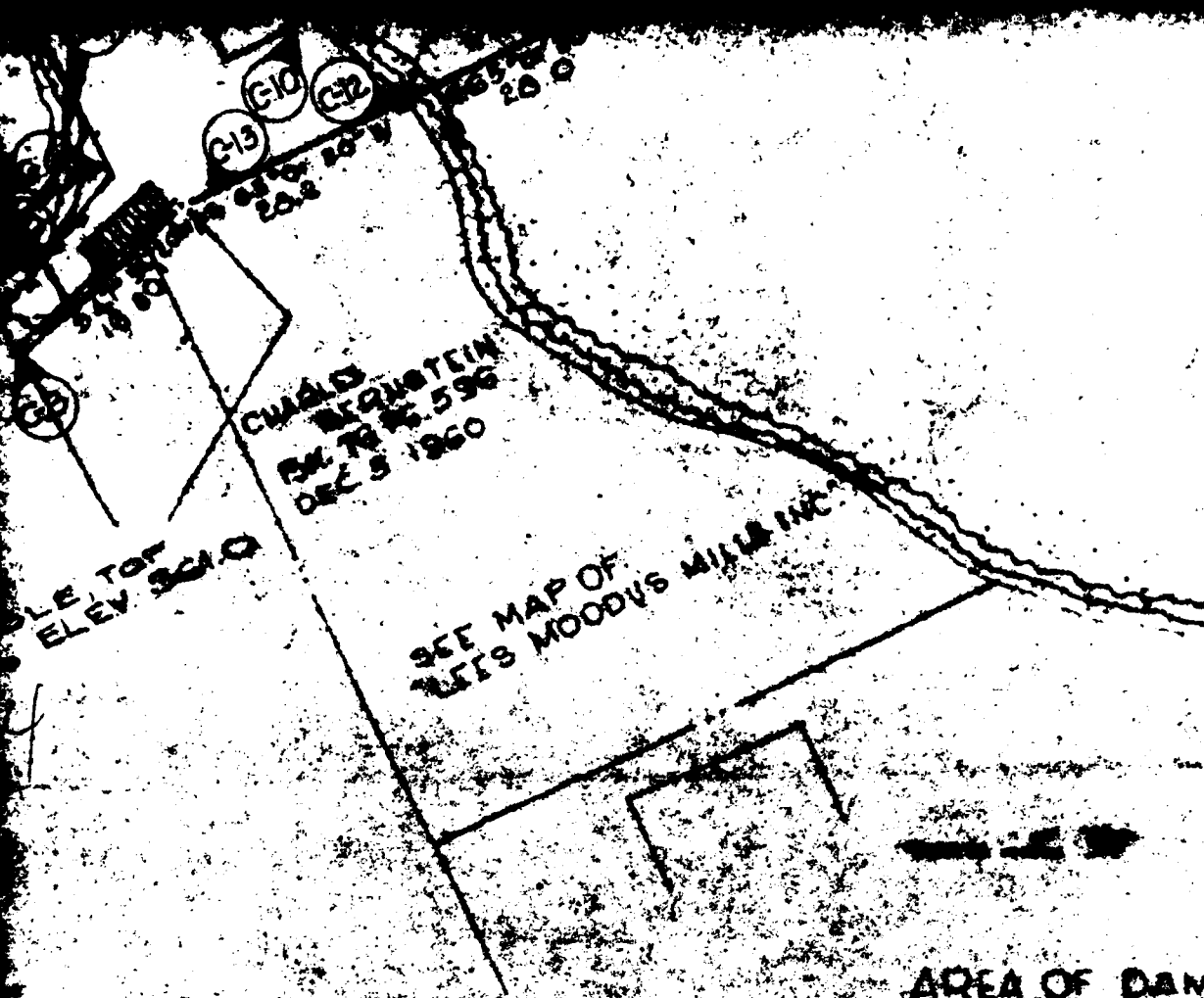
AREA OF DAM SITE
0.29 ACRES

FOR REFERENCE:
MOODY'S RESERVOIR CO.
TO STATE OF CONN.
EX. 65 PAGE 575

OUTLET CHANNEL

D.D.
CUT





AREA OF DAM SITE
0.29 ACRES

PHOTO INDEX WITH
OUTLET CHANNEL
SKETCHED

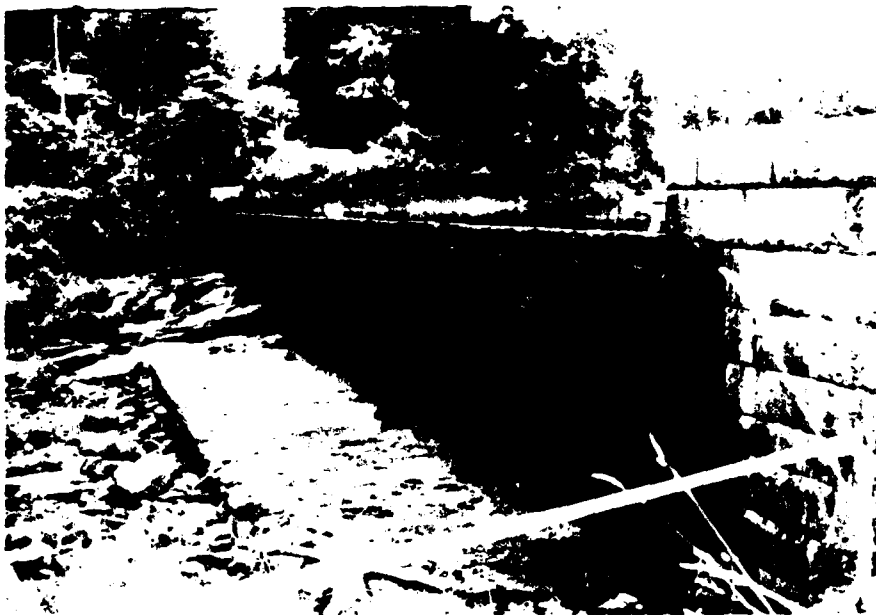
DEED REFERENCE:
MOODYS RESERVOIR CO
TO STATE OF CONN.
EX 63 PAGE 572
SEPT. 22, 1966
(SERIAL 1)

FOR
CONNECTICUT
AND OTHER RESOURCES
AND RECORDS
CONNECTICUT

HARTFORD, CONN.



C-2 SPILLWAY, GATEHOUSE AND LEFT ABUTMENT-LOOKING FROM RIGHT ABUTMENT.



C-3 RIGHT ABUTMENT AND SPILLWAY-LOOKING FROM LEFT ABUTMENT.



C-4 ROADWAY AND BRIDGE IMMEDIATELY DOWNSTREAM FROM DAM.



C-5 DOWNSTREAM CHANNEL BELOW HIGHWAY BRIDGE.



C-6 OUTLET CHANNEL FROM GATEHOUSE.



C-7 OUTLET CHANNEL FROM GATEHOUSE UNDER ROADWAY



C-8 OUTLET CHANNEL UNDER ROADWAY.



C-9 DOWNSTREAM OUTLET
WORKS' CHANNEL.



C-10 SURFACE EROSION AT
GATEHOUSE.

