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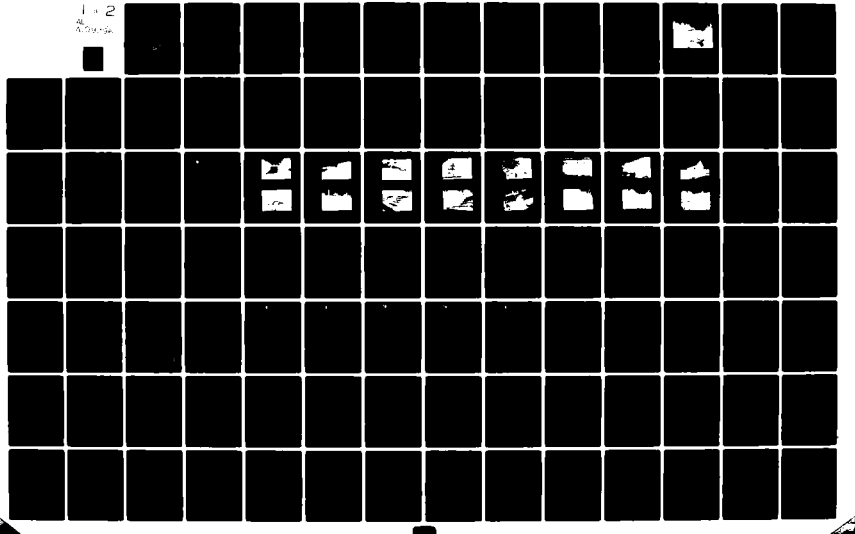

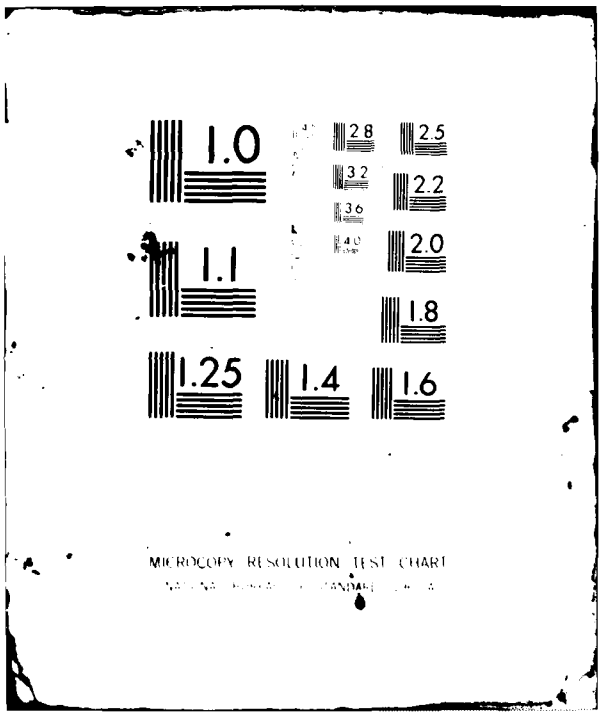
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LEVEL II

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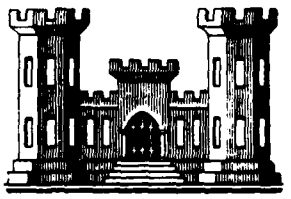
SUSQUEHANNA RIVER BASIN

LAKE LUDLOW CLUB DAM

CHENANGO COUNTY, NEW YORK
INVENTORY No. NY 350

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM



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NEW YORK DISTRICT, CORPS OF ENGINEERS
JULY 1981

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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Lake Ludlow Club Dam
Chanango County
Susquehanna River Basin

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

This report presents information and analysis on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam by the performing organization.

Examination of available documents and a visual inspection of the dam did not reveal conditions which constitute an immediate hazard to human life or property. However, the dam has some deficiencies that need to be evaluated and remedied. →

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

Using the Corps of Engineers' screening criteria for the initial review of spillway adequacy, it has been determined that the embankment would be overtopped by all storms exceeding 38 percent of the Probable Maximum Flood (PMF). Dam overtopping, the resulting erosion of the embankment and hence, dam breaching would cause water surface levels downstream to reach depths which would pose significant danger to residents. Therefore, the spillway is adjudged to be seriously inadequate and the dam is assessed as unsafe, nonemergency.

The classification "unsafe" applied to a dam because of a seriously inadequate spillway is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. It does mean that there appears to be a serious deficiency in spillway capacity and if a severe storm were to occur, overtopping and failure of the dam could take place, significantly increasing the hazard to life downstream of the dam.

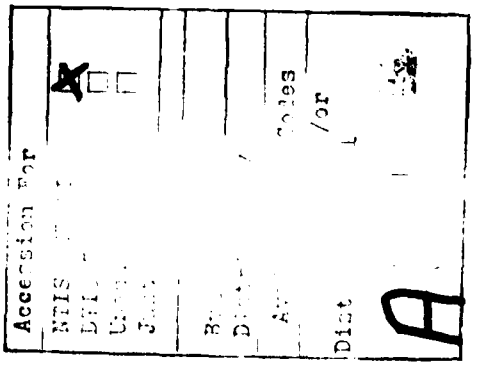
PREFACE

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 frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

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.



PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
LAKE LUDLOW CLUB DAM
INVENTORY NO. NY 350
SUSQUEHANNA RIVER BASIN
CHENANGO COUNTY, NEW YORK

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APPENDICES

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Lake Ludlow Club Dam

State Located: New York

County: Chenango

Watershed: Susquehanna River Basin

Watercourse: Ludlow Creek

Date of Inspection: April 8, 1981

ASSESSMENT

Examination of available documents and a visual inspection of the dam did not reveal conditions which constitute an immediate hazard to human life or property. However, the dam has some deficiencies that need to be evaluated and remedied.

Using the Corps of Engineers' screening criteria for the initial review of spillway adequacy, it has been determined that the embankment would be overtopped by all storms exceeding 38 percent of the Probable Maximum Flood (PMF). Dam overtopping, the resulting erosion of the embankment and hence, dam breaching would cause water surface levels downstream to reach depths which would pose significant danger to residents. Therefore, the spillway is adjudged to be seriously inadequate and the dam is assessed as unsafe, nonemergency.

The classification "unsafe" applied to a dam because of a seriously inadequate spillway is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. It does mean that there appears to be a serious deficiency in spillway capacity and if a severe storm were to occur, overtopping and failure of the dam could take place, significantly increasing the hazard to life downstream of the dam.

It is recommended that the following additional investigations be performed by a registered professional engineer engaged by the owner:

1. Conduct a detailed hydrologic and hydraulic analysis to more accurately determine the site specific characteristics of the watershed.

2. Monitor the seepage that was evident at the downstream end of the right spillway retaining wall, including observation when the uphill seepage is not active, evaluate the cause and recommend remedial measures, if appropriate.

3. There appeared to have been past erosion from heavy spillway discharge behind the stepped spillway retaining walls; therefore, evaluate the height of erosion protection that is necessary above these walls, and recommend measures to provide this protection.

It is recommended that within 3 months of the final approval date of this report, all of the additional investigations should be initiated and within 18 months, appropriate remedial measures should be completed. In the interim, a plan for providing around-the-clock surveillance of the dam during periods of unusually heavy precipitation should be developed and implemented.

The following remedial measures should be completed within 12 months to correct existing deficiencies:

1. Clear the brush and trees from the embankments, establish a vegetative cover, and cut the grass and weeds on the embankments at least annually.

2. Regrade and fill the low area at the right abutment (natural spillway) up to the level of the top of the core wall, reshape major embankment irregularities, and reestablish vegetative cover on all graded areas.

3. Place rockfill or riprap erosion protection upstream of the left spillway retaining wall and enlarge protected area upstream of right spillway retaining wall.

4. Remove the apparent remains of the concrete core wall of the dam that washed out in 1935 as well as the fallen logs, brush and man-made debris to permit unrestricted flow in the downstream channel.

5. Develop and implement a flood warning and emergency evacuation plan to alert the downstream residents in the event conditions occur which could result in failure of the dam.

6. A program for regular maintenance should be developed and implemented.

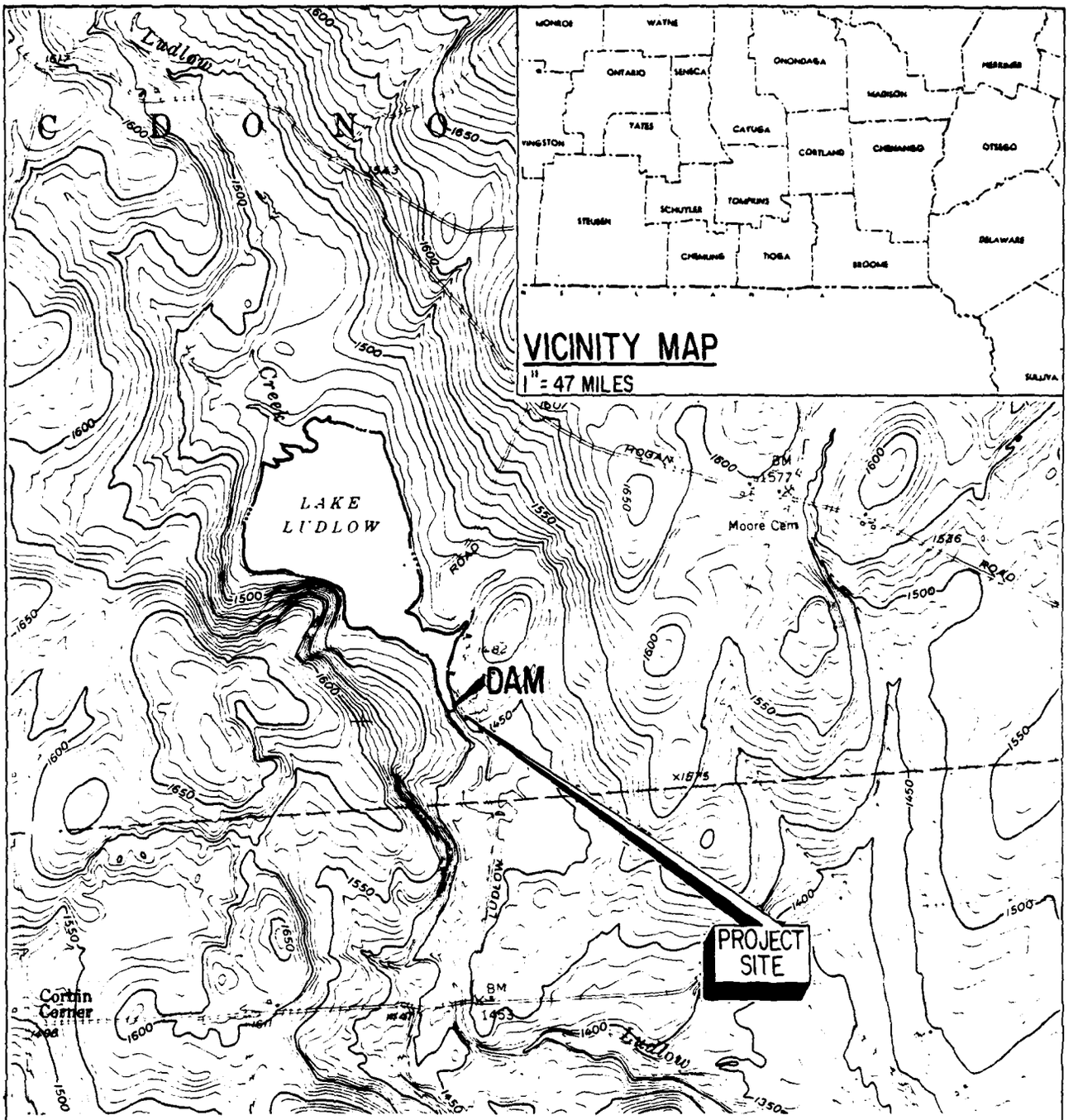
Submitted by: FLAHERTY GIAVARA ASSOCIATES, P.C.

Hugh C. Flaherty, P.E. & L.S.
Chairman of the Board
New York License No. 58508

Approved by: Col. W. M. Smith, Jr.
New York District Engineer

Date: 14 Sept 81

PHOTO #1: Overview of
Lake Ludlow Club Dam
Inventory No. NY 350



LOCATION MAP

LAKE LUDLOW CLUB DAM
INVENTORY No. NY 350

SUSQUEHANNA RIVER BASIN
CHENANGO COUNTY
Mc DONOUGH, NEW YORK

FLAHERTY · GIAVARA ASSOCIATES P.C.

NATIONAL DAM SAFETY PROGRAM
PHASE I INSPECTION REPORT
LAKE LUDLOW CLUB DAM
INVENTORY NO. NY 350
D.E.C. NO. 106A-1119
SUSQUEHANNA RIVER BASIN
CHENANGO COUNTY, NEW YORK

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

The Phase I Inspection reported herein was authorized by the Department of the Army, New York District, Corps of Engineers, to fulfill the requirements of the National Dam Inspection Act, Public Law 92-367. Flaherty Giavara Associates, P.C. has been retained by the New York District to inspect and report on selected dams in the State of New York. Authorization and notice to proceed was issued to Flaherty Giavara Associates, P.C. under a letter of December 24, 1980 from W. M. Smith Jr., Colonel, Corps of Engineers. Contract No. DACW 51-81-C-0006 has been assigned by the Corps of Engineers for this work.

b. Purpose

Evaluation of the existing conditions of the subject dam to identify deficiencies and hazardous conditions, determine if they constitute hazards to life and property and recommend remedial measures where necessary.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

Lake Ludlow Club Dam consists of an earthen embankment with a nearly full-width stepped overflow spillway originally constructed of rockfill but which is now capped with concrete on the downstream face. It was constructed in 1937 to replace an earlier dam that had washed out in the flood of July 8, 1935. The total length of the reconstructed dam is approximately 130 feet. A plan, section and elevation view of the 1937 dam are shown in Appendix G.

The dam embankment extends a short distance on either side of the 70 foot wide overflow spillway to abutments at the valley slopes. A concrete core wall projects above the side embankments and extends down through the

embankments and the spillway section to at least 5 feet "below grade of impervious hardpan". The dam height to the top of the core wall is approximately 24 feet. The upstream slope is shown on the 1937 plan as 3 horizontal to 1 vertical, and the average downstream spillway slope is similar. The earth embankment material is not known; the overflow spillway was constructed of timber cribbing with rockfill and planking, but it is now concrete steps with a concrete apron. There is a low, stepped concrete retaining wall on each side of the spillway, and there are weep holes in the vertical face of the lowest spillway step. There is also a natural spillway at the right abutment beyond the end of the core wall. The short side embankments have a cover of trees and brush, with no upstream erosion protection.

b. Location

The Lake Ludlow Club Dam is located off Ludlow Road approximately 2.8 miles northwest of the village of Tyner in the Town of McDonough, New York. The dam is located at latitude north 42°-27.5' and longitude west 75°-42.2' on the U.S. Geological Survey 7.5 minute series topographic map "Tyner, New York". The Location Map on page i indicates where the dam is situated.

c. Size Classification

The maximum height of the dam is 24 feet and the maximum storage capacity is 1220 acre-feet at the top of dam. Therefore, Lake Ludlow Club Dam is classified as an "Intermediate" dam as defined by the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification

There are three roads (including New York State Route 12), approximately 3 dwellings, 3 barns and a church within the dam failure flood hazard area. Additionally, on July 8, 1935, the Lake Ludlow Club Dam failed during an extremely heavy rainstorm which resulted in extensive property damage in Tyner (See Photo No. 16) and the loss of three lives in South Oxford (See Photo No. 17). A copy of a newspaper article relating these events and Flood Impact Maps showing where they occurred are included on pages D-21 through D-23 in Appendix D. Therefore, the dam is in the "High" hazard category as defined by the Recommended Guidelines for Safety Inspection of Dams.

e. Ownership

The dam is owned by the Lake Ludlow Club, Inc. The address and telephone number are as follows:

Owner

Contact: Lake Ludlow Club, Inc.
Ludlow Road
McDonough, New York 13801

Telephone: (607) 843-9404

f. Purpose

The primary purpose of this dam is to maintain the water level of the lake for recreational use.

g. Design and Construction History

The original date of construction is not known; however, it was sometime prior to 1925 when the dam was reconstructed making use of "a dry, laid up stone wall" which remained from the original dam.

On July 8, 1935, the dam built in 1925 failed during an extremely heavy rainstorm. The dam was then reconstructed in 1937, having been designed by H. C. Schloer and engineered by L. G. McCauley of Sidney, New York.

The only major post construction modification noted was the concrete cap over the rockfill and timber cribbing in August, 1961.

h. Normal Operating Procedure

There are no regular operating procedures for this dam. The normal water level in the lake is maintained by the crest elevation of the spillway weir at 1459.0 (NGVD).

1.3 PERTINENT DATA

a. Drainage Area (Square Miles)	6.34
b. Discharge at Dam Site (CFS)	
- Top of Dam	2864
- Crest of Natural Spillway	2092
- Crest of Overflow Spillway	-

c. Elevations (NGVD)

- Top of Dam	1464.7
- Crest of Natural Spillway	1463.7
- Crest of Overflow Spillway	1459.0

d. Reservoir Surface Area (Acres)

- Top of Dam	153
- Crest of Natural Spillway	-
- Crest of Overflow Spillway	100

e. Storage (Acre-Feet)

- Top of Dam	1220
- Crest of Natural Spillway	-
- Crest of Overflow Spillway	500

f. Dam

- Type: Earthfill with a projecting concrete core wall	
- Length (Feet)	130
- Upstream Slope (H:V)	3:1
- Downstream Slope (H:V)	3.3:1
- Crest Width (Feet)	1.5

g. Overflow Spillway

- Type: Stepped spillway consisting of timber cribbing and rock-fill with a concrete cap and concrete abutments and apron	
- Length (Feet)	67
- Width (Feet)	47
- Side Slopes (H:V)	vertical
- Channel Bottom Slopes (Feet/Foot)	
upstream	-
downstream (average)	0.030
- Control: None	

h. Natural Spillway

- Type: Two-stage earthen weir with an earthen discharge channel	
- Length (Feet)	
left weir	18±
right weir	10±
- Width (Feet)	5±
- Control: None	

i. Reservoir Drain

No reservoir drain is known to exist.

SECTION 2 - ENGINEERING DATA

2.1 GEOTECHNICAL DATA

a. Geology

The Lake Ludlow Club Dam is located on Ludlow Creek, an easterly flowing tributary to the Chenango River, about 2.8 miles northwest of the village of Tyner in the Allegheny Plateau physiographic province of New York State.

The topography in the area ranges from elevation 1440 at the downstream toe of the dam to elevation 1700 at the summits of the hills surrounding the dam and reservoir area.

The underlying bedrock at the site consists of the Ithaca Formation, belonging to the Upper Devonian Genesee group. This formation consists of coarse silty shales, siltstones and sandstones that were deposited in a shallow water, near-shore setting of the Catskill Delta that prograded across the state from east to west.

Above the bedrock, the valley bottom and side slopes are mantled by a heterogeneous mixture of clay, silt, sand and rock fragments known as glacial till, deposited at the base of ice sheets which once covered the region. Glacial outwash sands and silts may overlie the till in the bottom of the valley.

b. Subsurface Conditions

There is no record of subsurface explorations at the site of the Lake Ludlow Club Dam. A July 25, 1925 letter regarding a site visit during construction of the earlier dam refers to "clay hardpan" and "dense blue clay" with "small stones", indicating that the foundation material is probably glacial till.

2.2 DESIGN RECORDS

Some design information for the 1925 dam is included in Appendix D. No other design records were obtained.

2.3 CONSTRUCTION RECORDS

This dam was constructed in 1937. A plan, section and elevation view of the dam are included in Appendix G. No other construction records were obtained.

2.4 OPERATION RECORDS

No operation records were obtained for this dam.

2.5 EVALUATION OF DATA

The data presented herein was obtained primarily from the files of the New York State Department of Environmental Conservation (DEC). This information appears to be reliable and adequate for the purposes of a Phase I Inspection Report.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General

A visual inspection of the Lake Ludlow Club Dam was conducted on April 8, 1981. The weather was sunny and the temperature was 60± °F. At the time of the inspection, water was flowing in the overflow spillway (See Photos No. 5 and 7).

b. Dam

The dam has a short embankment section on each side of the overflow spillway (See Photos No. 8 and 9); these embankments are generally in fair condition. The irregular configuration tended to obscure any evidence of lateral movement or settlement, but there was some local erosion and possible seepage.

The following specific items were noted:

1. Most of the slopes and crest of the embankment had a moderate growth of brush and trees ranging up to about 15 inches in diameter (See Photos No. 3, 4, 5, 6, 7, 8, 9 and 13). There was considerable trash on the downstream slope of the left embankment.

2. The embankments were irregular, and for the most part there was no well-defined crest (See Photos No. 3 and 6). At the right end of the projecting core wall, and about 18 feet further right near the valley slope, the ground surface was a foot or more below the level of the top of the core wall and led to an earthen discharge channel (See Photo No. 13).

3. Slight seepage flow was exiting from the bottom of the right channel slope at and a short distance downstream from the end of the right spillway retaining wall (See Photo No. 11). There was no evident soil movement in the flow; the seepage appeared to be a continuation of downhill seepage that was observed further up above the lake level on the abutment (valley) slope, rather than seepage through or under the dam embankment.

4. The stepped spillway retaining walls were not high enough to fully protect the adjacent embankments (See Photos No. 8 and 9). There appeared to have been past erosion from heavy spillway discharge, exposing pieces of old timber both upstream and downstream from the walls. Rock fragments on the slopes above

the walls were either part of the original spillway construction, or had been placed as erosion protection.

5. Except for several concrete slab fragments to the right of the spillway (See Photo No. 3), there was no upstream erosion protection. However, there was also little evidence of wave action.

c. Overflow Spillway

The overflow spillway is in good condition consisting of a 67 foot long broad-crested weir and stepped discharge (see close-up in Photo No. 12) constructed of timber cribbing and rockfill and having a concrete cap. Remains of the timber cribbing were observed at the end of the stepped concrete retaining wall on either side of the spillway (See Photos No. 10 and 11).

d. Natural Spillway

This natural earthen two-stage weir is approximately 28 feet long, located between the end of the core wall and the right abutment. A 5± foot wide earthen discharge channel conveys flow from this spillway into the main discharge channel, Ludlow Creek (See Photo No. 13) but would not appear to be stable during periods of heavy flow.

e. Downstream Channel

The natural channel downstream of the dam has a bed of gravel, a width of 15± feet and a depth of 12 inches (See Photo No. 14). Fallen logs and brush as well as man-made debris were observed in the channel (See Photo No. 1). In addition, the apparent remains of the core wall of the dam that washed out in 1935 are located approximately 200 feet downstream of the existing dam on either side of the channel (See Photo No. 15) and would restrict channel flow during periods of heavy discharge.

f. Reservoir - Storage Pool Area

The lake shoreline is generally wooded or developed with cabins (See Photo No. 2) and, except for one steep point that is probably rock, the slopes are moderate to gentle. There is no significant possibility of landslides into the lake affecting the safety of the dam.