C-11 DETERIORATION OF SPILLWAY
APRON SLAB AT SPILLWAY FACE

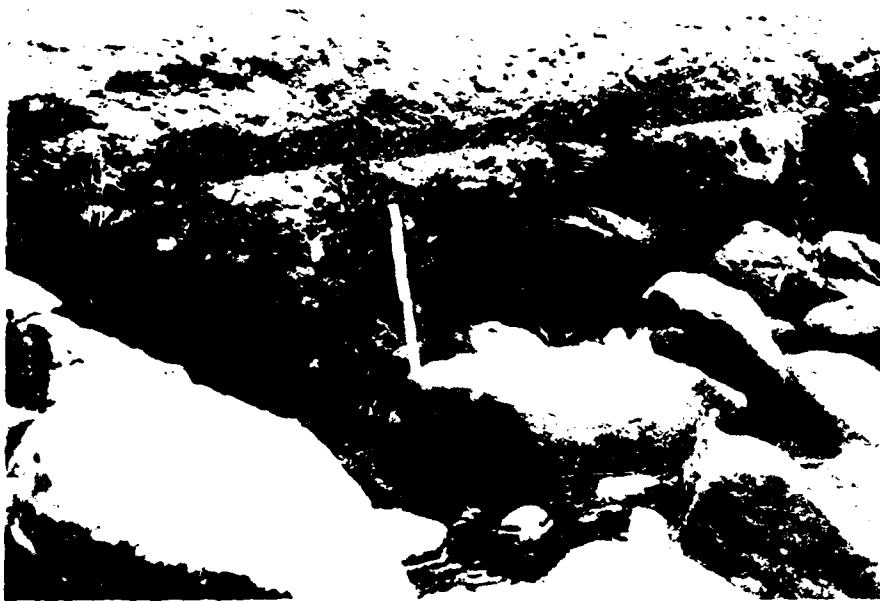




C-12 TREES AT WATERLINE AT LEFT ABUTMENT



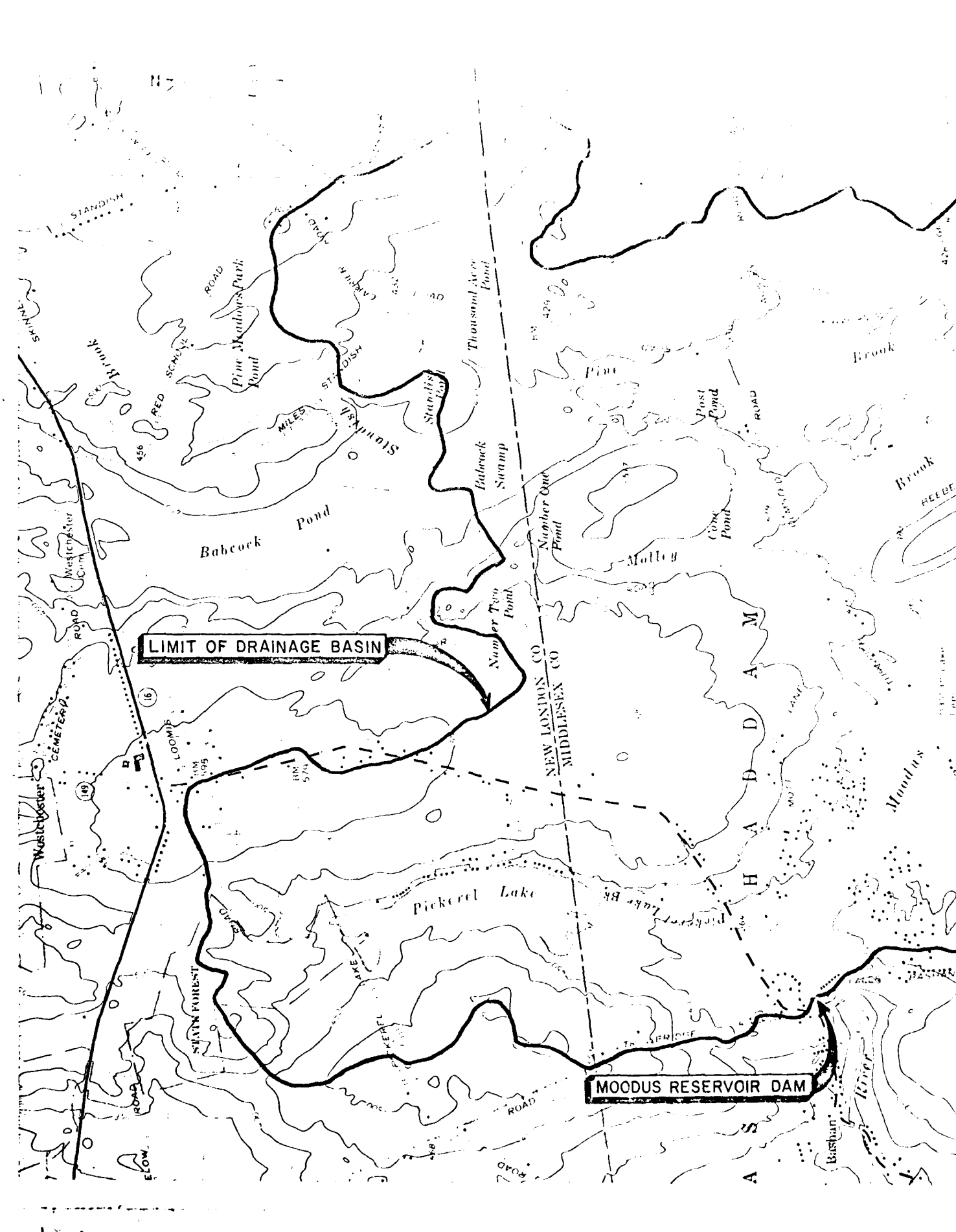
C-13 SURFACE EROSION FROM TRESSPASS AT GATEHOUSE