3.2 EVALUATION OF OBSERVATIONS

The visual inspection revealed several deficiencies on this structure. The following observations were made:

a. A moderate growth of brush and trees was noted on most slopes and on the crest of the embankment.

b. The embankments were irregular and generally, the crest was not well-defined.

c. Slight seepage was observed exiting from the bottom of the right channel slope at and a short distance downstream from the end of the right spillway retaining wall.

d. The stepped spillway retaining walls were apparently not high enough to fully protect the adjacent embankments from erosion due to heavy spillway discharge.

e. There was no upstream erosion protection except for several concrete slab fragments to the right of the spillway.

f. The apparent remains of the concrete core wall of the dam that washed out in 1935 were observed 200± feet downstream on either side of the channel.

g. Fallen logs and brush as well as man-made debris were noted in the downstream channel.

SECTION 4 - OPERATION AND MAINTENANCE PROCEDURES

4.1 PROCEDURES

The normal water surface level is maintained by the crest of the spillway weir at elevation 1459.0 (NGVD). No operational procedures are in effect at this time.

4.2 MAINTENANCE OF DAM

There was no evidence of any routine maintenance operations at the Lake Ludlow Club Dam; however, at least a partial reconstruction of the spillway was apparently built in August, 1961.

4.3 WARNING SYSTEM

No warning system is presently in effect.

4.4 EVALUATION

Presently, no operation or maintenance procedures are in effect for this dam. Therefore, a program of regular operation and maintenance procedures should be implemented.

SECTION 5 - HYDROLOGIC/HYDRAULIC

5.1 DRAINAGE AREA CHARACTERISTICS

The dam is located in the Town of McDonough on Ludlow Creek, approximately 18,500 feet upstream of Bowman Creek. Bowman Creek joins the Chenango River near the village of South Oxford, approximately twenty-nine miles upstream of the Susquehanna River at Binghamton, New York.

The watershed (shown on the Watershed Map on Page C-5 in Appendix C) consists of 4,059 acres (6.34 square miles) of rolling to hilly uplands with typical slopes of 10 percent. Land within the watershed is primarily agricultural with extensive open fields.

The watercourse upon which the reservoir is located, is a perennial stream with a typical flow width of 15 feet and a typical flow depth of 12 inches.

5.2 ANALYSIS CRITERIA

The purpose of the hydrologic/hydraulic analysis is to evaluate the spillway capacity and the potential for overtopping. The analysis of the spillway capacity of the dam and storage of the reservoir was performed using the Corps of Engineers' HEC-1 Computer Model - Dam Safety Version. The procedure included determining the Probable Maximum Flood (PMF) runoff from the watershed and routing the inflow hydrograph through the impoundment to determine the outflow hydrograph. The unit hydrograph was defined by the Snyder Synthetic Unit Hydrograph method, and the Modified Puls routing procedure was incorporated.

The initial rainfall loss was assumed to be 1.0 inches, and the uniform rainfall loss was assumed to be 0.1 inches per hour. In accordance with recommended guidelines of the Corps of Engineers, the Probable Maximum Precipitation (PMP) was 20.4 inches (24 hour duration, 200 square mile area).

The analysis was conducted for both the full PMF and for several fractional PMF conditions. The PMF inflow of 10,072 CFS was routed through the reservoir and the peak outflow was determined to be 8,982 CFS.

5.3 SPILLWAY CAPACITY

The total outlet capacity is the sum of the discharges from the overflow spillway and the natural spillway.

The overflow spillway consists of a 67 foot long broad-crested concrete weir.

The natural spillway consists of a two-stage earthen weir and an earthen discharge channel.

The stage discharge data for the combined capacity of the overflow and natural spillways was calculated for the stages tabulated below:

Stage (Feet)	Discharge Capacity (CFS)	Element of Structure
1459.0	0	Overflow Spillway Crest
1460.0	201	--
1461.0	568	--
1461.1	612	Top of Spillway Abutments
1462.0	1054	--
1463.0	1636	--
1463.7	2092	Natural Spillway Crest
1464.7	2864	Top of Dam

The total spillway capacity at the top of dam is 2864 CFS.

5.4 RESERVOIR CAPACITY

The storage capacity of the lake was obtained from the application for the reconstruction of the dam dated May 21, 1937 for the stages indicated below:

Stage (Feet)	Storage (Acre-Feet)	Storage (Inches of Runoff)
1459.0	500	1.48
1464.7	1220	3.55

5.5 FLOODS OF RECORD

No data regarding flood levels was obtained for this dam; however, on July 8, 1935, the original dam was swept away by an extremely heavy rainstorm.

5.6 OVERTOPPING POTENTIAL

The results of the HEC-1 DB computer analysis indicate that the crest of the dam is overtopped by all storms exceeding 38 percent of the PMF event. The PMF discharge rate of 8,982 cubic feet per second (CFS) would occur at a peak flood stage of 1468.9 feet, which is 4.2 feet above the crest of the dam.

The results of the analysis are tabulated below:

Flood Condition	Peak Inflow (CFS)	Peak Outflow (CFS)	Maximum Stage Elevation (NGVD)
0.5 PMF	5036	4044	1465.8
1.0 PMF	10072	8982	1468.9

5.7 EVALUATION

Using the Corps of Engineers' screening criteria for the initial review of spillway adequacy, it has been determined that the capacity of the overflow spillway is not adequate to pass either the full PMF or one half the PMF; only approximately 38 percent of the PMF can be safely passed before overtopping will occur. The PMF event would overtop the dam for a duration of 9.5 hours and the maximum depth of flow over the crest would be 4.2 feet. It is estimated that breaching of the dam as a result of overtopping, would cause water surface levels downstream to reach depths which would pose significant danger to residents. Therefore, the spillway is adjudged to be seriously inadequate and the dam is assessed as unsafe, nonemergency.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

There was no visible evidence of major settlement or lateral movement of the core wall, or overall structural instability of the dam during the site examination, although there may have been some settlement of the embankment on either side of the core wall. The slight seepage downstream from the right spillway retaining wall is not an immediate reason to question the static structural stability of the dam; however, its origin should be confirmed. In addition, the moderate tree growth on the slopes and embankment of the dam offers potential for long-term embankment deterioration, and both the low embankment crest at the right abutment and the low retaining walls at the overflow spillway could lead to damaging erosion under high flow conditions.

b. Design and Construction Data

There is no construction data to confirm the actual physical properties and configuration of the earthfill in the embankments. However, the dam proportions are considered to be reasonable for the soils that were available at the site and therefore, the dam would be expected to have adequate safety margins with respect to stability under static loading conditions.

c. Post Construction Changes

The 1937 drawing for the Lake Ludlow Club Dam in Appendix G shows a configuration for the dam and overflow spillway that generally corresponds to the conditions observed during the visual examination on April 8, 1981. However, the spillway and retaining walls are now concrete, and there appears to be two or three spillway "steps" less than are shown on the plan. The extent to which the rock-filled cribbing has been altered is not known.

d. Seismic Stability

The Lake Ludlow Club Dam is located in Seismic Zone 1 and in accordance with recommended Phase I guidelines does not require seismic analysis.

SECTION 7 - ASSESSMENT/RECOMMENDATIONS

7.1 ASSESSMENT

a. Condition

On the basis of the visual examination, there were no signs of impending structural failure or other conditions which would warrant urgent remedial action, but a number of deficiencies were noted.

b. Adequacy of Information

The evaluation of this dam is based primarily on visual examination, reference to the 1937 plan, approximate hydraulic and hydrologic computations, and application of engineering judgement. The available information that was obtained is adequate for the purposes of a Phase I assessment.

c. Need for Additional Investigations

It is recommended that the following additional investigations be performed by a registered professional engineer engaged by the owner:

1. Conduct a detailed hydrologic and hydraulic analysis to more accurately determine the site specific characteristics of the watershed.

2. Monitor the seepage that was evident at the downstream end of the right spillway retaining wall, including observation when the uphill seepage is not active, evaluate the cause and recommend remedial measures, if appropriate.

3. There appeared to have been past erosion from heavy spillway discharge behind the stepped spillway retaining walls; therefore, evaluate the height of erosion protection that is necessary above these walls, and recommend measures to provide this protection.

d. Urgency

It is recommended that within 3 months of the final approval date of this report, all of the additional investigations should be initiated and within 18 months, appropriate remedial measures should be completed. In the interim, a plan for providing around-the-clock surveillance of the dam during periods of unusually heavy precipitation should be developed and implemented. The recommended corrective measures presented in Section 7.2 should be completed within 12 months of final approval.

7.2 RECOMMENDED MEASURES

It is considered important that the following items be accomplished in addition to any items required as a result of the additional investigations recommended in Section 7.1c:

a. Clear the brush and trees from the embankments, establish a vegetative cover, and cut the grass and weeds on the embankments at least annually.

b. Regrade and fill the low area at the right abutment (natural spillway) up to the level of the top of core wall, reshape major embankment irregularities and reestablish vegetative cover on all graded areas.

c. Place rockfill or riprap erosion protection upstream of the left spillway retaining wall and enlarge the protected area upstream of the right spillway retaining wall.

d. Remove the apparent remains of the concrete core wall of the dam that washed out in 1935 as well as the fallen logs, brush and man-made debris to permit unrestricted flow in the downstream channel.

e. Develop and implement a flood warning and emergency evacuation plan to alert downstream residents in the event conditions occur which could result in the failure of the dam.

f. A program of regular maintenance should be developed and implemented.

APPENDIX A

PHOTOGRAPHS

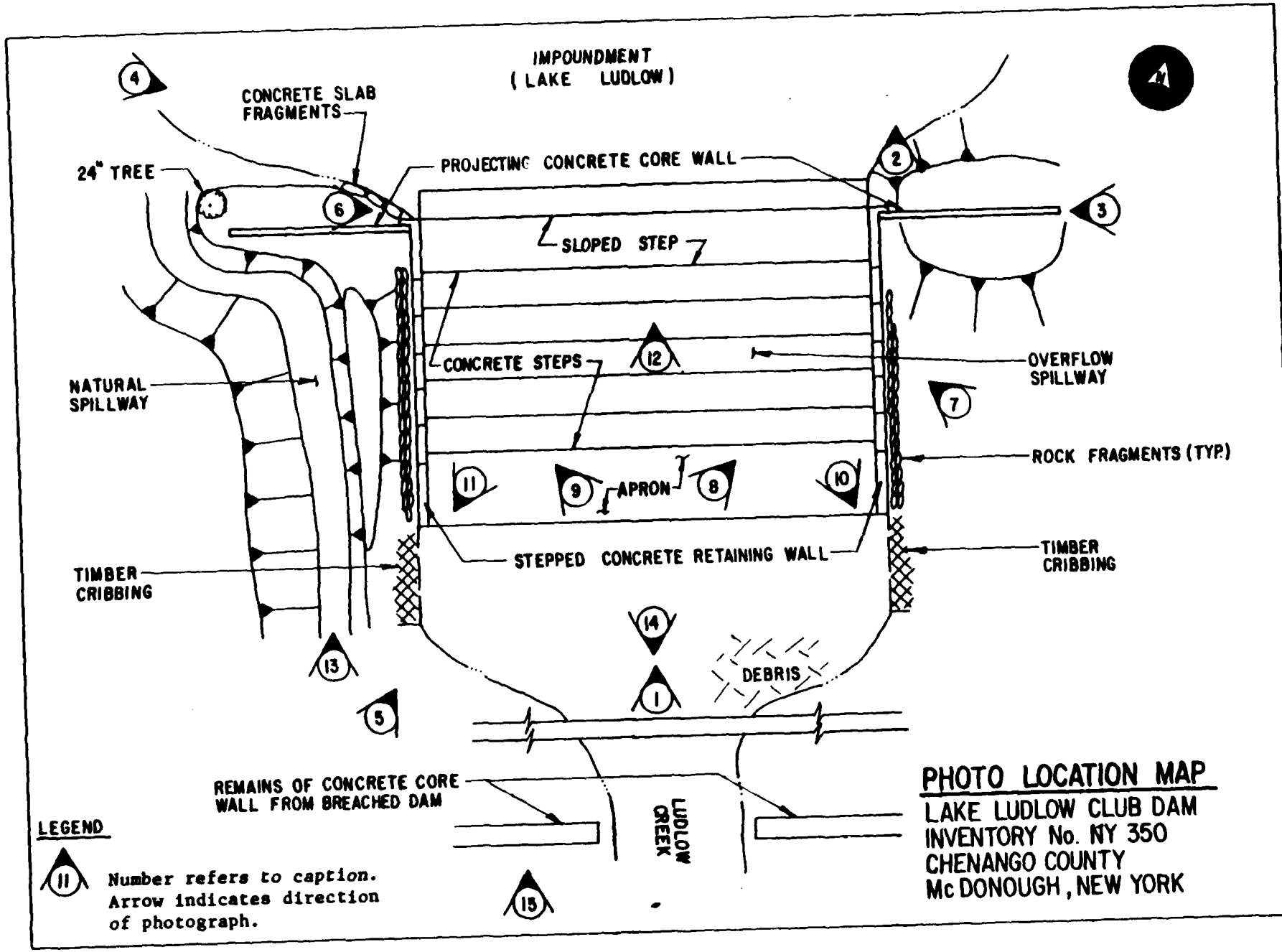

IMPOUNDMENT
(LAKE LUDLOW)
CONCRETE SLAB FRAGMENTS
24" TREE
PROJECTING CONCRETE CORE WALL
SLOPED STEP
CONCRETE STEPS
NATURAL SPILLWAY
OVERFLOW SPILLWAY
ROCK FRAGMENTS (TYP.)
APRON
TIMBER CRIBBING
STEPPED CONCRETE RETAINING WALL
TIMBER CRIBBING
DEBRIS
REMAINS OF CONCRETE CORE WALL FROM BREACHED DAM
LUDLOW CREEK
LEGEND
Number refers to caption.
Arrow indicates direction of photograph.
PHOTO LOCATION MAP
LAKE LUDLOW CLUB DAM
INVENTORY No. NY 350
CHENANGO COUNTY
Mc DONOUGH, NEW YORK

PHOTO #2: Overview of impoundment

PHOTO #3: Crest of dam looking toward right abutment

PHOTO #4: Overview of upstream face of dam

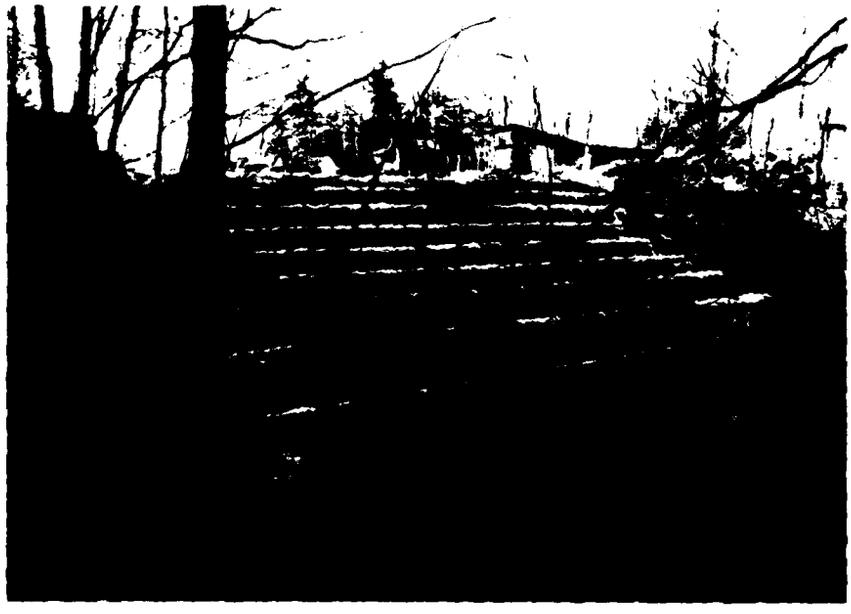


PHOTO #5: Overview of downstream face of dam

PHOTO #6: Upstream face of dam

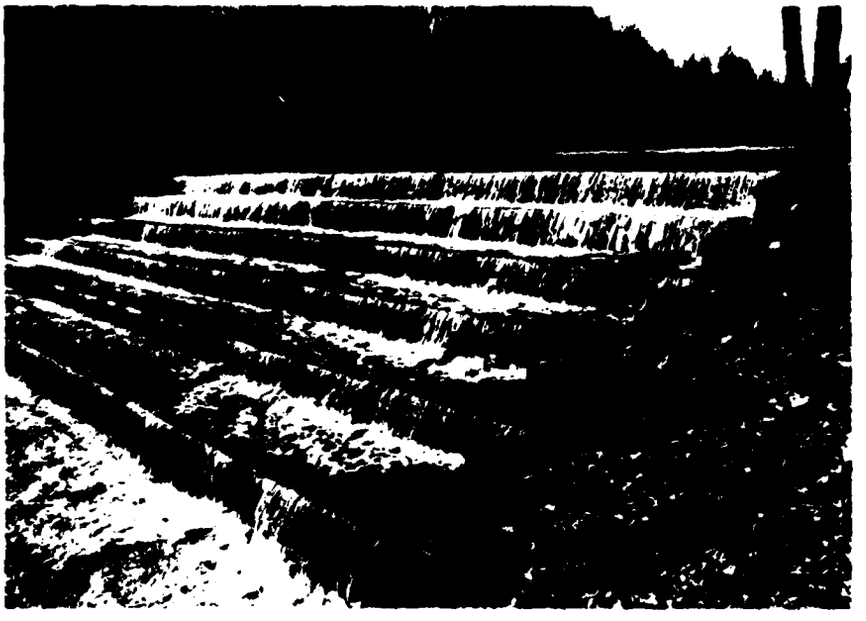


PHOTO #7: Downstream face of dam

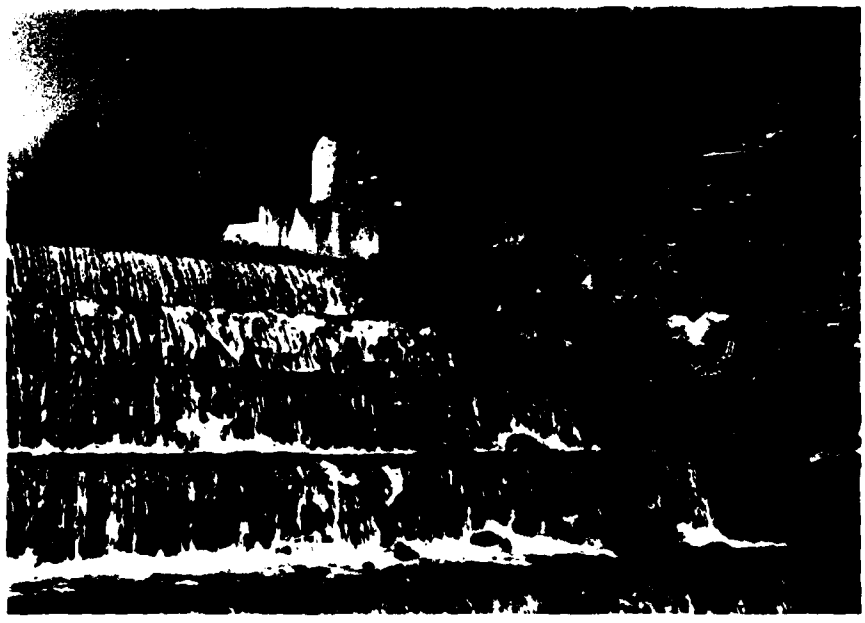


PHOTO #8: Stepped concrete retaining wall on left side of spillway

PHOTO #9: Stepped concrete retaining wall on right side of spillway

PHOTO #10: Remains of timber cribbing on left side of spillway

PHOTO #11: Remains of timber cribbing on right side of spillway

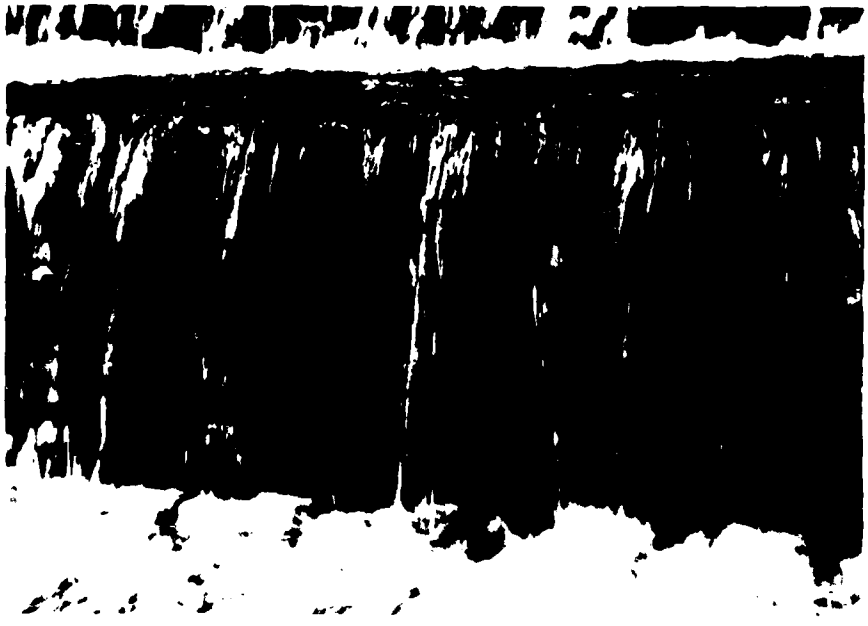


PHOTO #12: Close-up of concrete step of spillway

PHOTO #13: Earthen overflow discharge channel at right abutment

PHOTO #14: Downstream channel conditions

PHOTO #15: Remains of concrete core wall of dam that failed

PHOTO #16: Reconstructed church in Tyner which was washed away by 1935 flood

PHOTO #17: Site of Robbins' home in South Oxford near Route 12, also swept away by 1935 flood

APPENDIX B

VISUAL INSPECTION CHECKLIST

VISUAL INSPECTION CHECKLIST

1) Basic Data

a. General

Name of Dam: Lake Ludlow Club Dam

Fed. I.D. #: NY 350 DEC Dam No.: 106A-1119

River Basin: Susquehanna

Location: Town: McDonough County: Chenango

Stream Name: Ludlow Creek

Tributary of: Bowman Creek

Latitude (N): 42° - 27.5' Longitude (W): 75° - 42.2'

Type of Dam: Earthfill embankment with a rockfill overflow spillway

Hazard Category: High

Date(s) of Inspection: April 8, 1981

Weather Conditions: Sunny, 60° ± F.

Reservoir Level at Time of Inspection: Elevation 1459.1 ± (NGVD)

b. Inspection Personnel: T.L. Ward & R.A. Criscuolo of Flaherty Giavara Associates P.C.; P. L. LeCount of Haley & Aldrich, Inc.; B. Mcl. Whittingham of Salmon Associates

c. Persons Contacted (Including Address & Phone No.):

None

d. History:

Date Constructed: 1925 Date(s) Reconstructed: 1937

Designer: H.C. Schloer Engineer: L. G. McCauley

Constructed By: Unknown

Owner: Lake Ludlow Club, Inc.

2) Embankment

a. Characteristics

(1) Embankment Material Unknown

(2) Cutoff Type Core wall into "impervious hardpan"

(3) Impervious Core Concrete and stone masonry core wall

(4) Internal Drainage System None observed

(5) Miscellaneous No comments

b. Crest

(1) Vertical Alignment The top of the projecting core wall is level; however, the earthen crest is very irregular.

(2) Horizontal Alignment Good; substantially straight

(3) Surface Cracks None observed

(4) Miscellaneous The concrete and stone masonry core wall projects above the embankment crest at varying heights (1 to 3 feet); several small stumps left of the overflow spillway; grass, weeds, brambles, brush and trees

c. Upstream Slope

(1) Slope (Estimate - V:H) 1:3

(2) Undesirable Growth or Debris, Animal Burrows Grass, weeds, brush and trees up to 18 inches in diameter; no animal burrows were noted.

(3) Sloughing, Subsidence or Depressions None apparent; however, possible previous slight erosion adjacent to the overflow spillway

(4) Slope Protection Small broken concrete slab fragments to the right of the overflow spillway.

(5) Surface Cracks or Movement at Toe None evident

d. Downstream Slope

(1) Slope (Estimate - V:H) 1:3.3 (average for stepped overflow spillway)

(2) Undesirable Growth or Debris, Animal Burrows Brush, moss, weeds and trees to 15 inches in diameter; several small burrows near top of left embankment

(3) Sloughing, Subsidence or Depressions Minor incidental erosion related to surface runoff and foot traffic; past erosion above spillway walls.

(4) Surface Cracks or Movement at Toe None apparent; however, slope is very irregular

(5) Seepage None evident on left side; however, slight flow from behind end of right retaining wall and lesser flow from behind timber cribbing which extends downstream from end of wall; also, seepage coming downhill further up on right abutment slope

(6) External Drainage System (Ditches, Trenches, Blanket) Weep holes at the bottom step on either side of overflow spillway.

(7) Condition Around Outlet Structure Not applicable

(8) Seepage Beyond Toe None evident

e. Abutments - Embankment Contact at Overflow Spillway

Earth slopes above top of concrete retaining walls partially supported by stone and old timber.

(1) Erosion at Contact Described in 2)d.(3)

(2) Seepage Along Contact Described in 2)d.(5)

3) Drainage System

a. Description of System Broad-crested concrete weir and stepped concrete channel leading to the natural streambed.

b. Condition of System Good

c. Discharge from Drainage System Stepped concrete discharge dropping approximately 14 feet from weir to streambed

4) Instrumentation (Monumentation/Surveys, Observation Wells, Weirs, Peizometers, Etc.)

None observed

5) Reservoir

a. Slopes Moderate to gentle wooded slopes and lakeside cabins border the impoundment

b. Sedimentation Possible accumulation of sediment behind the dam

c. Unusual Conditions Which Affect Dam None noted

6) Area Downstream of Dam

a. Downstream Hazard (No. of Homes, Highways, etc.) Approximately 3 dwellings, 3 barns, a church and three roads (including New York State Route 12) are within the dam failure flood hazard area

b. Seepage, Unusual Growth None observed

c. Evidence of Movement Beyond Toe of Dam None evident

d. Condition of Downstream Channel Good; except remains of concrete core wall from previous dam would restrict channel flow

7) Spillway(s) (Including Discharge Conveyance Channel)

Overflow spillway, natural spillway and their discharge channels

a. General Overflow spillway and discharge channel handle nearly all flows

b. Condition of Overflow Spillway Good; no signs of deterioration except the exposed core wall on either side of the overflow spillway is deteriorating

c. Condition of Emergency Spillway Not applicable

d. Condition of Discharge Conveyance Channel Good condition, presently stable

8) Reservoir Drain/Outlet

Type: Pipe None Conduit None Other None

Material: Concrete _____ Metal _____ Other _____

Size: _____ Length _____

Invert Elevations: Entrance _____ Exit _____

Physical Condition (Describe): Unobservable _____

Material: _____

Joints: _____ Alignment _____

Structural Integrity: _____

Hydraulic Capability: _____

Means of Control: Gate _____ Valve _____ Uncontrolled _____

Operation: Operable _____ Inoperable _____ Uncontrolled _____

Present Condition (Describe): _____

9) Structural

a. Concrete Surfaces Concrete of the overflow spillway is generally in good condition; however, the concrete of the exposed core wall at the overflow spillway has spalled

b. Structural Cracking No evidence of any structural cracks; only minute surface cracks.

c. Movement - Horizontal & Vertical Alignment (Settlement) Very minor and only local at the slab section of the overflow spillway crest.

d. Junctions with Abutments or Embankments Stepped concrete retaining walls at both ends of the overflow spillway are in good condition.

e. Drains - Foundation, Joint, Face None evident

f. Water Passages, Conduits, Sluices Good condition

g. Seepage or Leakage No signs of seepage or leakage

h. Joints - Construction, etc. Good condition

i. Foundation Inaccessible

j. Abutments See 9) d. above

k. Control Gates None observed

l. Approach & Outlet Channels Not applicable

m. Energy Dissipators (Plunge Pool, etc.) Overflow spillway is comprised of concrete steps.

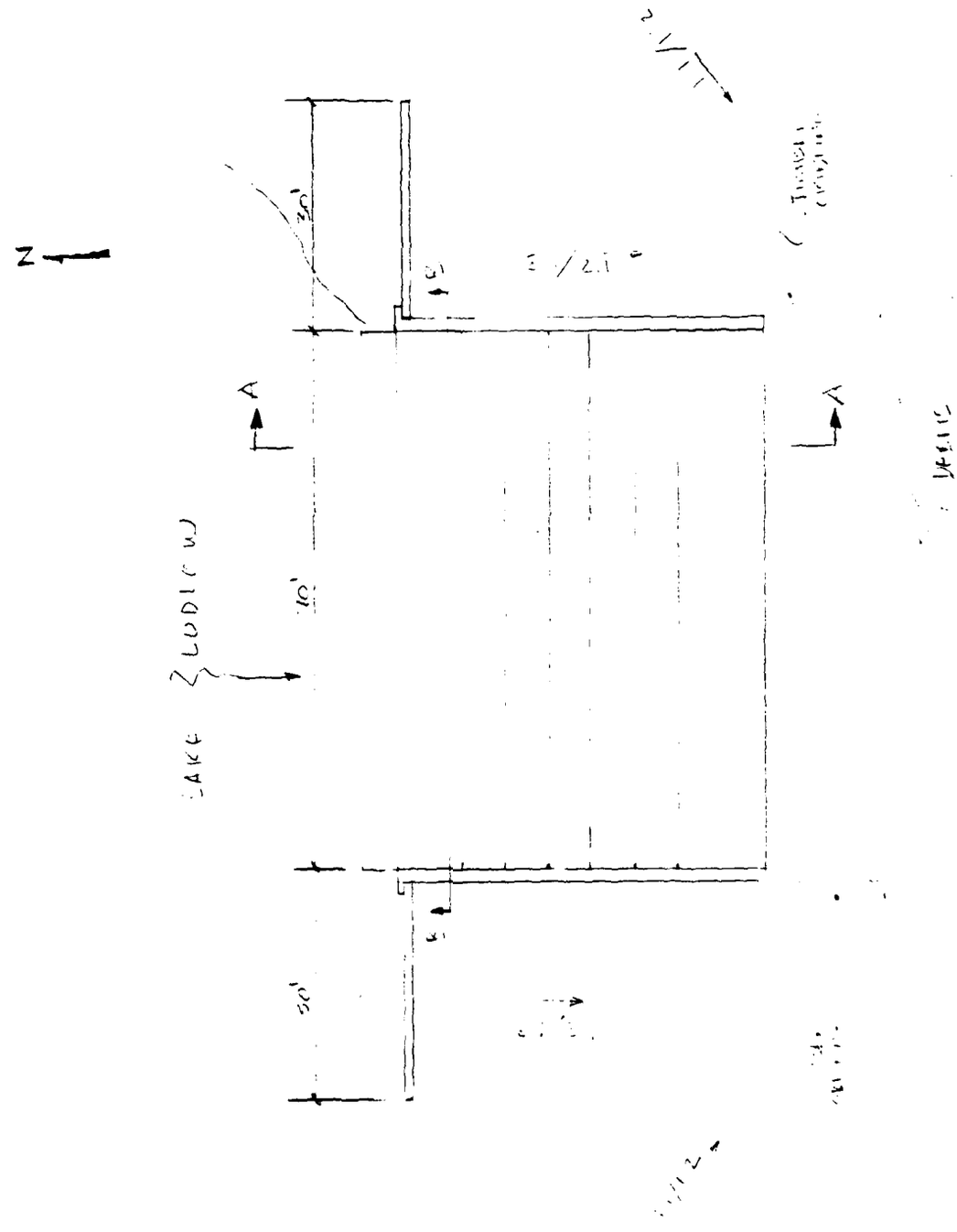
n. Intake Structures Not applicable

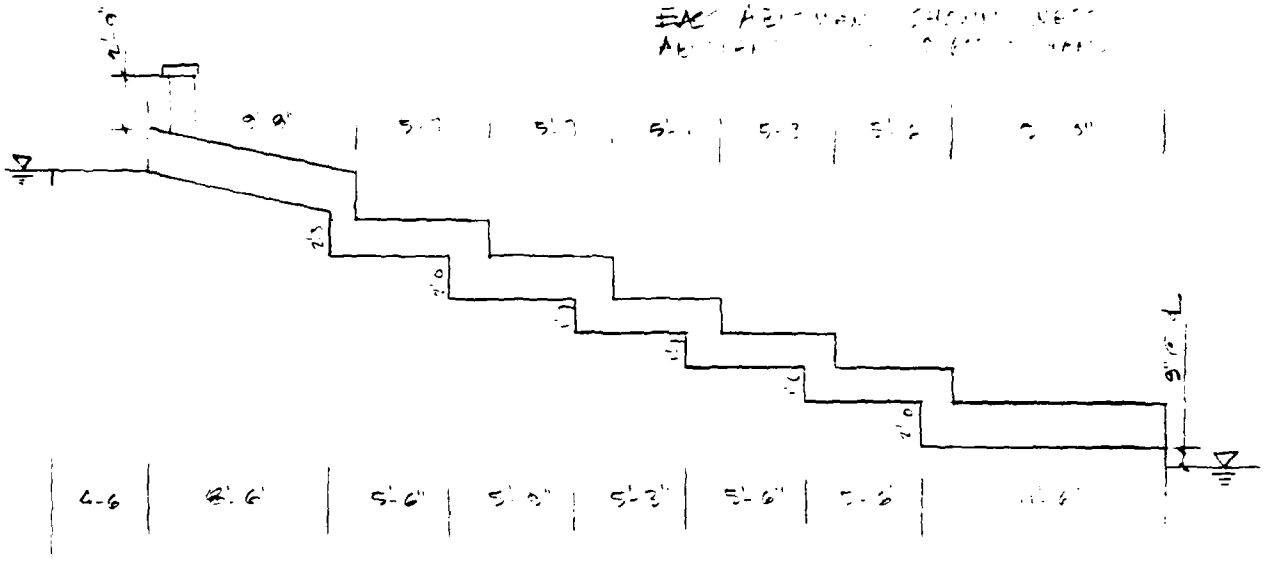
o. Stability Appears to be stable

p. Miscellaneous No comments

10) Appurtenant Structures (Power House, Lock, Gatehouse, Other)

a. Description and Condition None observed


Z
A
A
50'
50'
LAKE



ELEVATION A-A

APPENDIX C

HYDROLOGIC/HYDRAULIC ENGINEERING DATA AND COMPUTATIONS

CHECK LIST FOR DAMS
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

AREA-CAPACITY DATA:

	Elevation (ft.)	Surface Area (acres)	Storage Capacity (acre-ft.)
1) Top of Dam	1464.7	153	1220
2) Design High Water (Max. Design Pool)	--	--	--
3) Emergency Spillway Crest	--	--	--
4) Pool Level with Flashboards	--	--	--
5) Overflow Spillway Crest	1459.0	100	500

DISCHARGES:

	Volume (cfs)
1) Average Daily	Unknown
2) Overflow Spillway @ Maximum High Water (Top of Dam)	2807
3) Natural Spillway @ Maximum High Water (Top of Dam)	57
4) Principal Spillway @ Emergency Spillway Crest	--
5) Low Level Outlet @ Principal Spillway Crest	--
6) Total (of all facilities) @ Maximum High Water	2864
7) Maximum Known Flood	Unknown
8) At Time of Inspection	6 ±

CREST: ELEVATION: 1464.7 (NGVD)

Type: Earthen embankment with a projecting concrete core wall

Width: 1.5 feet Length: 130 feet

Spillover: Concrete overflow spillway weir

Location: Center of embankment

SPILLWAY:

OVERFLOW		EMERGENCY
1459.0 (NGVD)	Elevation	1462.7 and 1462.9 (NGVD)
Broad-crested weir	Type	Two-stage broad-crested weir
47 feet	Width	
	Type of Control	
Weir	Uncontrolled	Weir
--	Controlled	--
None	Type: (Flashboards; gate)	None
One	Number	One
67 foot long weir	Size/Length	28 foot long two-staged weir
Concrete	Invert Material	Earth
Continuously	Anticipated Length of Operating Service	Unknown
Unknown	Chute Length	Unknown
Unknown	Height Between Spillway Crest & Approach Channel Invert (Weir Flow)	Unknown

Type: _____

Location: _____

Records:

Date Unknown

Max. Reading Unknown

FLOOD WATER CONTROL SYSTEM:

Warning System None in effect

Method of Controlled Releases (mechanisms) None

DRAINAGE AREA: 4059 acres = 6.34 square miles

DRAINAGE BASIN RUNOFF CHARACTERISTICS:

Land Use - Type: Rural, agriculture

Terrain - Relief: Rolling uplands

Surface - Soil: Glacial till

Runoff Potential (existing or planned extensive alterations to existing surface or subsurface conditions)

Primarily woodlands with scattered open fields; some agriculture; glacial till soils; average watershed slope is 10 ± percent, some residential homes and roadways; possible future development around lake

Potential Sedimentation problem areas (natural or man-made; present or future)

Possible surface erosion from agricultural fields during fallow periods

Potential Backwater problem areas for levels at maximum storage capacity including surcharge storage:

Flooding of some lakeside cabins is possible

Dikes - Floodwalls (overflow & non-overflow) - Low reaches along the reservoir perimeter:

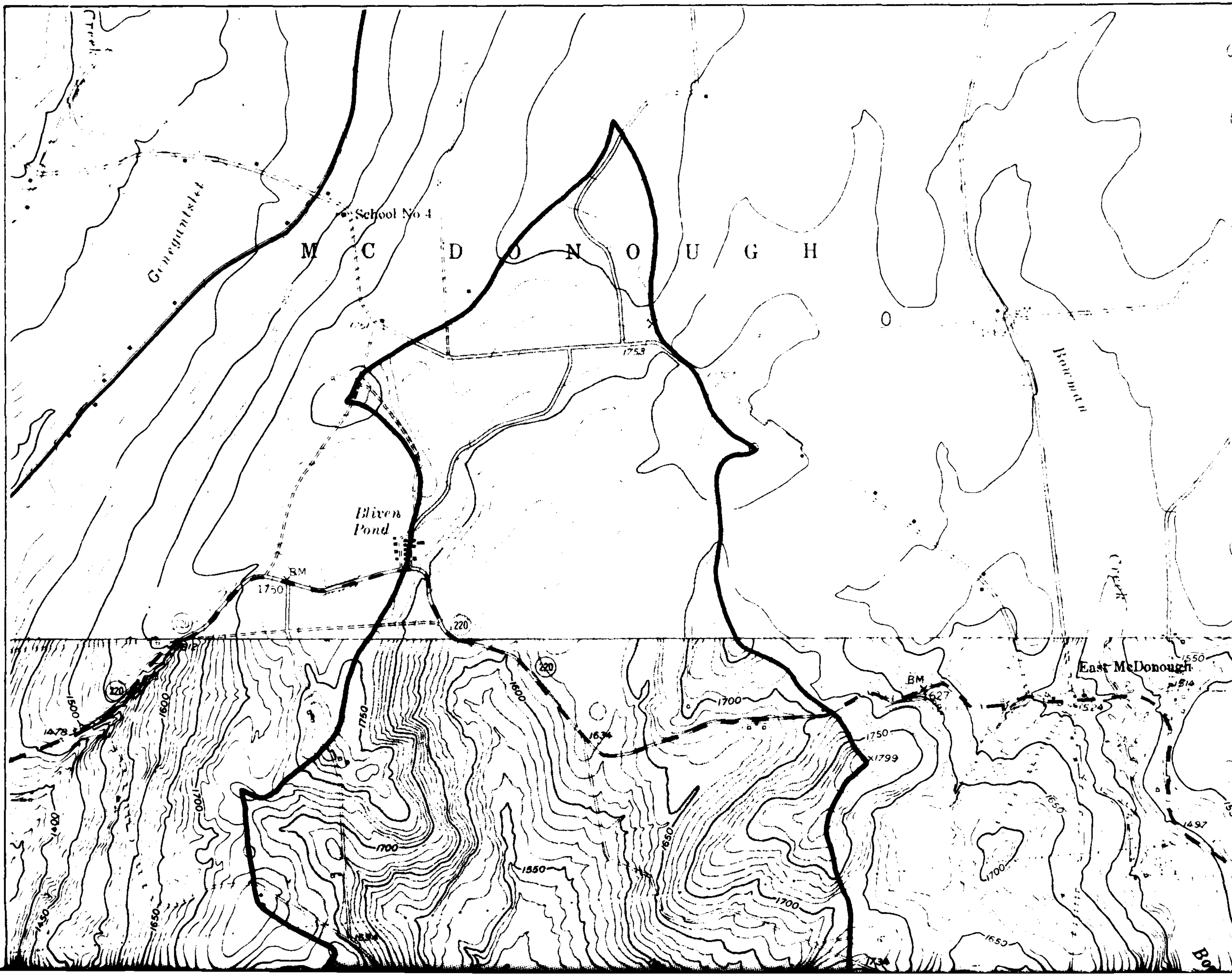
Location: Low reach (natural spillway) at the right abutment

Elevation: 1463.7 (NGVD)

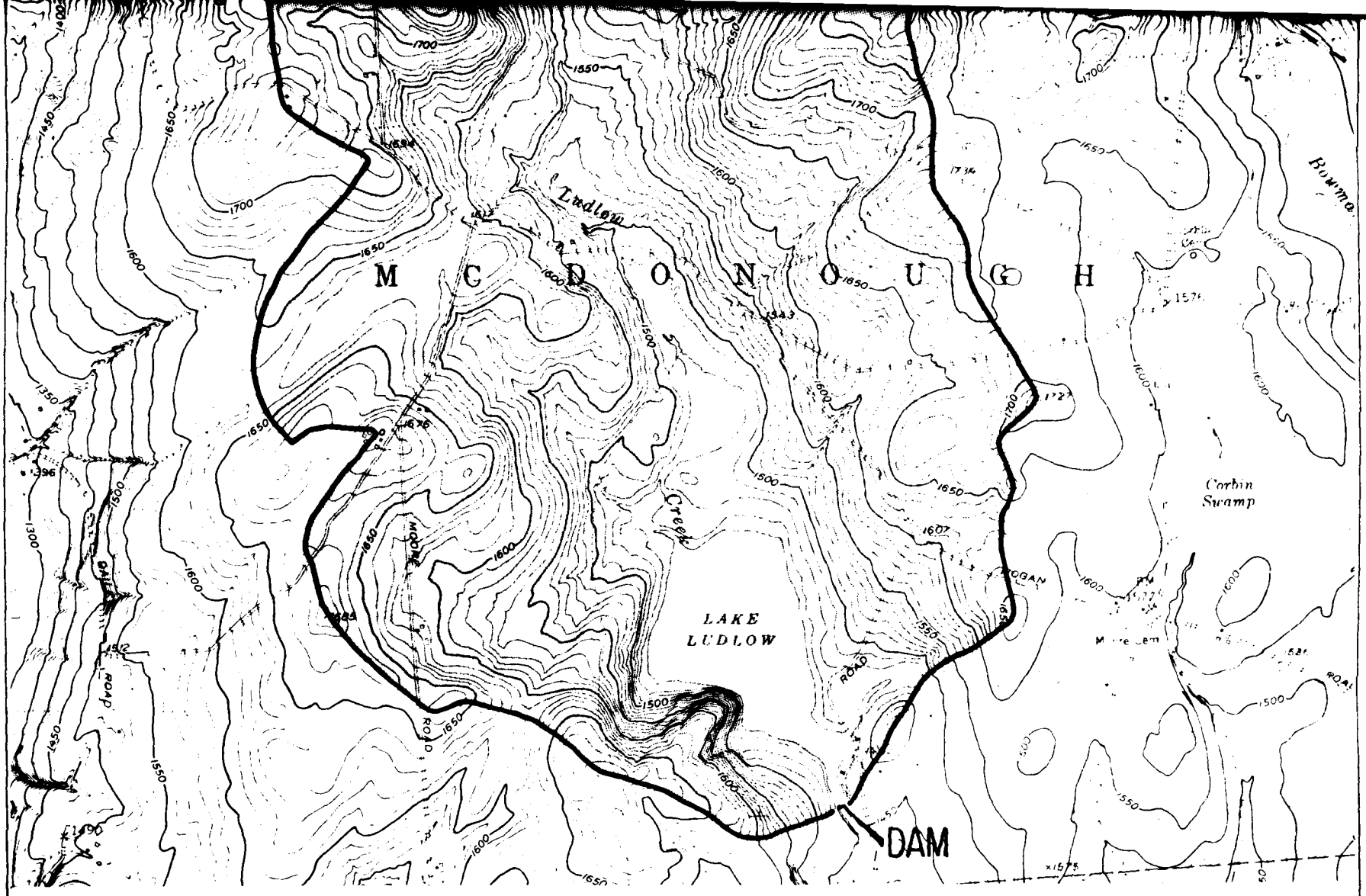
Reservoir:

Length @ Maximum Pool: 4500 ± feet = 0.9 miles (Miles)

Length of Shoreline (@ Spillway Crest): 13,000 ± feet= 2.5 miles (Miles)



School No 4
M C D O N O U G H
Genegantslet
Creek
Bowman
Creek
Bliven
Pond
1753
1750
BM
220
East McDonough
1550
1514
1524
1627
1497
1700
1750
1799
1634
1600
1650
1550
1500
1478
1450



WATERSHED MAP

LAKE LUDLOW CLUB DAM
INVENTORY No. NY 350

SUSQUEHANNA RIVER BASIN
CHENANGO COUNTY
Mc DONOUGH, NEW YORK

N

0 2000 4000

SCALE IN FEET

FLAHERTY · GIAVARA ASSOCIATES, P.C.