C-14 SEEPAGE BENEATH CONCRETE APRON AT SPILLWAY

APPENDIX D

HYDROLOGIC COMPUTATIONS



LIMIT OF DRAINAGE BASIN

MOODUS RESERVOIR DAM

NEW LONDON CO
MIDDLESEX CO

H
A
D
D
A
M

STANDISH

Babcock Pond

Pine Meadows Park Pond

Thousand Acre Pond

Babcock Swamp

Number One Pond

Number Two Pond

Post Pond

Cone Pond

Brook

REEBE Brook

Pickert Lake

Pickert Lake Bk

Moodus

STATE FOREST

149

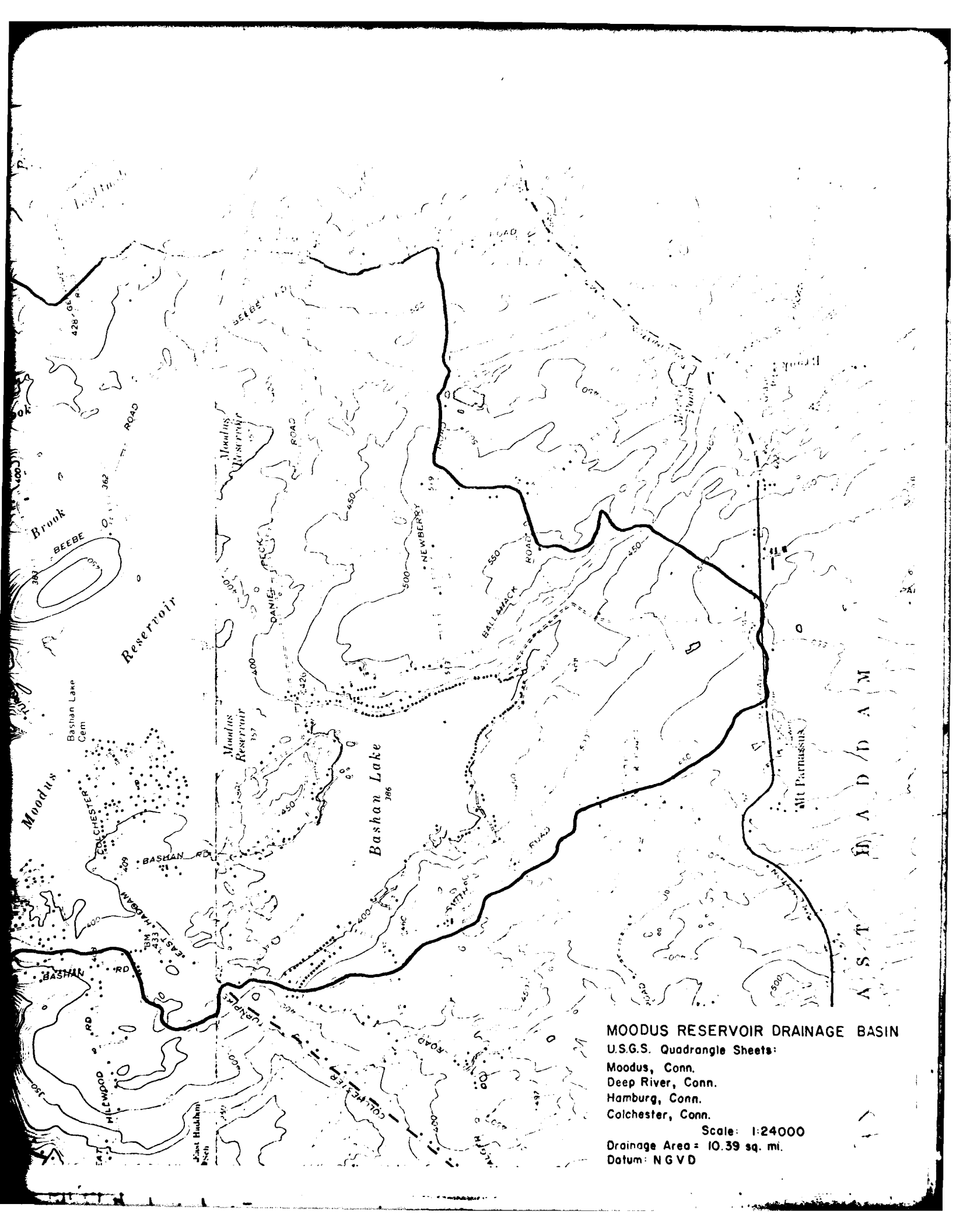
16

FLOW

ROAD

Bashan

WOOD



MOODUS RESERVOIR DRAINAGE BASIN
 U.S.G.S. Quadrangle Sheets:
 Moodus, Conn.
 Deep River, Conn.
 Hamburg, Conn.
 Colchester, Conn.
 Scale: 1:24000
 Drainage Area = 10.39 sq. mi.
 Datum: NGVD

A. Size Classification

Height of Dam = 15.0 feet; Hence SMALL

at crest elevation reservoir storage = 2940 AC-ft., hence INTERMEDIATE

adopted size category INTERMEDIATE

B. Hazard Potential

THE DAM IS LOCATED UPSTREAM FROM THE TOWN OF MOODUS
WITH SEVERAL HOUSES LOCATED DOWNSTREAM. FAILURE OF
THIS DAM MAY CAUSE LOSS OF A FEW LIVES AND MANY HOMES.
FAILURE WILL ALSO CAUSE APPRECIABLE ECONOMIC LOSS DUE
TO THE LOSS OF RECREATIONAL FACILITIES AND DISLOCATION
OF TRAFFIC AND UTILITIES BY ROADWAY WASHOUTS

It is estimated from the rule of "thumb" failure hydrograph as follows:

<u>Category</u>	<u>Loss of Life</u>	<u>Economic Loss</u>
		Homes = <u>YES</u>
		Buildings = <u>YES</u>
<u>SIGNIFICANT</u>	<u>YES</u>	Farms = <u>YES</u>
		Miscellaneous = <u>YES</u>
		Highways or roads = <u>YES</u>

C. Hazard Size "Test Flood" or Spillway Design Flood