CALCULATIONS

PROJECT CORE DAM - NY 350

FLAHERTY-GIAVARA ASSOCIATES
ENVIRONMENTAL DESIGN CONSULTANTS
ONE COLUMBUS PLAZA NEW HAVEN CONN 06510/203/789-1260

SHEET NO. 1 OF
BY RAC DATE 4-15-81
CHK'D. BY TLV DATE 4-20-81

WATERSHED DATA FOR HEC-1 SNYDER HYDROGRAPH

1) TIME TO PEAK

$L = 23{,}000' = 4.36$ miles
$L_c = 10{,}000' = 1.89$ miles
$C_T = 2.0$ for average slopes

$$T_p = C_T (L \times L_c)^{0.3}$$
$$= 2.0 (4.36 \times 1.89)^{0.3} = 3.77 \text{ Hours}$$

$$t_r = \frac{t_p}{5.5} = \frac{3.77}{5.5} = 0.68 \quad \text{USE } t_R = 0.5$$

$$t_{pR} = t_p + 0.25 (t_R - t_r)$$
$$= 3.77 + 0.25 (0.5 - 0.68) = 3.73 \text{ Hours}$$

2) $C_p = 0.63$ for HIGHLAND AREA

3) % IMPERVIOUS

ROADS - 65,000 LF x 25' = 1,625,000 FT²
HOUSES - 20 @ 1000 FT² = 20,000 FT²
1,645,000 FT²

1,645,000 FT² = 37.8 ACRES

$$\frac{37.8}{4059} = 0.9\%$$

4) WATERSHED AREA

4059 AC/640 = 6.34 square miles

Based on 1" = 2000' USGS maps

[illegible] RAINFALL DATA – (FROM HYDROMETEOROLOGICAL [illegible]

[illegible] No. 33

24 [illegible] = 20.4 [illegible] 200

[illegible]

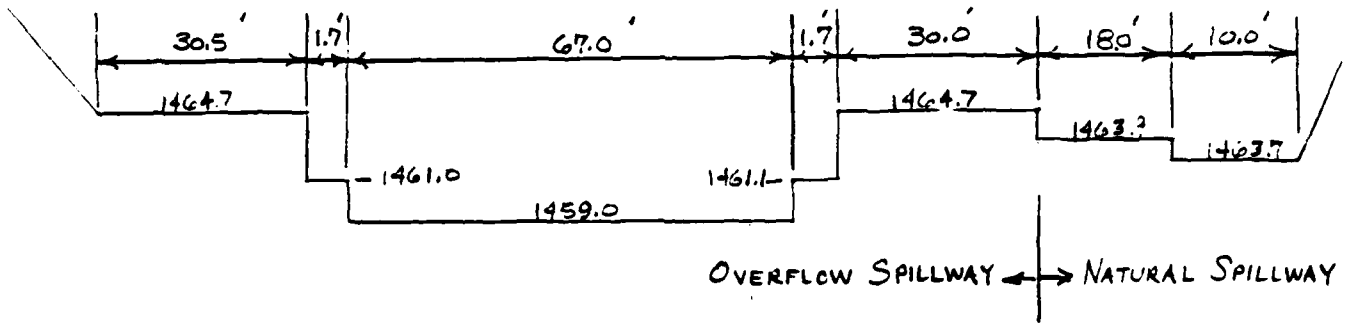
[illegible]	[illegible]
6	111
12	122
24	133
48	143

PROJECT CORPS DAMS
NY 350

FLAHERTY-GIAVARA ASSOCIATES
ENVIRONMENTAL DESIGN CONSULTANTS
ONE COLUMBUS PLAZA, NEW HAVEN, CONN 06510/203/789-1260

SHEET NO. 3 OF
BY RAC DATE 4-15-81
CHK'D. BY TLW DATE 4-20-81

STAGE DISCHARGE DATA



STAGE	$Q = 2.5LH^{1.5}$	$Q = 3.0LH^{1.5}$	DISCHARGE
1459.0	-	0.0	0.0
1460.0	-	201.0	201.0
1461.0	-	568.5	568.5
1461.1	-	611.8	611.8
1462.0	-	1053.9	1053.9
1463.0	-	1635.8	1635.8
1463.7	-	2092.1	2092.1
1463.9	2.2	2229.3	2231.5
1464.7	57.2	2806.5	2863.7
1465.0	89.0	3064.0	3153.0
1466.0	224.1	4103.9	4328.0

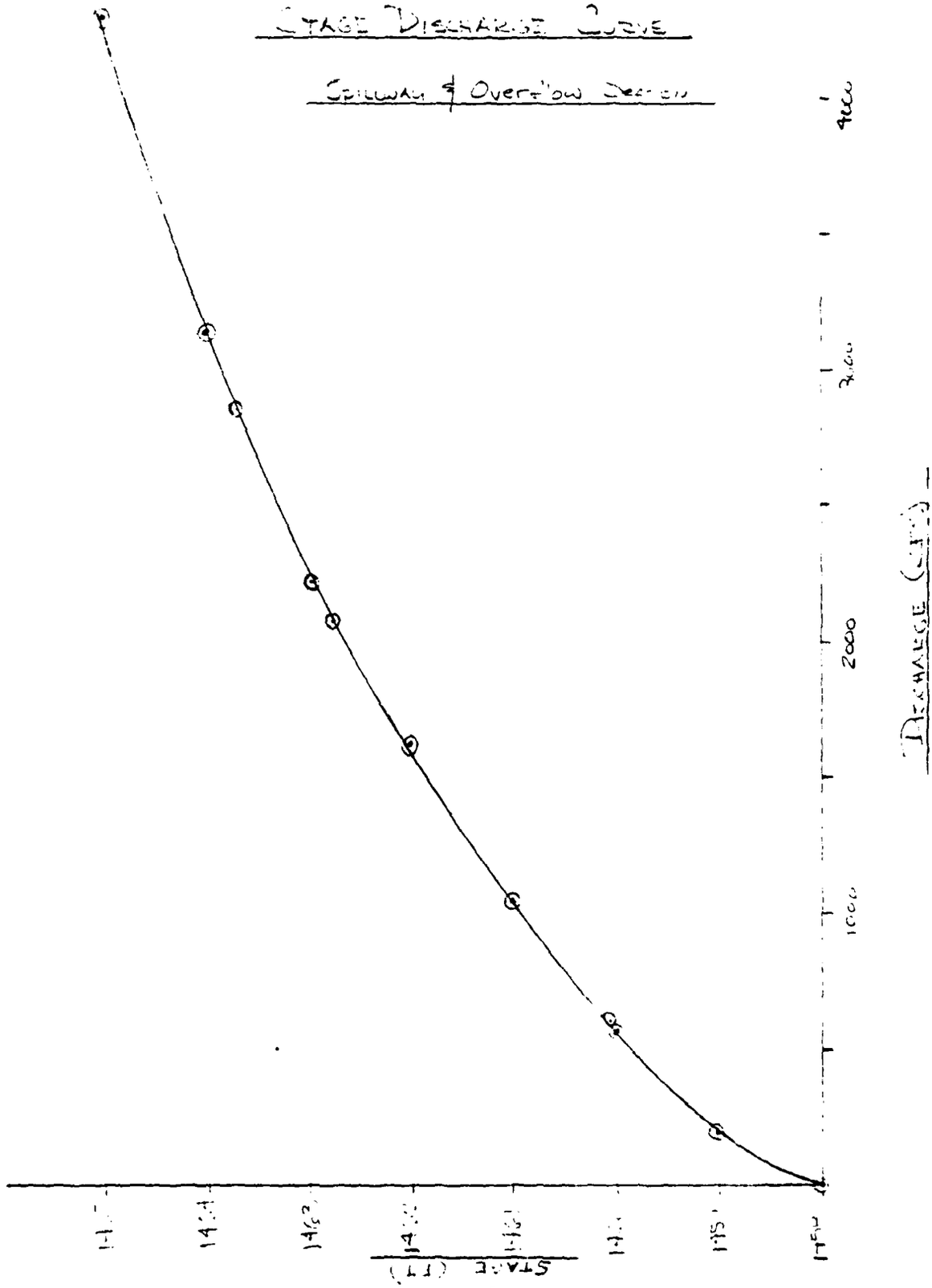
PROJECT [illegible] 359

FLAHERTY-GIAVARA ASSOCIATES
ENVIRONMENTAL DESIGN CONSULTANTS
ONE COLUMBUS PLAZA NEW HAVEN CONN 06510/203/789-1260

SHEET NO. 4 OF
BY [illegible] DATE 4-15-91
CHK'D. BY TLW DATE 4-20-91

STAGE DISCHARGE CURVE

Spillway & Overflow Section



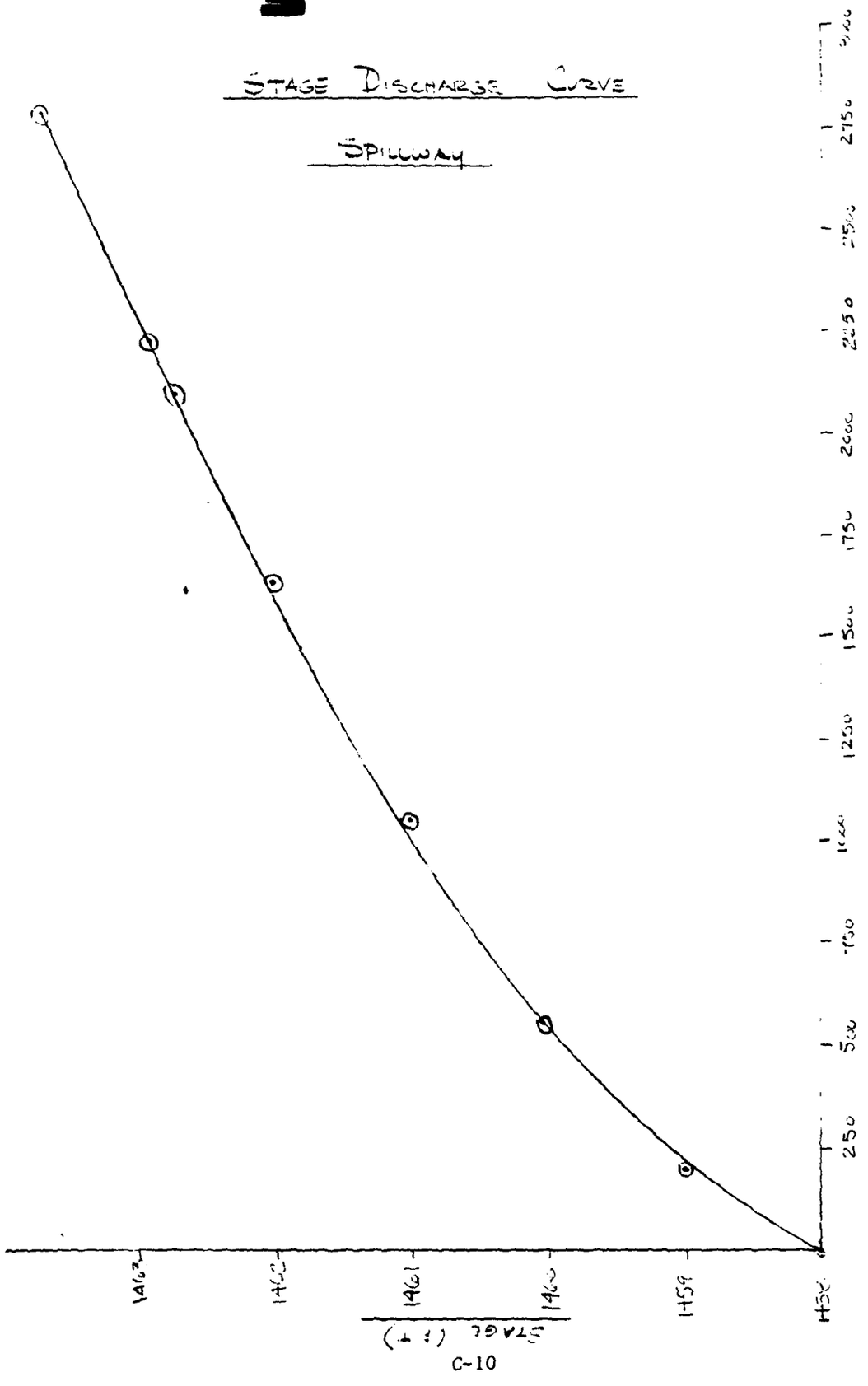
PROJECT Cobble Dam
NO. 3

FLAHERTY-GIAVARA ASSOCIATES
ENVIRONMENTAL DESIGN CONSULTANTS
ONE COLUMBUS PLAZA NEW HAVEN CONN 06510/203/789-1260

SHEET NO. 6 OF
BY [illegible] DATE 4-15-91
CHK'D. BY TLW DATE 4-20-91

STAGE DISCHARGE CURVE

SPILLWAY



HEC-1 FLOOD HYDROGRAPH COMPUTATIONS

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FLAHERTY GIAVARA ASSOCIATES, P.C.
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION  JULY 1978
 LAST MODIFICATION  26 FEB 79
**********
     1            A1 NATIONAL DAM INSPECTION PROGRAM, PHASE I REPORT, CORPS OF ENGINEERS - NEW YORK DISTRICT
     2            A2 DAM INVENTORY NO. NY 350, LAKE LUDLOW CLUB DAM, CHENANGO COUNTY, NEW YORK, APRIL 21, 1981
     3            A3 PREPARED BY FLAHERTY GIAVARA ASSOCIATES, P.C., ONE COLUMBUS PLAZA, NEW HAVEN, CONNECTICUT
     4            B   120       0      30       0       0       0       0       2       0       0
     5            B1    5
     6            J     1       9       1
     7            J1  0.30    0.33    0.36    0.37    0.38    0.39    0.40    0.50    1.00
     8            K     0       1                       0       0       1       0
     9            K1 INFLOW HYDROGRAPH - SNYDER METHOD
    10            M     1       1    6.34                       0       0                       1
    11            P     0    20.4     111     122     133     143                   1     0.1             0.009
    12            T
    13            W  3.73    0.63
    14            X  -2.0   -0.10     1.5                                   0      -1       1       0
    15            K     1       1                                                   1
    16            K1  RESERVOIR ROUTING - MODIFIED PLUS METHOD
    17            Y                                       1       1                       0      -1
    18            Y1    1
    19            Y1457.0  1460.0  1481.0  1481.1  1482.0  1483.0  1463.7  1483.9  1484.7  1485.0
    20            Y1466.0  1470.0
    21            Y5    0   201.0   568.5   611.8  1053.9  1635.8  2092.1  2231.5  2863.7  3123.1
    22            Y54059.1  8679.5
    23            $A 100.0   137.7   179.1   275.5
    24            $E1459.0  1460.0  1470.0  1480.0
    25            $$1459.0
    26            $D1464.7     3.0     1.5    60.5
    27            K    99
                                PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS
                                RUNOFF HYDROGRAPH AT          1
                                ROUTE HYDROGRAPH TO           1
                                END OF NETWORK

**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION  JULY 1978
 LAST MODIFICATION  26 FEB 79
**********

RUN  DATE: 8/20/
     TIME: 4:53 PM

                    NATIONAL DAM INSPECTION PROGRAM, PHASE I REPORT, CORPS OF ENGINEERS - NEW YORK DISTRICT
                    DAM INVENTORY NO. NY 350, LAKE LUDLOW CLUB DAM, CHENANGO COUNTY, NEW YORK, APRIL 21, 1981
                    PREPARED BY FLAHERTY GIAVARA ASSOCIATES, P.C., ONE COLUMBUS PLAZA, NEW HAVEN, CONNECTICUT

                                    JOB SPECIFICATION
                      NQ      NHR     NMIN    IDAY    IHR     IMIN    METRC   IPLT    IPRT    NSTAN
                     120        0       30       0       0       0       0       2       0       0
                                                JOPER   NWT   LROPT   TRACE
                                                    5     0       0       0
```

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 9 LRTIO= 1
RTIOS= 0.30 0.35 0.36 0.37 0.38 0.39 0.40 0.50 1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH - SNYDER METHOD

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDQ	IUHQ	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	6.34	0.00	5.34	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	20.40	111.00	122.00	133.00	143.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS 0.800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOR	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.10	0.00	0.01

UNIT HYDROGRAPH DATA
TP= 3.73 CP=0.63 NTA= 0

RECESSION DATA
STRTQ= -2.00 QRCSN= -0.10 RTIOR= 1.50

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 8.62 AND R= 6.71 INTERVALS

UNIT HYDROGRAPH 41 END-OF-PERIOD ORDINATES, LAG= 3.74 HOURS, CP= 0.63 VOL= 1.00

32.	117.	233.	365.	498.	608.	677.	702.	670.	593.
511.	440.	379.	326.	281.	242.	209.	180.	155.	133.
115.	99.	85.	73.	63.	54.	47.	40.	35.	30.
26.	22.	19.	16.	14.	12.	11.	9.	8.	7.
6.									

END-OF-PERIOD FLOW

MO. DA	HR. MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO. DA	HR. MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	0.30	1	0.00	0.00	0.00	12.	1.02	6.30	61	0.15	0.10	0.05	76.
1.01	1.00	2	0.00	0.00	0.00	12.	1.02	7.00	62	0.15	0.10	0.05	88.
1.01	1.30	3	0.00	0.00	0.00	11.	1.02	7.30	63	0.15	0.10	0.05	110.
1.01	2.00	4	0.00	0.00	0.00	11.	1.02	8.00	64	0.15	0.10	0.05	144.
1.01	2.30	5	0.00	0.00	0.00	10.	1.02	8.30	65	0.15	0.10	0.05	190.
1.01	3.00	6	0.00	0.00	0.00	10.	1.02	9.00	66	0.15	0.10	0.05	245.
1.01	3.30	7	0.00	0.00	0.00	10.	1.02	9.30	67	0.15	0.10	0.05	307.
1.01	4.00	8	0.00	0.00	0.00	9.	1.02	10.00	68	0.15	0.10	0.05	371.
1.01	4.30	9	0.00	0.00	0.00	9.	1.02	10.30	69	0.15	0.10	0.05	431.
1.01	5.00	10	0.00	0.00	0.00	9.	1.02	11.00	70	0.15	0.10	0.05	485.
1.01	5.30	11	0.00	0.00	0.00	8.	1.02	11.30	71	0.15	0.10	0.05	531.
1.01	6.00	12	0.00	0.00	0.00	8.	1.02	12.00	72	0.15	0.10	0.05	571.
1.01	6.30	13	0.01	0.00	0.01	8.	1.02	12.30	73	0.91	0.86	0.05	627.
1.01	7.00	14	0.01	0.00	0.01	7.	1.02	13.00	74	0.91	0.86	0.05	746.

1.01	7.30	15	0.01	0.00	0.01	7.	1.02	13.30	75	1.09	1.04	0.05	954.
1.01	8.00	16	0.01	0.00	0.01	7.	1.02	14.00	76	1.09	1.04	0.05	1273.
1.01	8.30	17	0.01	0.00	0.01	7.	1.02	14.30	77	1.36	1.31	0.05	1719.
1.01	9.00	18	0.01	0.00	0.01	7.	1.02	15.00	78	1.36	1.31	0.05	2294.
1.01	9.30	19	0.01	0.00	0.01	6.	1.02	15.30	79	1.65	1.60	0.05	2983.
1.01	10.00	20	0.01	0.00	0.01	6.	1.02	16.00	80	5.23	5.18	0.05	3882.
1.01	10.30	21	0.01	0.00	0.01	6.	1.02	16.30	81	1.27	1.22	0.05	5019.
1.01	11.00	22	0.01	0.00	0.01	6.	1.02	17.00	82	1.27	1.22	0.05	6248.
1.01	11.30	23	0.01	0.00	0.01	6.	1.02	17.30	83	1.00	0.95	0.05	7466.
1.01	12.00	24	0.01	0.00	0.01	5.	1.02	18.00	84	1.00	0.95	0.05	8587.
1.01	12.30	25	0.07	0.00	0.07	5.	1.02	18.30	85	0.09	0.04	0.05	9463.
1.01	13.00	26	0.07	0.00	0.07	5.	1.02	19.00	86	0.09	0.04	0.05	9969.
1.01	13.30	27	0.08	0.00	0.08	5.	1.02	19.30	87	0.09	0.04	0.05	10072.
1.01	14.00	28	0.08	0.00	0.08	5.	1.02	20.00	88	0.09	0.04	0.05	9732.
1.01	14.30	29	0.10	0.00	0.10	5.	1.02	20.30	89	0.09	0.04	0.05	9027.
1.01	15.00	30	0.10	0.00	0.10	6.	1.02	21.00	90	0.09	0.04	0.05	8164.
1.01	15.30	31	0.12	0.00	0.12	6.	1.02	21.30	91	0.09	0.04	0.05	7263.
1.01	16.00	32	0.39	0.19	0.21	12.	1.02	22.00	92	0.09	0.04	0.05	6375.
1.01	16.30	33	0.10	0.05	0.05	30.	1.02	22.30	93	0.09	0.04	0.05	5551.
1.01	17.00	34	0.10	0.05	0.05	57.	1.02	23.00	94	0.09	0.04	0.05	4827.
1.01	17.30	35	0.07	0.03	0.05	91.	1.02	23.30	95	0.09	0.04	0.05	4203.
1.01	18.00	36	0.07	0.03	0.05	130.	1.03	0.00	96	0.09	0.04	0.05	3666.
1.01	18.30	37	0.01	0.00	0.01	168.	1.03	0.30	97	0.00	0.00	0.00	3202.
1.01	19.00	38	0.01	0.00	0.01	197.	1.03	1.00	98	0.00	0.00	0.00	2799.
1.01	19.30	39	0.01	0.00	0.01	217.	1.03	1.30	99	0.00	0.00	0.00	2448.
1.01	20.00	40	0.01	0.00	0.01	221.	1.03	2.00	100	0.00	0.00	0.00	2136.
1.01	20.30	41	0.01	0.00	0.01	210.	1.03	2.30	101	0.00	0.00	0.00	1861.
1.01	21.00	42	0.01	0.00	0.01	192.	1.03	3.00	102	0.00	0.00	0.00	1617.
1.01	21.30	43	0.01	0.00	0.01	171.	1.03	3.30	103	0.00	0.00	0.00	1400.
1.01	22.00	44	0.01	0.00	0.01	150.	1.03	4.00	104	0.00	0.00	0.00	1209.
1.01	22.30	45	0.01	0.00	0.01	130.	1.03	4.30	105	0.00	0.00	0.00	1042.
1.01	23.00	46	0.01	0.00	0.01	112.	1.03	5.00	106	0.00	0.00	0.00	977.
1.01	23.30	47	0.01	0.00	0.01	97.	1.03	5.30	107	0.00	0.00	0.00	938.
1.02	0.00	48	0.01	0.00	0.01	83.	1.03	6.00	108	0.00	0.00	0.00	901.
1.02	0.30	49	0.06	0.01	0.05	72.	1.03	6.30	109	0.00	0.00	0.00	865.
1.02	1.00	50	0.06	0.01	0.05	64.	1.03	7.00	110	0.00	0.00	0.00	830.
1.02	1.30	51	0.06	0.01	0.05	58.	1.03	7.30	111	0.00	0.00	0.00	797.
1.02	2.00	52	0.06	0.01	0.05	54.	1.03	8.00	112	0.00	0.00	0.00	766.
1.02	2.30	53	0.06	0.01	0.05	53.	1.03	8.30	113	0.00	0.00	0.00	735.
1.02	3.00	54	0.06	0.01	0.05	54.	1.03	9.00	114	0.00	0.00	0.00	706.
1.02	3.30	55	0.06	0.01	0.05	56.	1.03	9.30	115	0.00	0.00	0.00	678.
1.02	4.00	56	0.06	0.01	0.05	59.	1.03	10.00	116	0.00	0.00	0.00	651.
1.02	4.30	57	0.06	0.01	0.05	63.	1.03	10.30	117	0.00	0.00	0.00	625.
1.02	5.00	58	0.06	0.01	0.05	66.	1.03	11.00	118	0.00	0.00	0.00	600.
1.02	5.30	59	0.06	0.01	0.05	69.	1.03	11.30	119	0.00	0.00	0.00	577.
1.02	6.00	60	0.06	0.01	0.05	71.	1.03	12.00	120	0.00	0.00	0.00	554.
									SUM	23.34	19.66	3.67	165814.
										(593.)	(499.)	(93.)	(4695.33)

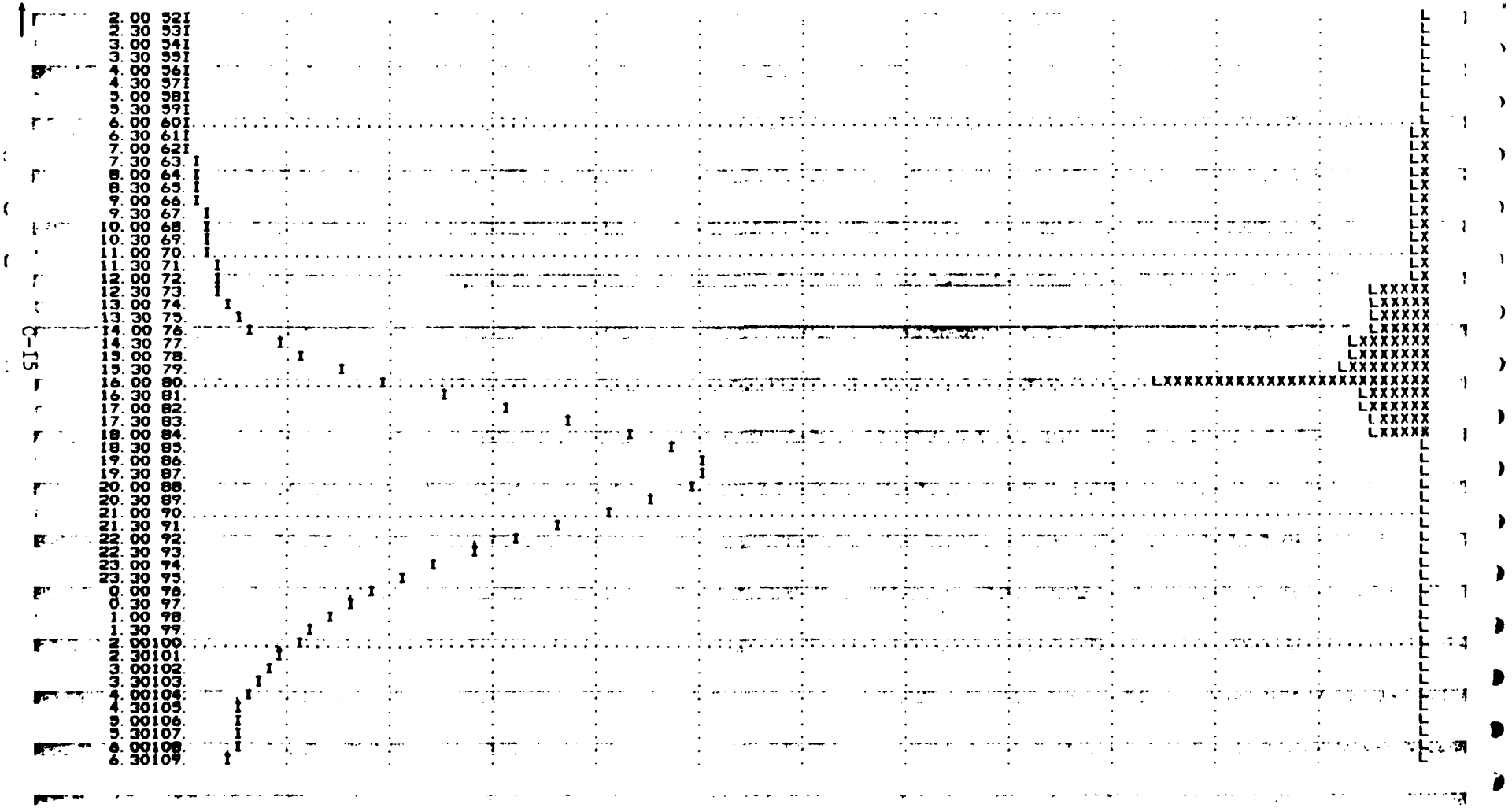
	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	10072.	8138.	3313.	1379.	165535.
CMS	285.	230.	94.	39.	4687.
INCHES		11.94	19.45	20.24	20.24
MM		303.28	493.91	514.10	514.10
AC-FT		4035.	6572.	6840.	6840.
THOUS CU M		4977.	8108.	8437.	8437.

OVF

STATION 1

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

	0.	2000.	4000.	6000.	8000.	10000.	12000.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	6.	PRECIP(L) AND EXCESS(X) 4.	2.	0.
0.30	11												
1.00	21												
1.30	31												
2.00	41												
2.30	51												
3.00	61												
3.30	71												
4.00	81												
4.30	91												
5.00	101												
5.30	111												
6.00	121												
6.30	131												
7.00	141												
7.30	151												
8.00	161												
8.30	171												
9.00	181												
9.30	191												
10.00	201												
10.30	211												
11.00	221												
11.30	231												
12.00	241												
12.30	251												
13.00	261												
13.30	271												
14.00	281												
14.30	291												
15.00	301												LX
15.30	311												LX
16.00	321												LXX
16.30	331												
17.00	341												
17.30	351												
18.00	36. I												
18.30	37. I												
19.00	38. I												
19.30	39. I												
20.00	40. I												
20.30	41. I												
21.00	42. I												
21.30	43. I												
22.00	44. I												
22.30	45. I												
23.00	46. I												
23.30	471												
0.00	481												
0.30	491												
1.00	501												
1.30	511												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2.30 53
3.00 54
3.30 55
4.00 56
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7.00 62
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8.00 64.
8.30 65.
9.00 66.
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10.00 68.
10.30 69.
11.00 70.
11.30 71.
12.00 72.
12.30 73.
13.00 74.
13.30 75.
14.00 76.
14.30 77.
15.00 78.
15.30 79.
16.00 80.
16.30 81.
17.00 82.
17.30 83.
18.00 84.
18.30 85.
19.00 86.
19.30 87.
20.00 88.
20.30 89.
21.00 90.
21.30 91.
22.00 92.
22.30 93.
23.00 94.
23.30 95.
0.00 96.
0.30 97.
1.00 98.
1.30 99.
2.00100.
2.30101.
3.00102.
3.30103.
4.00104.
4.30105.
5.00106.
5.30107.
6.00108.
6.30109.
C-15

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10.30117...I
11.00118...I
11.30119...I
12.00120...I
```

OVN

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 1

4.	4.	3.	3.	3.	3.	3.	3.	3.	3.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	4.	9.	17.	27.	39.	50.	59.	65.	66.
63.	58.	51.	45.	39.	34.	29.	25.	22.	19.
17.	16.	16.	16.	17.	18.	19.	20.	21.	21.
23.	26.	33.	43.	57.	74.	92.	111.	129.	146.
159.	171.	189.	224.	286.	382.	516.	688.	895.	1165.
1506.	1874.	2240.	2576.	2839.	2991.	3022.	2920.	2708.	2449.
2179.	1913.	1665.	1448.	1261.	1100.	961.	840.	734.	641.
558.	485.	420.	363.	312.	293.	281.	270.	259.	249.
239.	230.	221.	212.	203.	195.	188.	180.	173.	166.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3022.	2441.	994.	414.	49661.
CMS	86.	69.	28.	12.	1406.
INCHES		3.58	5.83	6.07	6.07
MM		90.98	148.17	154.23	154.23
AC-FT		1211.	1972.	2052.	2052.
THOUS CU M		1493.	2432.	2531.	2531.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 2

4.	4.	4.	4.	4.	4.	3.	3.	3.	3.
3.	3.	3.	3.	3.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	4.	10.	20.	32.	46.	59.	69.	76.	77.
74.	67.	60.	52.	45.	39.	34.	29.	25.	22.
20.	19.	19.	19.	20.	21.	22.	23.	24.	25.
26.	31.	39.	50.	66.	86.	107.	130.	151.	170.
186.	200.	220.	261.	334.	446.	602.	803.	1044.	1359.
1757.	2187.	2813.	3006.	3312.	3489.	3529.	3406.	3160.	2837.
2542.	2231.	1943.	1689.	1471.	1283.	1121.	980.	856.	748.
651.	566.	490.	423.	365.	342.	328.	315.	303.	291.
279.	268.	257.	247.	237.	228.	219.	210.	202.	194.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3529.	2848.	1160.	483.	57937.
CMS	100.	81.	33.	14.	1641.
INCHES		4.18	6.81	7.08	7.08
MM		106.15	172.87	179.93	179.93

AC-FT		1412.	2300.	2394.		2394.			
THOUS CU M		1742.	2837.	2953.		2953.			

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 3

4.	4.	4.	4.	4.	4.	3.	3.	3.	3.
3.	3.	3.	3.	3.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	4.	11.	20.	33.	47.	60.	71.	78.	79.
76.	69.	62.	54.	47.	40.	35.	30.	26.	23.
21.	20.	19.	19.	20.	21.	23.	24.	25.	26.
27.	32.	40.	52.	68.	88.	111.	133.	155.	175.
191.	206.	226.	269.	343.	458.	619.	826.	1074.	1398.
1807.	2249.	2688.	3091.	3407.	3589.	3626.	3504.	3250.	2939.
2615.	2295.	1998.	1738.	1513.	1320.	1153.	1008.	881.	769.
670.	582.	504.	435.	375.	332.	338.	324.	311.	299.
287.	276.	265.	254.	244.	234.	225.	216.	208.	199.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3626.	2930.	1193.	497.	59593.
CMS	103.	83.	34.	14.	1687.
INCHES		4.30	7.00	7.29	7.29
MM		109.18	177.81	185.07	185.07
AC-FT		1453.	2366.	2463.	2463.
THOUS CU M		1792.	2918.	3037.	3037.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 4

3.	4.	4.	4.	4.	4.	4.	3.	3.	3.
3.	3.	3.	3.	3.	3.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	4.	11.	21.	34.	48.	62.	73.	80.	82.
78.	71.	63.	55.	48.	41.	36.	31.	27.	24.
21.	20.	20.	20.	21.	22.	23.	24.	25.	26.
28.	32.	41.	53.	70.	91.	114.	137.	160.	179.
197.	211.	233.	276.	353.	471.	636.	849.	1104.	1436.
1897.	2312.	2762.	3177.	3501.	3688.	3727.	3601.	3340.	3021.
2687.	2359.	2054.	1786.	1555.	1357.	1185.	1036.	905.	790.
689.	598.	518.	447.	389.	361.	347.	333.	320.	307.
295.	283.	272.	261.	251.	241.	231.	222.	213.	205.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3727.	3011.	1226.	510.	61248.
CMS	106.	85.	35.	14.	1734.
INCHES		4.42	7.19	7.49	7.49
MM		112.21	182.75	190.22	190.22
AC-FT		1493.	2432.	2531.	2531.
THOUS CU M		1842.	2999.	3122.	3122.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 5

5.	4.	4.	4.	4.	4.	4.	4.	3.	3.
3.	3.	3.	3.	3.	3.	3.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	5.	11.	22.	35.	50.	64.	75.	82.	84.
80.	73.	65.	57.	49.	43.	37.	32.	28.	24.
22.	21.	20.	21.	21.	23.	24.	25.	26.	27.
29.	33.	42.	55.	72.	93.	117.	141.	164.	184.

202.	217.	239.	284.	363.	484.	653.	872.	1133.	1479.
1907.	2374.	2837.	3263.	3596.	3788.	3828.	3698.	3430.	3102.
2760.	2423.	2109.	1834.	1597.	1393.	1217.	1064.	930.	812.
707.	614.	532.	459.	396.	371.	356.	342.	329.	316.
303.	291.	279.	268.	258.	247.	238.	228.	219.	210.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3828.	3092.	1259.	524.	62903.
CMS	108.	88.	36.	15.	1781.
INCHES		4.54	7.39	7.69	7.69
MM		115.24	187.69	195.36	195.36
AC-FT		1533.	2497.	2599.	2599.
THOUS CU M		1891.	3080.	3206.	3206.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 6

5.	5.	4.	4.	4.	4.	4.	4.	3.	3.
3.	3.	3.	3.	3.	3.	3.	3.	3.	3.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	5.	12.	22.	36.	51.	65.	77.	84.	86.
82.	75.	67.	58.	51.	44.	38.	33.	28.	25.
23.	21.	21.	21.	22.	23.	25.	26.	27.	28.
30.	34.	43.	56.	74.	96.	120.	145.	168.	189.
207.	223.	245.	291.	372.	496.	671.	895.	1163.	1514.
1957.	2437.	2912.	3349.	3691.	3888.	3928.	3796.	3521.	3184.
2833.	2486.	2165.	1883.	1639.	1430.	1249.	1092.	954.	833.
726.	631.	546.	471.	406.	381.	366.	351.	337.	324.
311.	299.	287.	275.	264.	254.	244.	234.	225.	216.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3928.	3174.	1292.	538.	64559.
CMS	111.	90.	37.	15.	1828.
INCHES		4.66	7.58	7.89	7.89
MM		118.28	192.62	200.50	200.50
AC-FT		1574.	2563.	2668.	2668.
THOUS CU M		1941.	3161.	3291.	3291.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 7

5.	5.	4.	4.	4.	4.	4.	4.	4.	3.
3.	3.	3.	3.	3.	3.	3.	3.	3.	3.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	5.	12.	23.	37.	52.	67.	79.	87.	88.
84.	77.	68.	60.	52.	45.	39.	33.	29.	26.
23.	22.	21.	22.	23.	24.	25.	26.	27.	28.
30.	35.	44.	58.	76.	98.	123.	148.	173.	194.
213.	228.	251.	279.	382.	509.	688.	917.	1193.	1553.
2008.	2499.	2986.	3435.	3785.	3987.	4029.	3893.	3611.	3265.
2905.	2550.	2220.	1931.	1681.	1467.	1281.	1120.	979.	854.
744.	647.	560.	484.	417.	391.	375.	360.	346.	332.
319.	306.	294.	282.	271.	260.	250.	240.	231.	221.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4029.	3255.	1325.	552.	66214.
CMS	114.	92.	38.	16.	1875.
INCHES		4.78	7.78	8.10	8.10
MM		121.31	197.36	205.64	205.64
AC-FT		1614.	2629.	2736.	2736.

THOUS CU M			1991.	3242.	3375.		3375.			

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 8

6.	6.	6.	5.	5.	5.	5.	4.	4.	
4.	4.	4.	4.	4.	3.	3.	3.	3.	
3.	3.	3.	3.	3.	3.	3.	3.	3.	
3.	6.	15.	28.	46.	65.	84.	99.	108.	110.
109.	96.	85.	75.	65.	56.	48.	42.	36.	32.
29.	27.	27.	27.	28.	30.	31.	33.	34.	35.
38.	44.	55.	72.	95.	123.	154.	185.	216.	243.
266.	286.	314.	373.	477.	636.	860.	1147.	1491.	1941.
2509.	3124.	3733.	4274.	4732.	4984.	5038.	4866.	4514.	4082.
3631.	3188.	2776.	2414.	2102.	1833.	1601.	1400.	1223.	1068.
931.	808.	700.	604.	521.	488.	469.	450.	432.	415.
399.	383.	368.	353.	339.	326.	313.	300.	288.	277.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	5036.	4069.	1657.	690.	82767.
CMS	143.	115.	47.	20.	2344.
INCHES		9.77	9.72	10.12	10.12
MM		151.64	246.95	257.05	257.05
AC-FT		2018.	3286.	3420.	3420.
THOUS CU M		2489.	4053.	4219.	4219.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 9

12.	12.	11.	11.	10.	10.	10.	9.	9.	9.
8.	8.	8.	7.	7.	7.	7.	7.	6.	6.
6.	6.	6.	5.	5.	5.	5.	5.	5.	6.
6.	12.	30.	57.	91.	130.	168.	197.	217.	221.
210.	192.	171.	150.	130.	112.	97.	83.	72.	64.
58.	54.	53.	54.	56.	59.	63.	66.	69.	71.
76.	88.	110.	144.	190.	245.	307.	371.	431.	485.
531.	571.	629.	746.	954.	1273.	1719.	2294.	2983.	3882.
5019.	6248.	7466.	8587.	9463.	9969.	10072.	9732.	9027.	8164.
7263.	6379.	5551.	4827.	4203.	3668.	3203.	2799.	2446.	2136.
1861.	1617.	1400.	1209.	1042.	977.	938.	901.	865.	830.
797.	766.	735.	706.	678.	651.	625.	600.	577.	554.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	10072.	8138.	3313.	1379.	165535.
CMS	285.	230.	94.	39.	4687.
INCHES		11.94	19.45	20.24	20.24
MM		303.28	493.91	514.10	514.10
AC-FT		4035.	6572.	6840.	6840.
THOUS CU M		4977.	8106.	8437.	8437.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

RESERVOIR ROUTING - MODIFIED PLUS METHOD

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	1	0	0	0	1	1	0	0

ROUTING DATA

GLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP		LSTR
0.0	0.000	0.00	1	1	0	0		0
	NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
	1	0	0	0.000	0.000	0.000	0	-1

STAGE	1459.00	1460.00	1461.00	1461.10	1462.00	1463.00	1463.70	1463.90	1464.70	1465.00
	1466.00	1470.00								
FLOW	0.00	201.00	568.50	611.80	1053.90	1635.80	2092.10	2231.90	2863.70	3123.10
	4059.10	8679.50								
SURFACE AREA=	100.	138.	179.	276.						
CAPACITY=	0.	118.	1698.	3954.						
ELEVATION=	1459.	1460.	1470.	1480.						

CREL	SPWID	COGW	EXPW	ELEVL	COGL	CAREA	EXPL
1459.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COGD	EXPD	DAMWID
1464.7	3.0	1.5	61.

STATION 1, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	1.	1.	1.	1.	1.	1.	1.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	3.	4.	6.	9.	13.	17.	20.
24.	26.	28.	30.	31.	31.	31.	31.	30.	29.
29.	28.	27.	26.	25.	25.	24.	24.	23.	23.
23.	23.	24.	25.	27.	29.	33.	38.	44.	51.
58.	66.	74.	83.	93.	111.	133.	163.	201.	287.
395.	528.	714.	937.	1187.	1448.	1685.	1896.	2046.	2135.
2166.	2149.	2084.	1998.	1893.	1776.	1653.	1537.	1427.	1319.
1207.	1103.	1011.	930.	852.	779.	714.	656.	605.	564.
531.	501.	473.	446.	422.	399.	377.	357.	339.	321.

STORAGE

0.	0.	0.	0.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	2.	3.	5.	6.	8.	10.
12.	13.	14.	15.	16.	16.	16.	16.	15.	15.
15.	14.	14.	13.	13.	12.	12.	12.	12.	12.
12.	12.	12.	13.	14.	15.	17.	20.	23.	26.
30.	35.	39.	44.	51.	61.	74.	93.	118.	151.
192.	242.	302.	367.	435.	501.	560.	609.	644.	664.
671.	666.	653.	633.	608.	581.	553.	524.	496.	467.
440.	414.	389.	365.	342.	321.	302.	285.	270.	256.
244.	232.	221.	211.	202.	193.	185.	177.	170.	164.