SIGNIFICANT INTERMEDIATE 1/2 PMF TO PMF

Adopted S.D.F. (test flood) = 1/2 PMF

Adopted value of test flood due to watershed characteristics = 825 CSM

Estimating Maximum Probable Discharges - Inflow and Outflow Values Date of Inspection: 7/5/78

Name of Dam MOODUS RESERVOIR DAM; Location of Dam MOODUS RIVER Town EAST HADDAM, CT.

Watershed Characterization ROLLING HILLS WITH SWAMPS

Adopted "test" flood = HALF PMF = 825 CSM = 8662 C.F.S.

D.A. = Drainage Area = 10.5 Square Miles = 451 Acres

S.A. = Surface Area of Reservoir = 0.105 Square Miles = 451 Acres

Shape and Type of Spillway = FREE VERTICAL-BROAD CRESTED - VERTICAL OVERFALL

B = Width of Spillway = 140 feet; C = Coefficient of Discharge = (3.09 - Friction) = 3.00

Maximum Capacity of Spillway Without Overstopping = 2182 C.F.S. = 25.19 % of test flood

Top of Dam Elevation = 360.00; Spillway Crest Elevation = 357.00

Length of Dam = 275 feet

Name of Dam	Test Flood QP ₁ CSM	Inflow Characteristics		Outflow Characteristics First Approximation		Outflow Characteristics Second Approximation		Outflow Characteristics Third Approximation					
		h ₁ in feet	S ₁ in inc.	QP ₂ CFS	h ₂ in feet	S ₂ in inc	h ₃ in ft.	QP ₃ CFS	S ₄ in inc.	h ₄ in ft.	QP ₄ CFS		
1	2	3	4	5	6	7	8	9	10	11	12	13	14
MOODUS RESERVOIR	825	8662	7.51	6.05	8662	7.51	6.05	4.67	5.80	5357	5.36	6.65	6898

NOTE: Outflow discharge values are computed as per C.O.E. guidelines but with due consideration given to storage in reservoir and maximum spillway capacity.