STAGE

1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0
1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0
1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0
1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.1	1459.1	1459.1
1459.1	1459.1	1459.1	1459.1	1459.2	1459.2	1459.2	1459.2	1459.1	1459.1
1459.1	1459.1	1459.1	1459.1	1459.1	1459.1	1459.1	1459.1	1459.1	1459.1
1459.1	1459.1	1459.1	1459.1	1459.1	1459.1	1459.2	1459.2	1459.2	1459.3
1459.3	1459.3	1459.4	1459.4	1459.5	1459.8	1459.7	1459.8	1460.0	1460.2
1460.5	1460.9	1461.3	1461.8	1462.2	1462.7	1463.1	1463.4	1463.6	1463.8
1463.8	1463.8	1463.7	1463.6	1463.4	1463.2	1463.0	1462.8	1462.6	1462.4
1462.3	1462.1	1461.9	1461.7	1461.6	1461.4	1461.3	1461.2	1461.1	1461.0
1460.9	1460.8	1460.7	1460.7	1460.6	1460.5	1460.5	1460.4	1460.4	1460.3

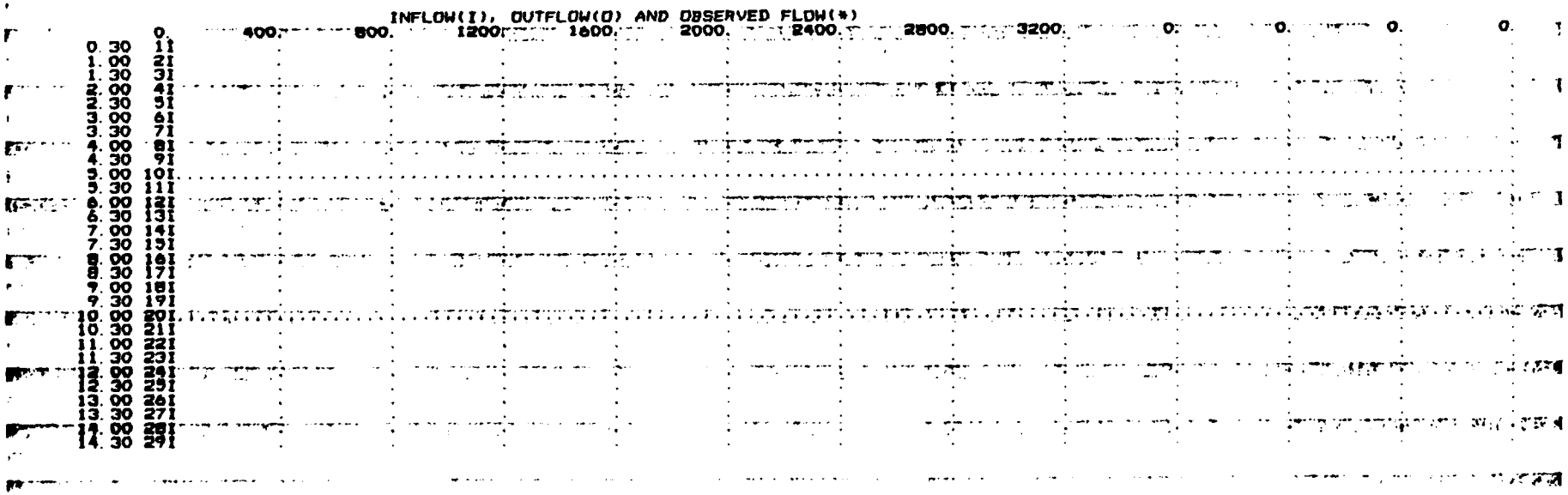
PEAK OUTFLOW IS 2166. AT TIME 45.50 HOURS

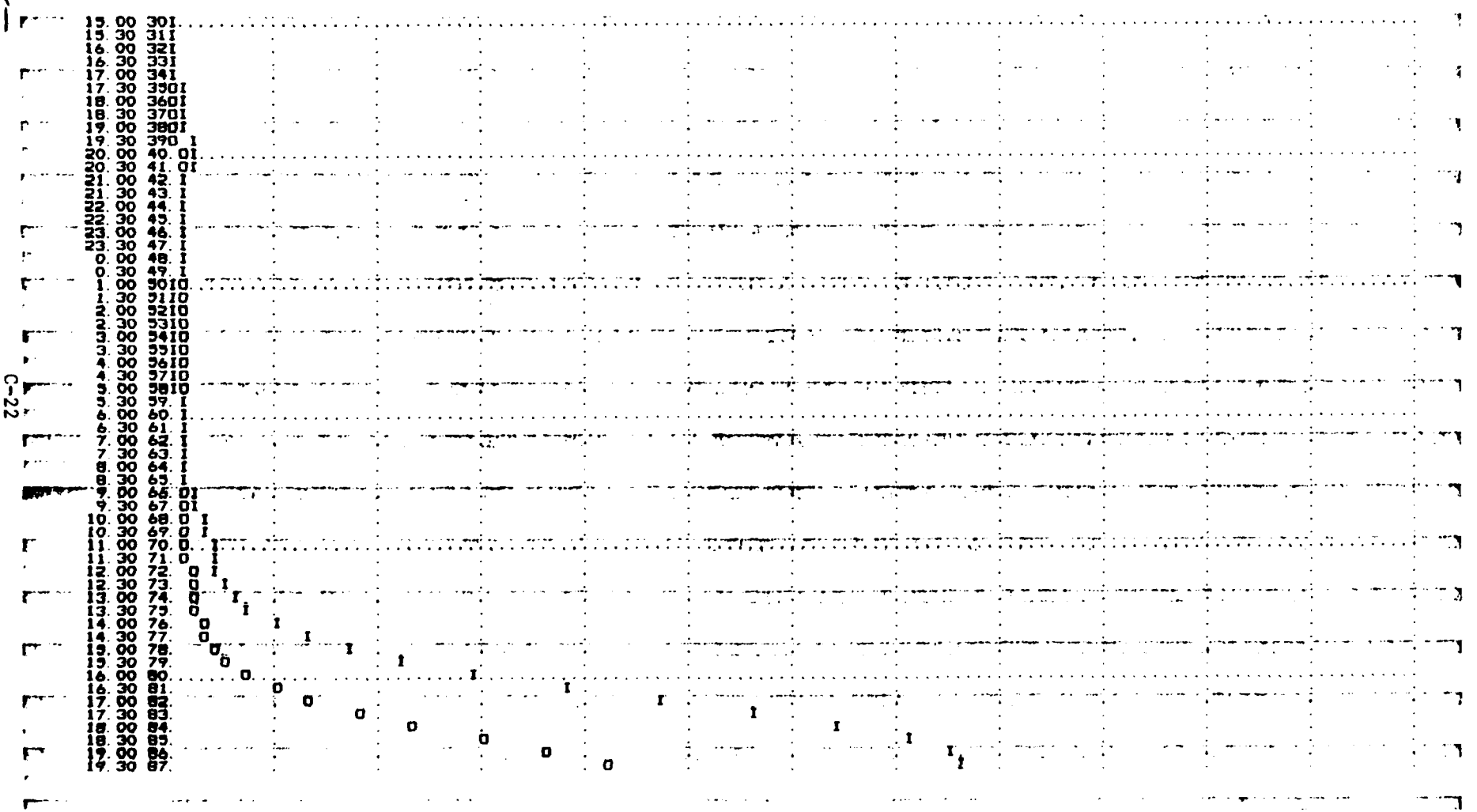
	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2166.	1914.	929.	380.	45644.
CMS	61.	54.	26.	11.	1293.
INCHES		2.81	5.45	5.58	5.58
MM		71.34	138.43	141.76	141.76
AC-FT		949.	1842.	1886.	1886.
THOUS CU M		1171.	2272.	2327.	2327.

#OVF#

STATION 1

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

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16.00 321
16.30 331
17.00 341
17.30 350I
18.00 360I
18.30 370I
19.00 380I
19.30 390 I
20.00 40.0I
20.30 41.0I
21.00 42.I
21.30 43.I
22.00 44.I
22.30 45.I
23.00 46.I
23.30 47.I
0.00 48.I
0.30 49.I
1.00 5010
1.30 5110
2.00 5210
2.30 5310
3.00 5410
3.30 5510
4.00 5610
4.30 5710
5.00 5810
5.30 59.I
6.00 60.I
6.30 61.I
7.00 62.I
7.30 63.I
8.00 64.I
8.30 65.I
9.00 66.0I
9.30 67.0I
10.00 68.0 I
10.30 69.0 I
11.00 70.0 I
11.30 71.0 I
12.00 72. 0 I
12.30 73. 0 I
13.00 74. 0 I
13.30 75. 0 I
14.00 76. 0 I
14.30 77. 0 I
15.00 78. 0 I
15.30 79. 0 I
16.00 80. 0 I
16.30 81. 0 I
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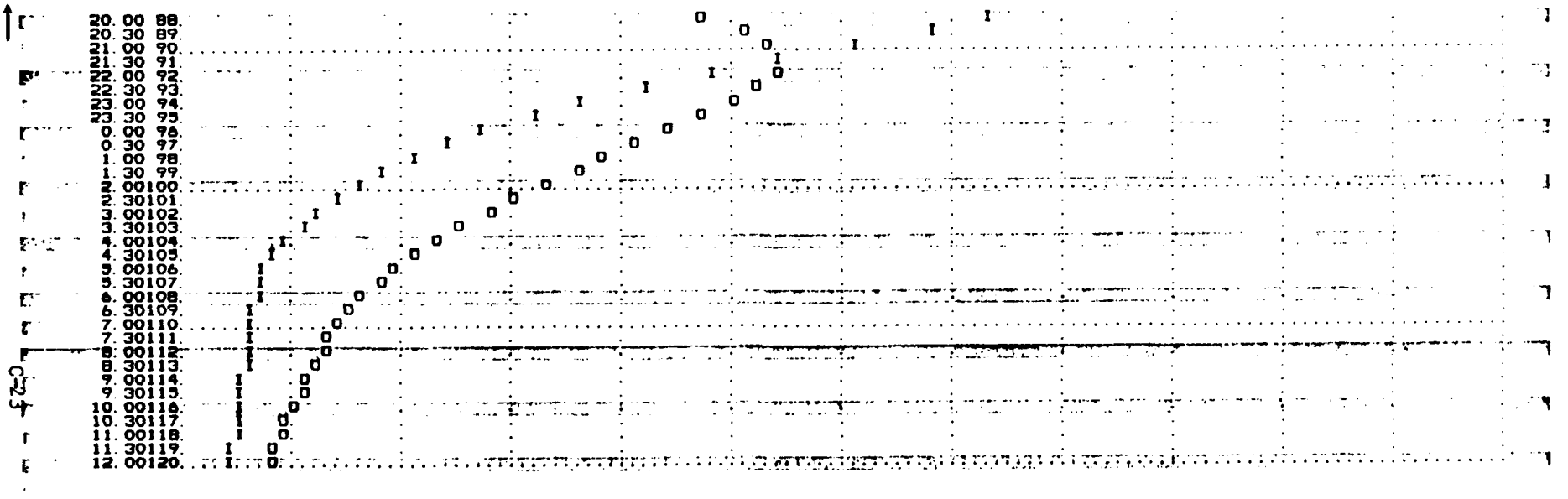
18.00 84. 0 I
18.30 85. 0 I
19.00 86. 0 I
19.30 87. 0 I



OVN

STATION 1, PLAN 1, RATIO 2

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	1.	1.	1.	1.	1.	2.	2.	2.	2.	
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	
2.	2.	2.	3.	5.	8.	11.	15.	19.	24.	
27.	31.	33.	35.	36.	36.	36.	36.	35.	34.	
33.	32.	31.	30.	29.	29.	28.	28.	27.	27.	
27.	27.	28.	29.	31.	34.	39.	45.	52.	59.	
68.	77.	86.	96.	110.	129.	154.	187.	233.	352.	
476.	642.	874.	1140.	1445.	1747.	2035.	2284.	2475.	2577.	
2800.	2939.	2869.	2344.	2201.	2061.	1921.	1778.	1636.	1511.	
1390.	1272.	1159.	1052.	966.	886.	813.	748.	690.	638.	
593.	557.	527.	499.	472.	448.	425.	403.	383.	364.	

STORAGE

0.	0.	0.	1.	1.	1.	1.	1.	1.	1.

1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	2.	1.	1.	1.	1.	1.	1.
1.	1.	1.	2.	2.	4.	5.	8.	10.	12.	18.
14.	16.	17.	18.	18.	19.	19.	18.	18.	14.	14.
17.	16.	18.	15.	15.	15.	14.	14.	14.	27.	31.
14.	14.	14.	15.	16.	16.	20.	23.	27.	31.	175.
36.	41.	46.	52.	60.	71.	87.	109.	138.	175.	753.
222.	281.	349.	423.	500.	575.	642.	693.	733.	753.	517.
757.	749.	732.	707.	679.	647.	615.	582.	549.	517.	280.
486.	456.	428.	401.	376.	352.	331.	312.	295.	280.	
266.	254.	242.	231.	221.	212.	203.	195.	187.	180.	

STAGE

1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0
1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0
1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0
1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.1	1459.1	1459.1	1459.1
1459.1	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2
1459.2	1459.2	1459.2	1459.2	1459.1	1459.1	1459.1	1459.1	1459.1	1459.1	1459.1
1459.1	1459.1	1459.1	1459.1	1459.2	1459.2	1459.2	1459.2	1459.3	1459.3	1460.4
1459.3	1459.4	1459.7	1459.9	1459.9	1459.8	1459.8	1459.9	1460.1	1460.4	1464.3
1460.7	1461.2	1461.6	1462.1	1462.7	1463.2	1463.6	1464.0	1464.2	1464.3	1462.8
1464.4	1464.3	1464.2	1464.0	1463.9	1463.7	1463.4	1463.2	1463.0	1462.8	1461.2
1462.6	1462.4	1462.2	1462.0	1461.8	1461.7	1461.5	1461.4	1461.3	1461.2	1460.4
1461.1	1461.0	1460.9	1460.8	1460.7	1460.7	1460.8	1460.5	1460.5	1460.4	

C-24

PEAK OUTFLOW IS 2600. AT TIME 45.50 HOURS

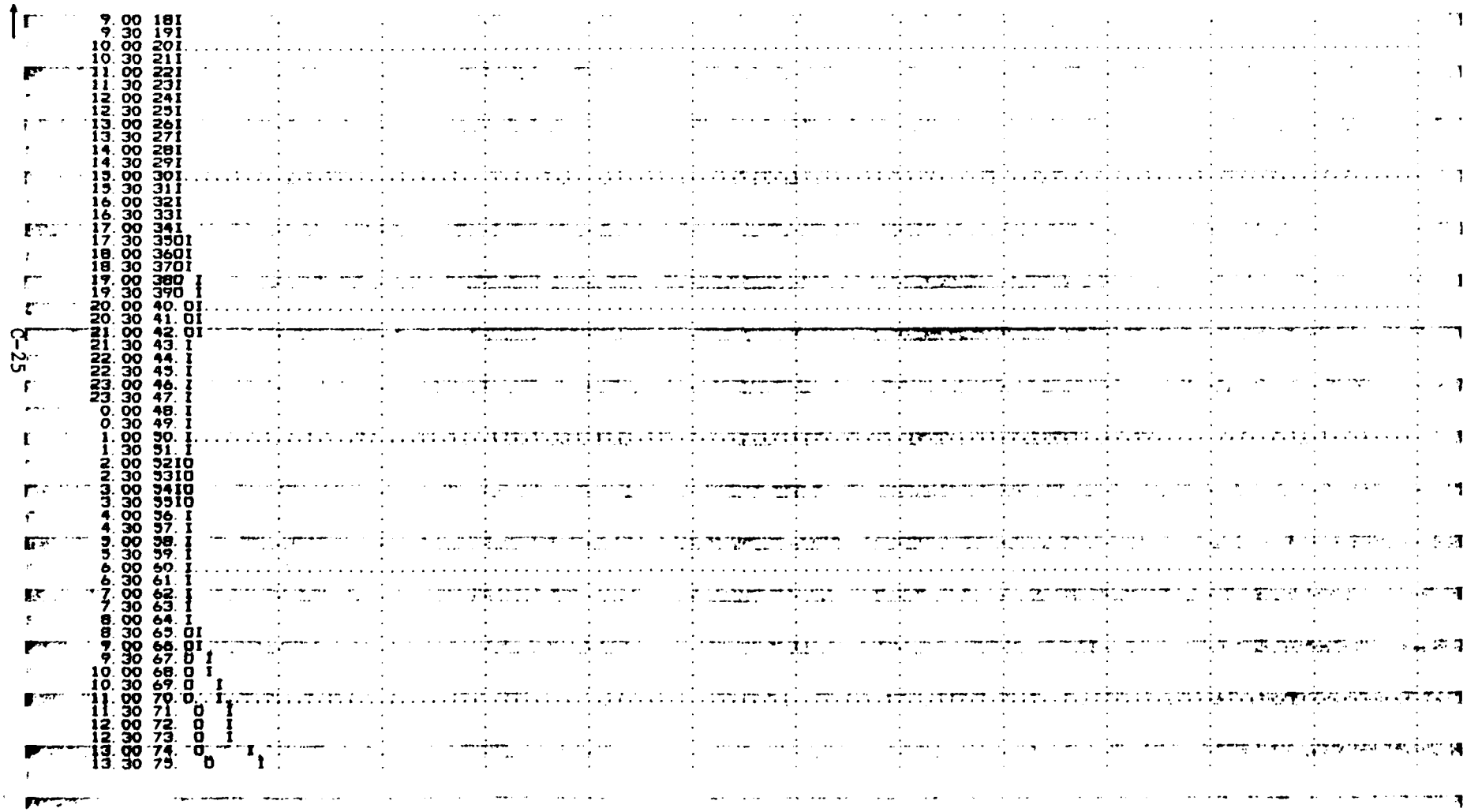
	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2600.	2274.	1089.	446.	53534.
CMS	74.	64.	31.	13.	1516.
INCHES		3.34	6.39	6.55	6.55
MM		84.75	162.38	166.28	166.28
AC-FT		1128.	2160.	2212.	2212.
THOUS CU M		1391.	2669.	2729.	2729.

OVF

STATION 1

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

		0.	400.	800.	1200.	1600.	2000.	2400.	2800.	3200.	3600.	0.	0.	0.
0.	30	11												
1.	00	21												
1.	30	31												
2.	00	41												
2.	30	51												
3.	00	61												
3.	30	71												
4.	00	81												
4.	30	91												
5.	00	101												
5.	30	111												
6.	00	121												
6.	30	131												
7.	00	141												
7.	30	151												
8.	00	161												
8.	30	171												


9.00 181
9.30 191
10.00 201
10.30 211
11.00 221
11.30 231
12.00 241
12.30 251
13.00 261
13.30 271
14.00 281
14.30 291
15.00 301
15.30 311
16.00 321
16.30 331
17.00 341
17.30 3501
18.00 3601
18.30 3701
19.00 380 I
19.30 390 I
20.00 40. 01
20.30 41. 01
21.00 42. 01
21.30 43. I
22.00 44. I
22.30 45. I
23.00 46. I
23.30 47. I
0.00 48. I
0.30 49. I
1.00 50. I
1.30 51. I
2.00 5210
2.30 5310
3.00 5410
3.30 5510
4.00 56. I
4.30 57. I
5.00 58. I
5.30 59. I
6.00 60. I
6.30 61. I
7.00 62. I
7.30 63. I
8.00 64. I
8.30 65. 01
9.00 66. 01
9.30 67. 0 I
10.00 68. 0 I
10.30 69. 0 I
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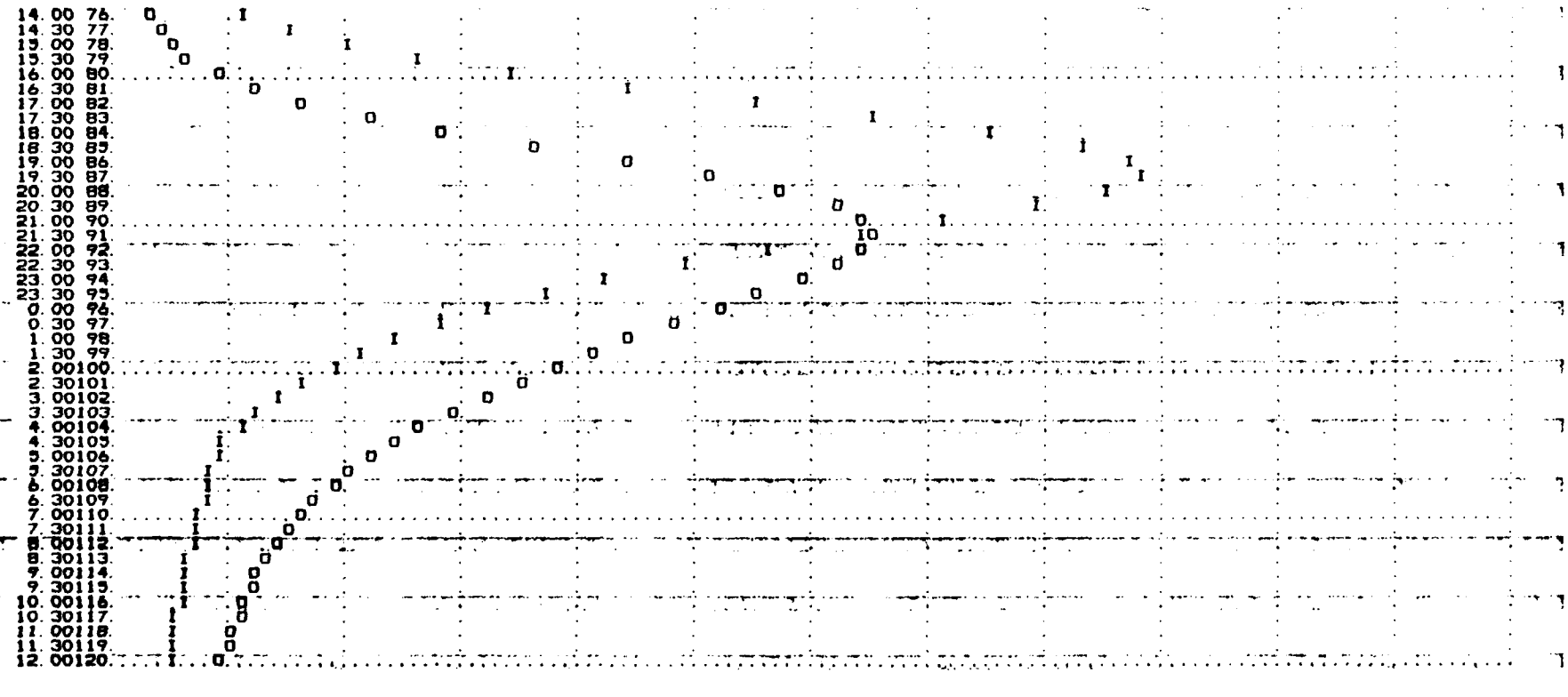
13.30 75. 0 I



#OVN#

STATION 1, PLAN 1, RATIO 3

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

2.	2.	2.	3.	5.	8.	11.	15.	20.	24.	
28.	31.	34.	36.	37.	37.	37.	37.	36.	35.	
34.	33.	32.	31.	30.	29.	29.	28.	28.	28.	
28.	28.	28.	30.	32.	35.	40.	46.	53.	61.	
70.	79.	88.	99.	113.	132.	158.	192.	264.	365.	
492.	668.	906.	1184.	1495.	1810.	2104.	2370.	2562.	2663.	
2685.	2641.	2547.	2417.	2265.	2115.	1971.	1825.	1680.	1548.	
1424.	1304.	1189.	1079.	987.	906.	832.	766.	706.	653.	
606.	567.	537.	509.	482.	457.	434.	412.	391.	372.	

STORAGE

0.	0.	0.	1.	1.	1.	1.	1.	1.	1.	
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	
1.	1.	1.	2.	3.	4.	6.	8.	10.	12.	
14.	16.	17.	18.	19.	19.	19.	19.	19.	18.	
17.	17.	16.	16.	15.	15.	15.	15.	14.	14.	
14.	14.	14.	15.	16.	18.	21.	24.	28.	32.	
37.	42.	47.	54.	62.	73.	90.	112.	142.	180.	
229.	288.	358.	434.	513.	589.	657.	712.	750.	770.	
774.	765.	747.	721.	692.	660.	626.	593.	559.	527.	
495.	464.	435.	408.	382.	358.	336.	317.	300.	284.	
270.	258.	246.	239.	229.	219.	206.	198.	190.	183.	