Overtopping Potential

Spillway crest elevation = 357.0 M.S.L.

Top of dam elevation = 360.0 M.S.L.

Maximum discharge capacity of)
Spillway without overtopping) = 2182 C.F.S.

"Test flood" outflow discharge = 6298 C.F.S.

% of "Test flood" carried by)
Spillway without overtopping) = 31.6% 1

"Test flood" outflow discharge = 4716 C.F.S.
which flows over the dam

= 68.4 % of "Test flood" 2

1 + 2 = 100%

"Rule of Thumb Guidance for Estimating
Downstream Dam Failure Hydrograph"

BASIC DATA

Name of dam Moodus Reservoir Dam Name of town East Haddam, Conn.
 Drainage area = 10.50 sq.mi. Top of dam 360.00 NGVD
 Spillway type = Free-broad crest overflow. Crest of spillway 357.0 NGVD
 Surface area at crest elevation = 451 acres
 Reservoir bottom near dam = 345 NGVD
 Assumed side slopes of embankments = 2:1
 Depth of reservoir at dam site = 15.0 ft. = y_o = 15.0 ft.
 Mid-height elevation of dam = 351.50 NGVD
 Length of dam at crest = 275 ft.
 Length of dam at mid-height = 195 ft.
 40% of dam length at mid-height = W_b = 78 ft.

Step 1:

Elevation NGVD	Reservoir Estimated Storage In AC-ft.
357.0	2940
358.0	3391
359.0	3842
360.0	4293
361.0	4744
362.0	5195

Step 2:

$$Q_{p1} = \frac{8}{27} W_b \sqrt{g} y_o^{3/2}$$

$$= \underline{1.68} W_b y^{3/2} = 7613 \text{ CFS}$$

Note: Failure of dam is assumed to be instantaneous when pool reaches top of dam.

DAM FAILURE ANALYSIS

MOODUS RESERVOIR DAM

1. Failure discharge with pool at top of dam = 7613 CFS
2. Depth of water in reservoir at time of failure = 15 feet
3. Maximum depth of flow downstream at dam at time of failure = 10 feet
4. Water surface elevation just downstream of dam at time of failure = 355.0 NGVD

Johnson Pond is located 600 feet downstream of Moodus Dam. Valley storage between Moodus Dam and Johnson Pond is not significant in reducing the discharge. There is a 75-foot drop into Johnson Pond which will cause the dissipation of wave and kinetic energy of the failure discharge. Consequently, it is estimated that the watersurface elevation between Moodus Dam and Johnson Pond will be 355 NGVD. The discharge below Johnson Pond will flow obeying Manning's Formula as a uniform flow. It is estimated that the depth of flow below Johnson Pond will be 7 feet in the channel assuming a bottom width of 52 feet. The flow will have the following hydraulic characteristics until the channel joins the Salmon River.

Q = 7613 CFS
s = 0.03
n = 0.05 (weighted)
b = 52 feet
d = 7 feet
sideslopes = 1V on 2H

The increase of depth in Johnson Pond due to failure of Moodus Reservoir Dam is estimated to be 3 ft.±.