STAGE

1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	
1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	
1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	
1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.1	1459.1	1459.1	1459.1	
1459.1	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	
1459.2	1459.2	1459.2	1459.2	1459.2	1459.1	1459.1	1459.1	1459.1	1459.1	
1459.1	1459.1	1459.1	1459.1	1459.2	1459.2	1459.2	1459.2	1459.3	1459.3	
1459.3	1459.4	1459.4	1459.5	1459.8	1459.7	1459.8	1460.0	1460.2	1460.4	
1460.8	1461.2	1461.7	1462.2	1462.8	1463.3	1463.7	1464.1	1464.3	1464.4	
1464.5	1464.4	1464.3	1464.1	1463.9	1463.7	1463.5	1463.3	1463.1	1462.8	
1462.6	1462.4	1462.2	1462.0	1461.9	1461.7	1461.5	1461.4	1461.3	1461.2	
1461.1	1461.0	1460.9	1460.8	1460.8	1460.7	1460.8	1460.8	1460.5	1460.5	

PEAK OUTFLOW IS 2685. AT TIME 45.50 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2685.	2347.	1121.	459.	99109.
CMS	76.	66.	32.	13.	1561.
INCHES		3.44	6.58	6.74	6.74
MM		87.45	167.18	171.15	171.15
AC-FT		1164.	2224.	2277.	2277.
THOUS CU M		1435.	2743.	2809.	2809.

#OVF#

STATION 1

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

		0.	500.	1000.	1500.	2000.	2500.	3000.	3500.	4000.	0.	0.	0.	0.
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1.30	31													
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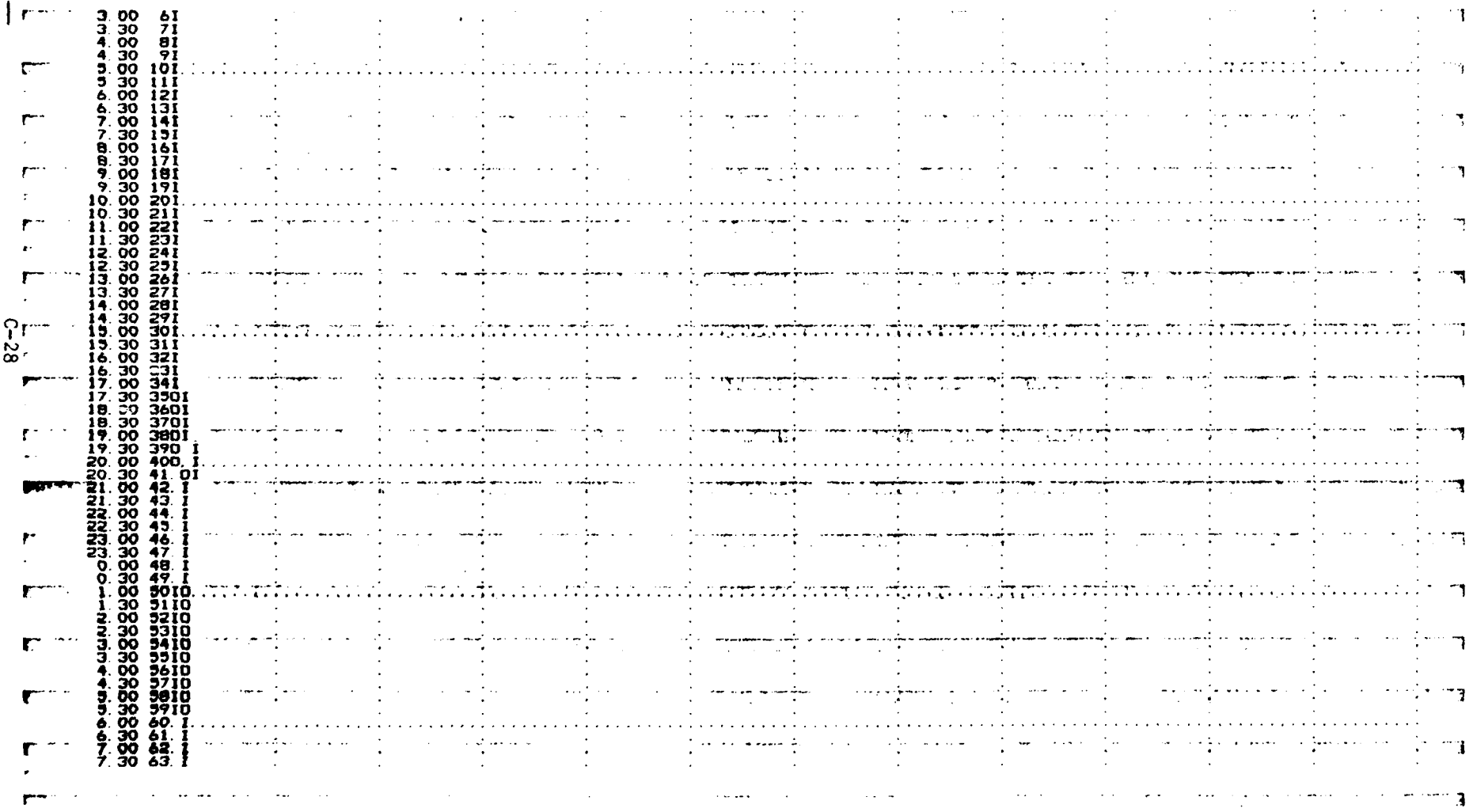
2.30	51													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6.00 121
6.30 131
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8.30 171
9.00 181
9.30 191
10.00 201
10.30 211
11.00 221
11.30 231
12.00 241
12.30 251
13.00 261
13.30 271
14.00 281
14.30 291
15.00 301
15.30 311
16.00 321
16.30 331
17.00 341
17.30 3501
18.00 3601
18.30 3701
19.00 3801
19.30 390 I
20.00 400. I
20.30 41.0I
21.00 42. I
21.30 43. I
22.00 44. I
22.30 45. I
23.00 46. I
23.30 47. I
0.00 48. I
0.30 49. I
1.00 5010
1.30 5110
2.00 5210
2.30 5310
3.00 5410
3.30 5510
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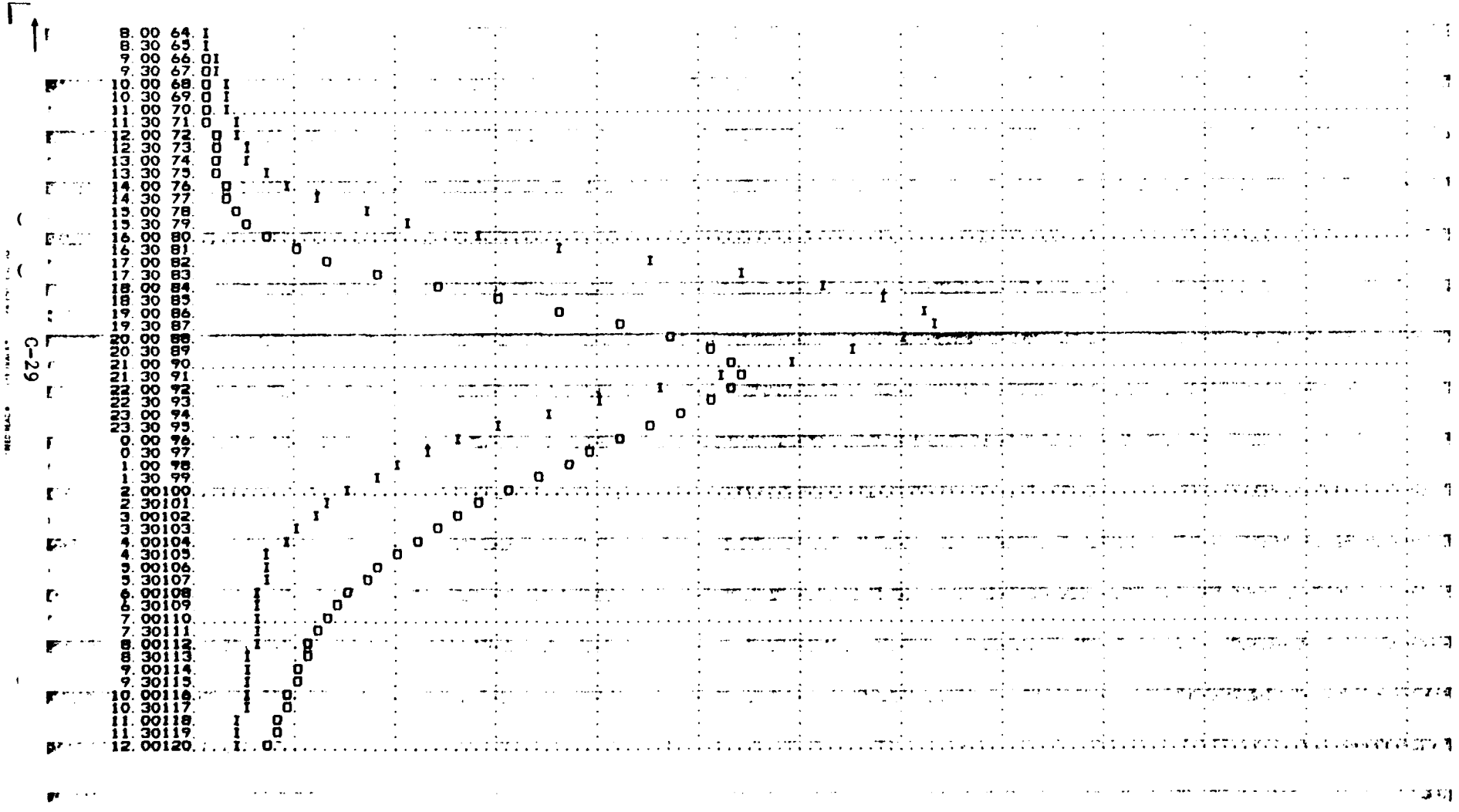
6.30 61. I
7.00 62. I
7.30 63. I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17.00 82.O I
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18.00 84.O I
18.30 85.O I
19.00 86.O I
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23.30 95.O I
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0.30 97.O I
1.00 98.O I
1.30 99.O I
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10.30117.O I
11.00118.O I
11.30119.O I
12.00120.O I

DVN

STATION 1, PLAN 1, RATIO 4

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	1.	1.	1.	1.	1.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	3.	5.	8.	12.	16.	20.	25.
29.	32.	35.	37.	38.	38.	38.	38.	37.	36.
33.	34.	33.	32.	31.	30.	30.	29.	29.	29.
29.	29.	29.	31.	33.	36.	41.	47.	54.	63.
72.	81.	91.	102.	118.	135.	162.	197.	275.	378.
508.	694.	937.	1227.	1545.	1873.	2177.	2455.	2649.	2750.
2769.	2723.	2625.	2490.	2333.	2171.	2020.	1872.	1723.	1585.
1458.	1336.	1218.	1106.	1009.	925.	850.	783.	722.	668.
619.	579.	547.	518.	492.	468.	443.	420.	399.	380.

STORAGE

0.	0.	0.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	2.	3.	4.	6.	8.	10.	13.
15.	17.	18.	19.	19.	20.	20.	19.	19.	19.
18.	17.	17.	16.	16.	16.	15.	15.	15.	15.
15.	15.	15.	16.	17.	19.	21.	24.	28.	33.
38.	43.	49.	55.	64.	76.	92.	115.	146.	185.
235.	296.	367.	445.	526.	604.	673.	729.	767.	787.
791.	781.	762.	736.	705.	672.	638.	603.	569.	536.
504.	472.	443.	415.	388.	364.	342.	322.	304.	288.
274.	261.	250.	239.	228.	219.	210.	201.	193.	186.

STAGE

1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0
1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0
1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0
1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.1	1459.1	1459.1
1459.1	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2
1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.1	1459.1	1459.1	1459.1
1459.1	1459.1	1459.1	1459.2	1459.2	1459.2	1459.2	1459.2	1459.3	1459.3
1459.4	1459.4	1459.5	1459.5	1459.6	1459.7	1459.8	1460.0	1460.2	1460.5
1460.8	1461.3	1461.8	1462.3	1462.8	1463.4	1463.8	1464.2	1464.4	1464.6
1464.6	1464.5	1464.4	1464.2	1464.0	1463.8	1463.6	1463.4	1463.1	1462.9
1462.7	1462.5	1462.3	1462.1	1461.9	1461.7	1461.6	1461.4	1461.3	1461.2
1461.1	1461.0	1460.9	1460.9	1460.8	1460.7	1460.7	1460.6	1460.5	1460.5

PEAK OUTFLOW IS 2769. AT TIME 45.50 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2769.	2420.	1154.	472.	56696.
CMS	78.	69.	33.	13.	1605.
INCHES		3.55	6.77	6.93	6.93
MM		90.17	171.97	176.08	176.08
AC-FT		1200.	2288.	2343.	2343.

THOUS CU M 1480. 2822. 2890. 2890.

OVF

STATION 1

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

0. 500. 1000. 1500. 2000. 2500. 3000. 3500. 4000. 0 0 0 0

0.30 1I
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1.30 3I
2.00 4I
2.30 5I
3.00 6I
3.30 7I
4.00 8I
4.30 9I
5.00 10I
5.30 11I
6.00 12I
6.30 13I
7.00 14I
7.30 15I
8.00 16I
8.30 17I
9.00 18I
9.30 19I
10.00 20I
10.30 21I
11.00 22I
11.30 23I
12.00 24I
12.30 25I
13.00 26I
13.30 27I
14.00 28I
14.30 29I
15.00 30I
15.30 31I
16.00 32I
16.30 33I
17.00 34I
17.30 350I
18.00 360I
18.30 370I
19.00 380I
19.30 390 I
20.00 400. I
20.30 41. OI
21.00 42. I
21.30 43. I
22.00 44. I
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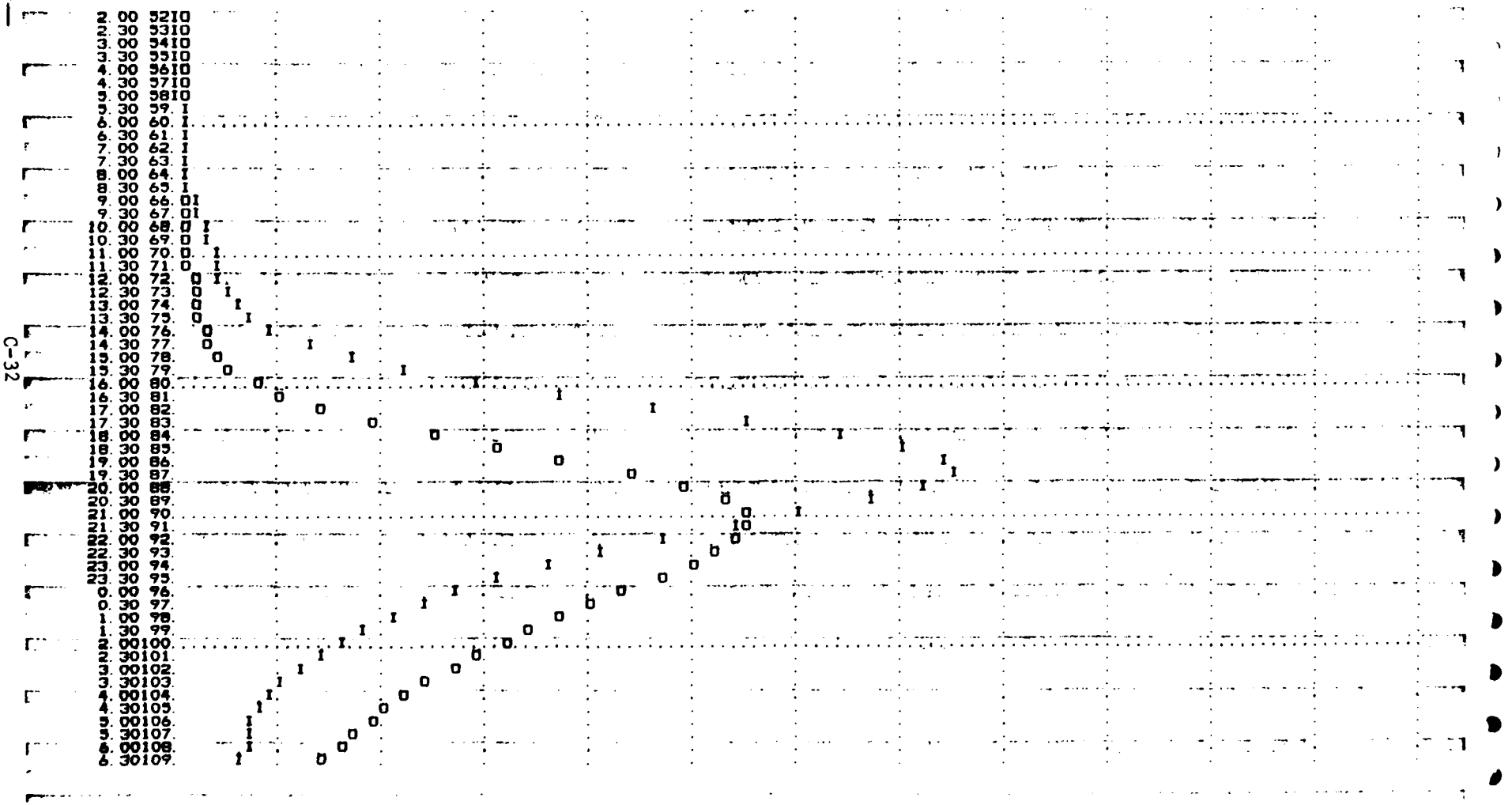
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5.30107.
6.00108.
6.30109.