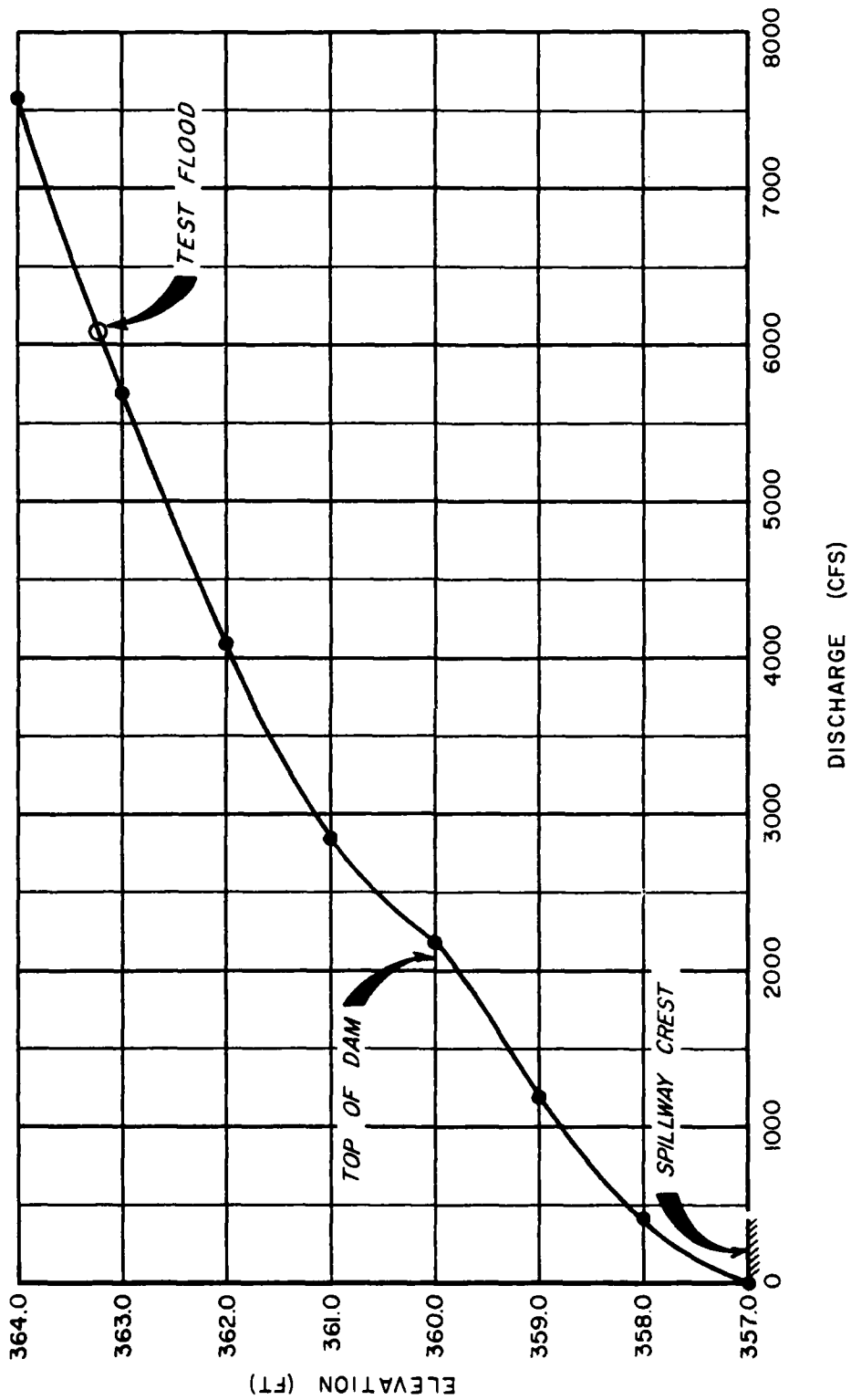
Spillway Rating Curve Computations
Moodus Reservoir Dam

Spillway Width = 140 ft.;
Length of Dam = 275 ft.;
C = 3.0

Spillway Crest Elevation = 357.0 NGVD
Top of Dam Elevation = 360.0 NGVD

Elevation (ft.) NGVD	Discharge (CFS)	Remarks
357.0	0	Spillway Crest
358.0	420	
359.0	1188	
360.0	2182	Top of Dam
361.0	2857	
362.0	4091	
363.0	5689	
364.0	7582	

<u>Frequency and Discharge (CFS)</u>	<u>Elevation (Ft.) NGVD</u>
Q ₁₀ = 947	358.72
Q ₅₀ = 2250	360.20
Q ₁₀₀ = 2535	360.65
Test Flood (1/2 PMF) = 6898	363.65



SPILLWAY RATING CURVE
MOODUS RESERVOIR DAM

APPENDIX E

INVENTORY FORMS

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