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 9.30115....I...O
10.00116....I..O.
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11.00118...I..O
11.30119...I..O
12.00120...I..O.
```

OVN

STATION 1, PLAN 1, RATIO 5

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	1.	1.	1.	1.	1.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	3.	4.	5.	8.	12.	16.	21.	26.
30.	33.	36.	38.	39.	39.	39.	39.	38.	37.
36.	35.	34.	33.	32.	31.	31.	30.	30.	29.
29.	29.	30.	31.	34.	37.	42.	48.	56.	64.
74.	83.	93.	105.	119.	139.	166.	202.	286.	391.
524.	721.	969.	1271.	1595.	1935.	2291.	2540.	2735.	2835.
2853.	2804.	2702.	2563.	2401.	2227.	2069.	1918.	1767.	1621.
1492.	1367.	1247.	1133.	1030.	945.	869.	800.	739.	683.
634.	591.	557.	528.	501.	475.	451.	429.	408.	388.

STORAGE

0.	0.	0.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	2.	3.	4.	6.	8.	11.	13.
15.	17.	18.	19.	20.	20.	20.	20.	20.	19.
19.	18.	17.	17.	16.	16.	16.	15.	15.	15.
15.	15.	15.	16.	17.	19.	22.	25.	29.	34.
39.	44.	50.	57.	66.	78.	93.	119.	150.	190.
241.	304.	376.	456.	539.	618.	689.	746.	784.	804.
807.	797.	777.	750.	718.	684.	649.	614.	579.	545.
512.	480.	450.	421.	394.	369.	347.	327.	309.	293.
278.	265.	253.	242.	232.	222.	213.	204.	196.	189.

STAGE

1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0
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1459.1	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2
1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.1	1459.1	1459.1
1459.1	1459.1	1459.1	1459.2	1459.2	1459.2	1459.2	1459.2	1459.3	1459.3
1459.4	1459.4	1459.5	1459.5	1459.8	1459.7	1459.8	1460.0	1460.2	1460.3
1460.9	1461.3	1461.8	1462.4	1462.9	1463.5	1463.9	1464.3	1464.5	1464.7

1464.7	1464.6	1464.5	1464.3	1464.1	1463.9	1463.7	1463.4	1463.2	1463.0
1462.8	1462.5	1462.3	1462.1	1462.0	1461.8	1461.6	1461.3	1461.4	1461.2
1461.1	1461.1	1461.0	1460.9	1460.8	1460.7	1460.7	1460.6	1460.6	1460.5

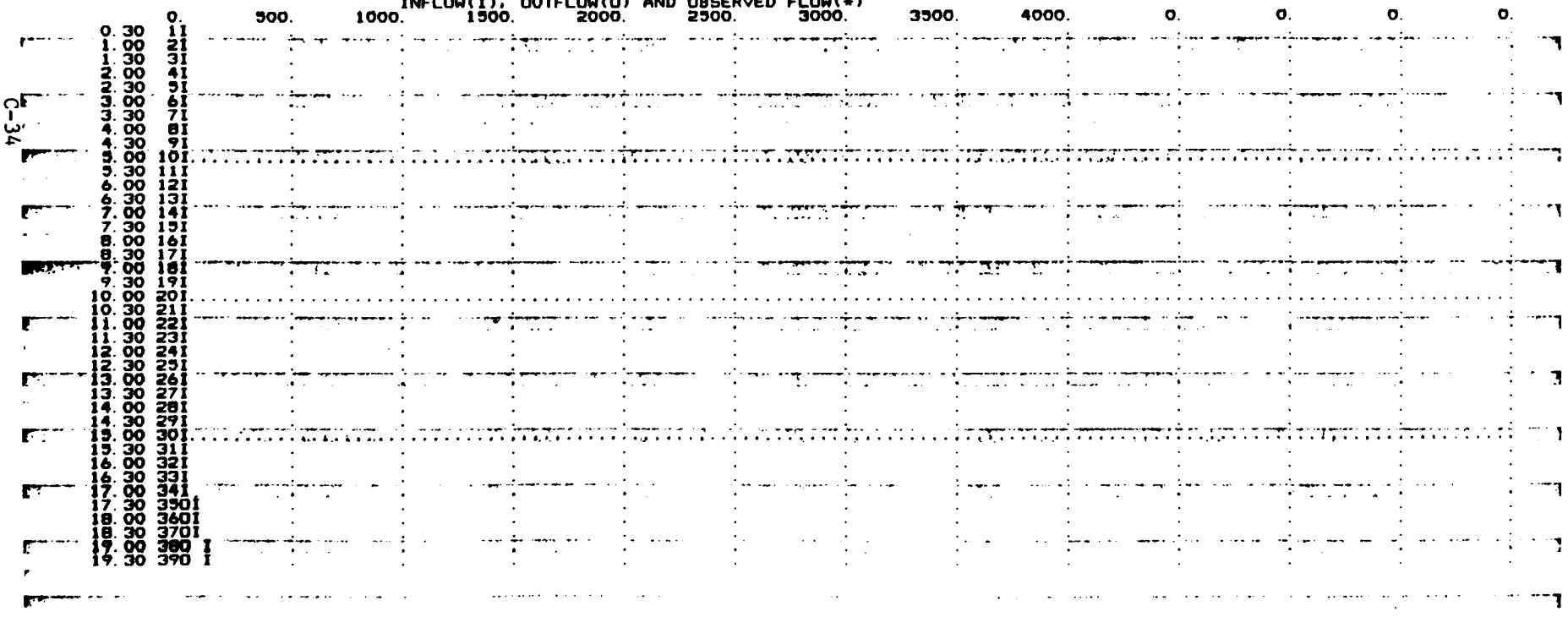
PEAK OUTFLOW IS 2853. AT TIME 45.50 HOURS

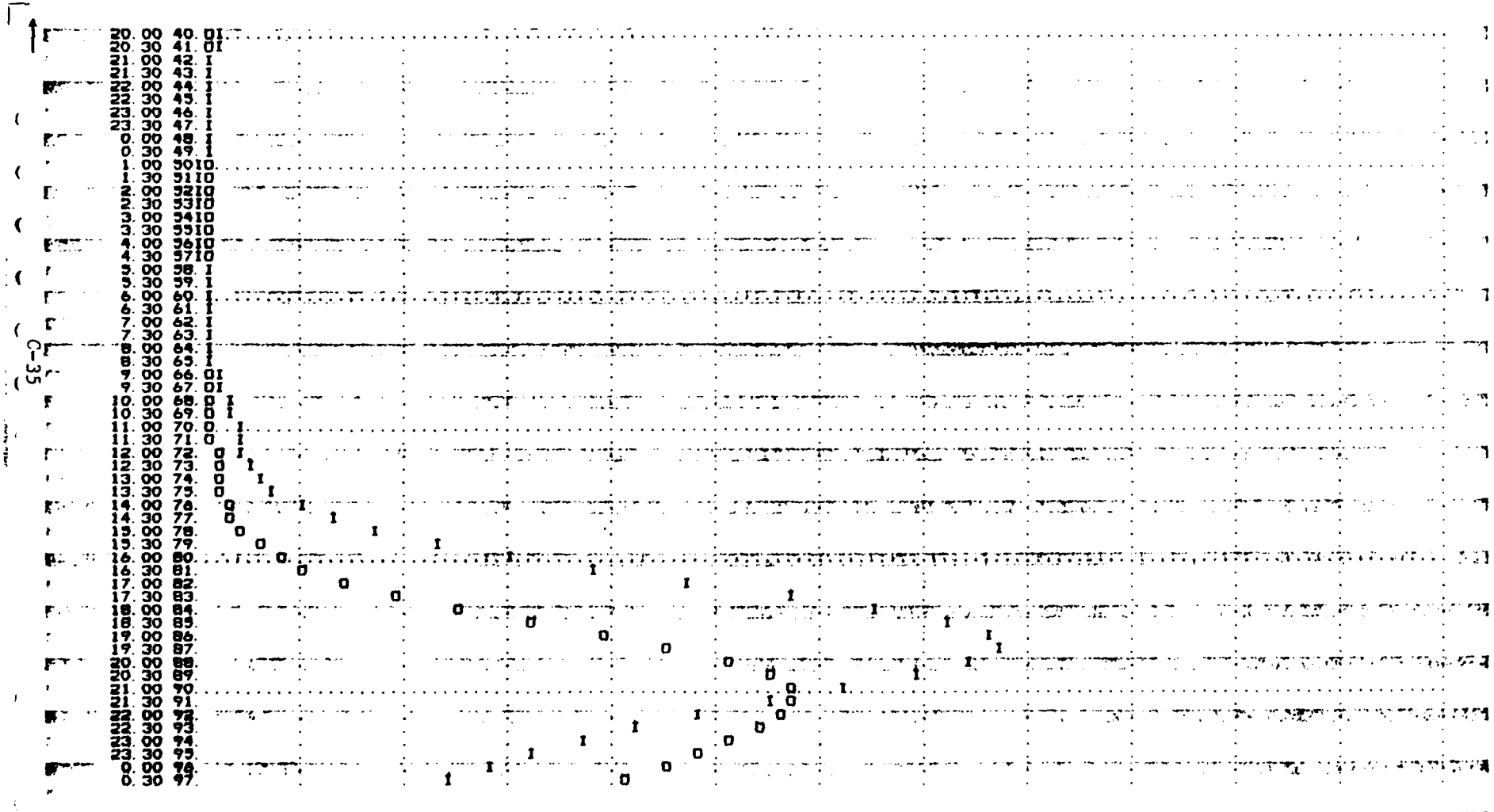
	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2853.	2492.	1186.	486.	58274.
CMS	81.	71.	34.	14.	1650.
INCHES		3.66	6.96	7.13	7.13
MM		92.88	176.76	180.98	180.98
AC-FT		1236.	2352.	2408.	2408.
THOUS CU M		1524.	2901.	2970.	2970.

OVF

STATION 1

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

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0.30 49. I
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1.30 5110
2.00 5210
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5.00 58. I
5.30 59. I
6.00 60. I
6.30 61. I
7.00 62. I
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8.00 64. I
8.30 65. I
9.00 66. OI
9.30 67. OI
10.00 68. O I
10.30 69. O I
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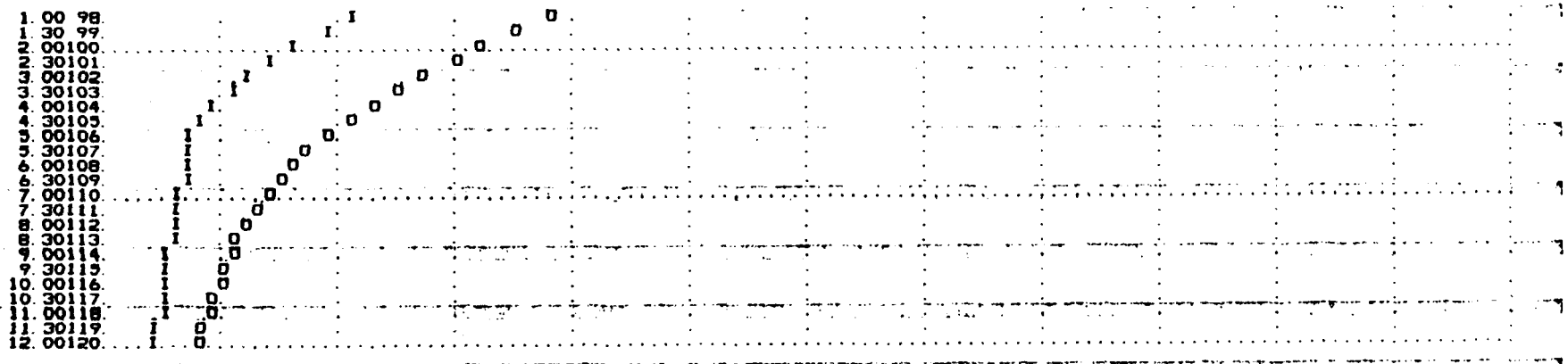
0.30 97. O I



DVN

STATION I, PLAN I, RATIO 6

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	1.	1.	1.	1.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	3.	4.	6.	8.	12.	17.	21.	26.
31.	34.	37.	39.	40.	40.	40.	40.	39.	38.
37.	36.	35.	34.	33.	32.	31.	31.	31.	30.
30.	30.	31.	32.	35.	38.	43.	50.	57.	66.
75.	85.	95.	107.	122.	142.	170.	211.	276.	403.
540.	746.	1000.	1314.	1646.	1997.	2331.	2624.	2820.	2928.
2946.	2883.	2776.	2633.	2466.	2287.	2118.	1962.	1808.	1658.
1525.	1398.	1276.	1159.	1050.	964.	887.	817.	755.	698.
648.	603.	568.	537.	510.	484.	460.	438.	416.	398.

STORAGE

0.	0.	0.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	2.	3.	4.	6.	8.	11.	13.
16.	17.	19.	20.	20.	21.	21.	21.	20.	20.
19.	18.	18.	17.	17.	16.	16.	16.	16.	15.
15.	15.	16.	16.	18.	20.	22.	26.	30.	35.
40.	46.	52.	58.	67.	80.	97.	122.	154.	195.
247.	311.	386.	467.	551.	633.	705.	762.	801.	820.
823.	813.	792.	764.	731.	696.	660.	624.	589.	554.
521.	488.	457.	428.	400.	375.	352.	332.	314.	297.

283.	269.	257.	246.	236.	226.	216.	208.	200.	192.
STAGE									
1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0
1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0
1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0
1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.1	1459.1	1459.1	1459.1
1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2
1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2
1459.1	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.3	1459.3
1459.4	1459.4	1459.5	1459.5	1459.6	1459.7	1459.8	1460.0	1460.3	1460.6
1460.9	1461.4	1461.9	1462.4	1463.0	1463.6	1464.0	1464.4	1464.6	1464.8
1464.8	1464.7	1464.6	1464.4	1464.2	1464.0	1463.7	1463.3	1463.3	1463.0
1462.8	1462.6	1462.4	1462.2	1462.0	1461.8	1461.7	1461.5	1461.4	1461.3
1461.2	1461.1	1461.0	1460.9	1460.8	1460.8	1460.7	1460.6	1460.6	1460.5

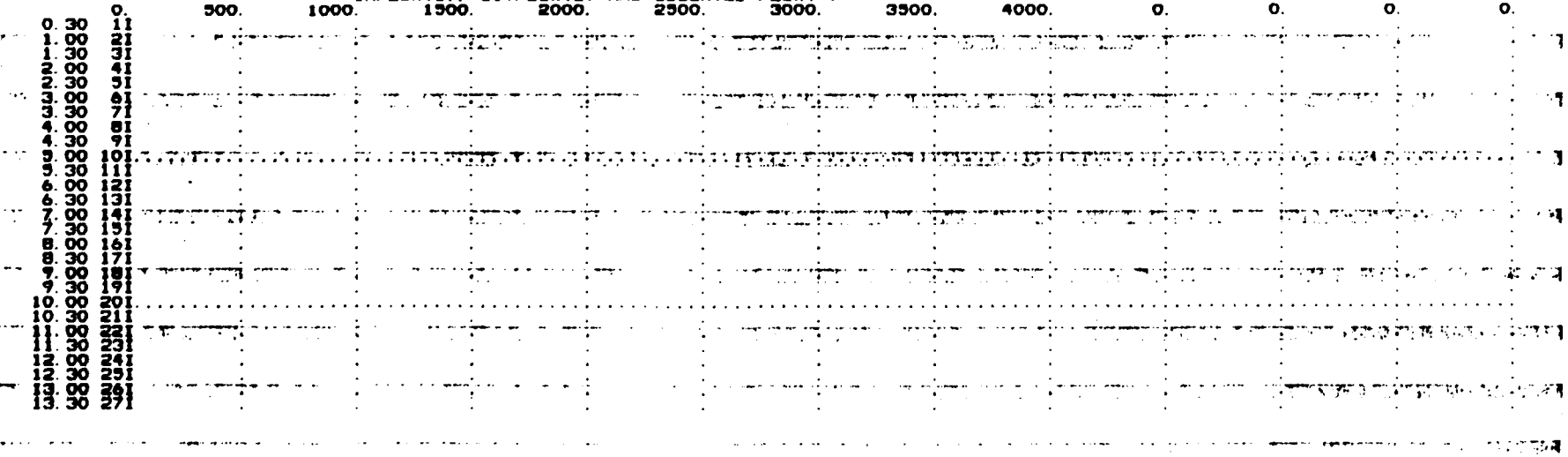
PEAK OUTFLOW IS 2946. AT TIME 49.50 HOURS

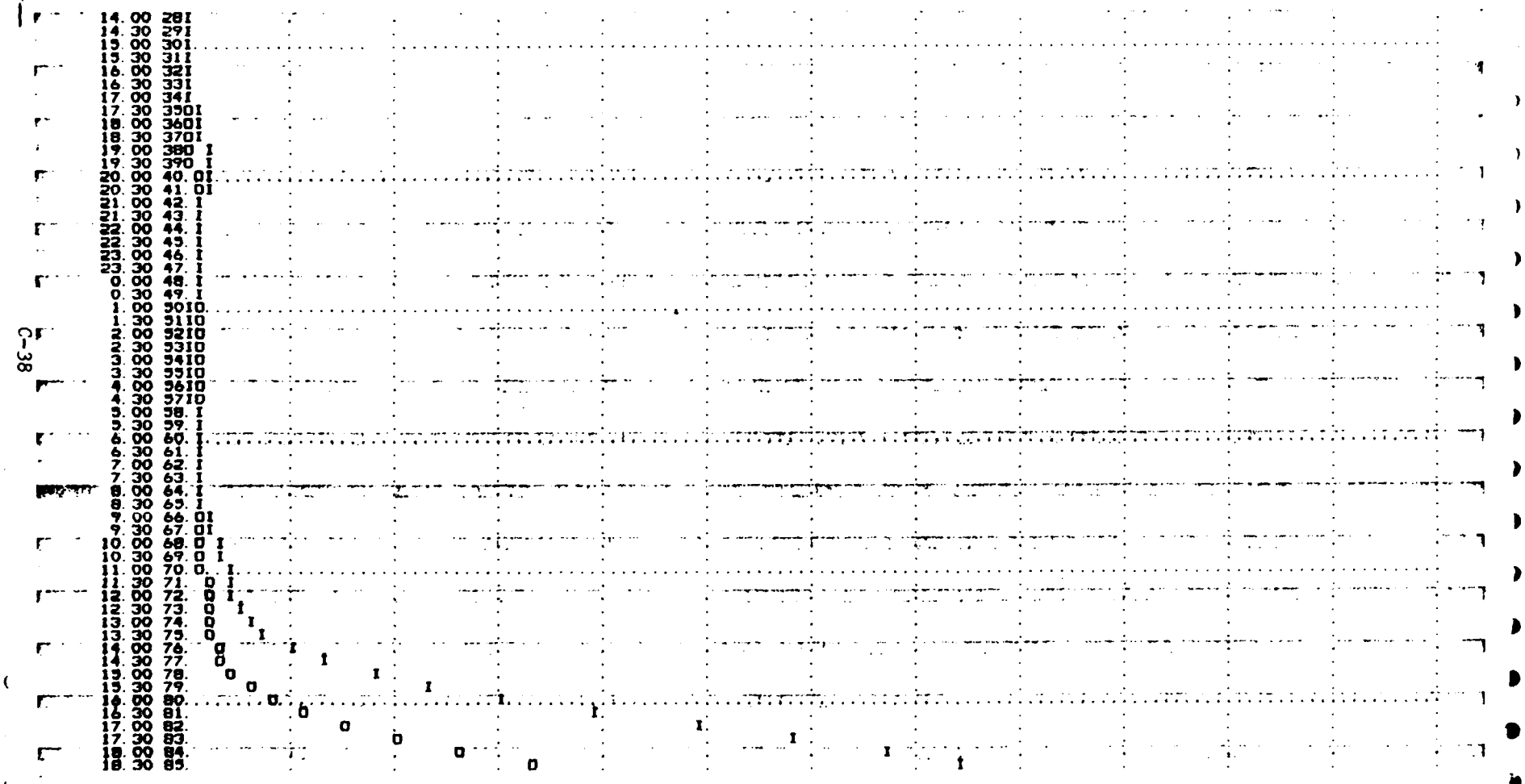
	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2946.	2566.	1218.	499.	59857.
CMS	83.	73.	34.	14.	1695.
INCHES		3.76	7.15	7.32	7.32
MM		95.63	181.56	185.90	185.90
AC-FT		1272.	2416.	2473.	2473.
THOUS CU M		1569.	2980.	3051.	3051.

OVF

STATION 1

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(#)

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17.00 341
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18.00 3601
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19.00 380 I
19.30 390 I
20.00 40. 01
20.30 41. 01
21.00 42. I
21.30 43. I
22.00 44. I
22.30 45. I
23.00 46. I
23.30 47. I
0.00 48. I
0.30 49. I
1.00 5010
1.30 5110
2.00 5210
2.30 5310
3.00 5410
3.30 5510
4.00 5610
4.30 5710
5.00 58. I
5.30 59. I
6.00 60. I
6.30 61. I
7.00 62. I
7.30 63. I
8.00 64. I
8.30 65. I
9.00 66. 01
9.30 67. 01
10.00 68. 0 I
10.30 69. 0 I
11.00 70. 0. I
11.30 71. 0 I
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13.30 75. 0 I
14.00 76. 0 I
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15.00 78. 0 I
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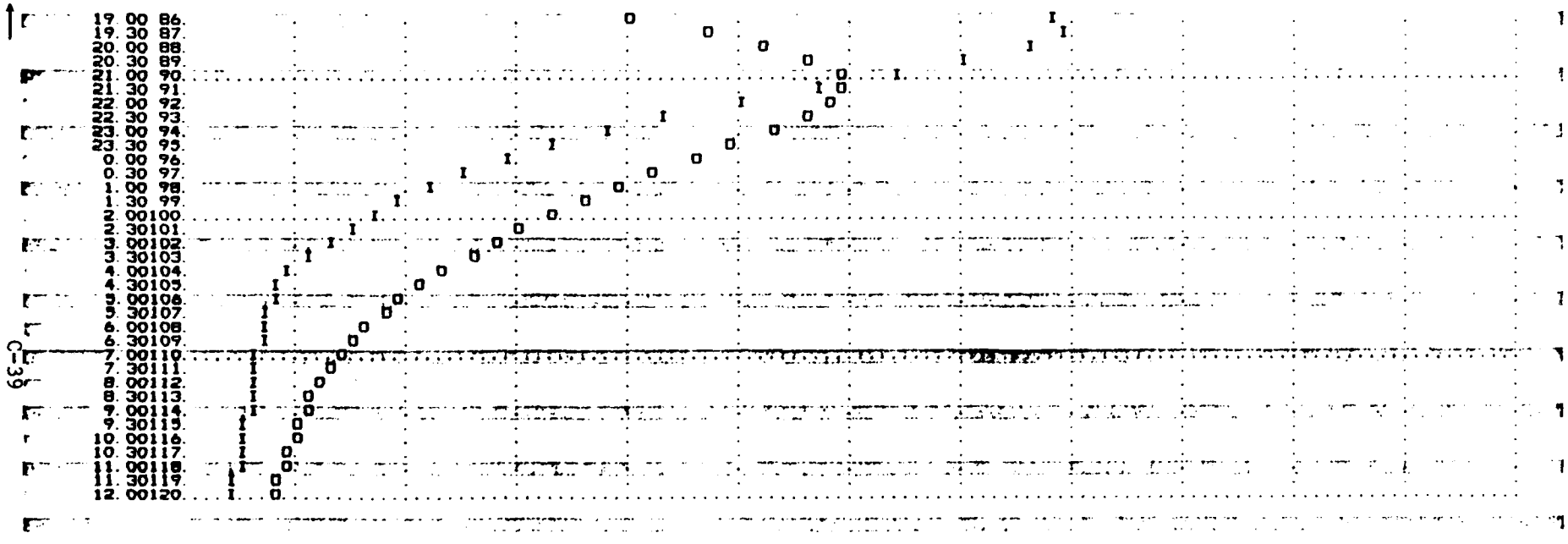
18.00 84. 0 I
18.30 85. 0 I



DVN

STATION 1r PLAN 1r RATIO 7

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	1.	1.	1.	1.	2.	2.	2.	2.	2.	
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.	
2.	2.	3.	4.	6.	9.	13.	17.	22.	27.	
31.	35.	38.	40.	41.	41.	41.	41.	40.	39.	
38.	37.	36.	35.	34.	33.	32.	32.	31.	31.	
31.	31.	32.	33.	35.	39.	44.	51.	59.	68.	
77.	87.	98.	110.	125.	146.	174.	219.	306.	416.	
556.	772.	1031.	1357.	1701.	2039.	2411.	2706.	2909.	3027.	
3041.	2970.	2849.	2699.	2529.	2346.	2167.	2005.	1849.	1695.	
1556.	1427.	1303.	1185.	1073.	983.	904.	834.	770.	713.	
661.	615.	577.	546.	519.	493.	469.	446.	424.	404.	

STORAGE

0.	0.	0.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	2.	3.	4.	6.	9.	11.	14.
16.	18.	19.	20.	21.	21.	21.	21.	21.	20.
20.	19.	18.	18.	17.	17.	16.	16.	16.	16.
16.	16.	16.	17.	18.	20.	23.	26.	31.	36.
41.	47.	53.	60.	69.	82.	100.	125.	158.	200.
253.	319.	395.	478.	564.	647.	720.	778.	817.	836.
839.	827.	806.	777.	743.	708.	671.	634.	598.	563.
529.	496.	464.	434.	406.	381.	357.	337.	318.	301.
286.	273.	261.	249.	239.	229.	220.	211.	203.	195.

STAGE

1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0
1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0
1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0
1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.1	1459.1	1459.1	1459.1
1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2
1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2
1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.3	1459.3	1459.3
1459.4	1459.4	1459.5	1459.5	1459.6	1459.7	1459.9	1460.0	1460.3	1460.6
1461.0	1461.4	1462.0	1462.5	1463.1	1463.6	1464.1	1464.5	1464.8	1464.9
1464.9	1464.8	1464.7	1464.5	1464.3	1464.0	1463.8	1463.6	1463.3	1463.1
1462.9	1462.6	1462.4	1462.2	1462.0	1461.9	1461.7	1461.6	1461.4	1461.3
1461.2	1461.1	1461.0	1460.9	1460.9	1460.8	1460.7	1460.7	1460.6	1460.6

PEAK OUTFLOW IS 3041. AT TIME 45.50 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3041.	2640.	1250.	512.	61441.
CMS	86.	75.	35.	14.	1740.
INCHES		3.87	7.34	7.51	7.51
MM		98.40	186.37	190.82	190.82
AC-FT		1309.	2480.	2539.	2539.
THOUS CU M		1615.	3059.	3132.	3132.

OVF

STATION 1

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

		0.	500.	1000.	1500.	2000.	2500.	3000.	3500.	4000.	4500.	0.	0.	0.
0.30	11													
1.00	21													
1.30	31													
2.00	41													
2.30	51													
3.00	61													
3.30	71													
4.00	81													
4.30	91													
5.00	101													
5.30	111													
6.00	121													
6.30	131													
7.00	141													
7.30	151													

```
 8.00 161
 8.30 171
 9.00 181
 9.30 191
10.00 201
10.30 211
11.00 221
11.30 231
12.00 241
12.30 251
13.00 261
13.30 271
14.00 281
14.30 291
15.00 301
15.30 311
16.00 321
16.30 331
17.00 341
17.30 3501
18.00 3601
18.30 3701
19.00 380 I
19.30 390 I
20.00 40. 01
20.30 41. 01
21.00 42. 01
21.30 43. I
22.00 44. I
22.30 45. I
23.00 46. I
23.30 47. I
 0.00 48. I
 0.30 49. I
 1.00 50. I
 1.30 9110
 2.00 9210
 2.30 9310
 3.00 9410
 3.30 9510
 4.00 9610
 4.30 57. I
 5.00 58. I
 5.30 59. I
 6.00 60. I
 6.30 61. I
 7.00 62. I
 7.30 63. I
 8.00 64. I
 8.30 65. 01
 9.00 66. 01
 9.30 67. 01
10.00 68. 0 I
10.30 69. 0 I
11.00 70. 0. I
11.30 71. 0 I
12.00 72. 0 I
12.30 73. 0 I
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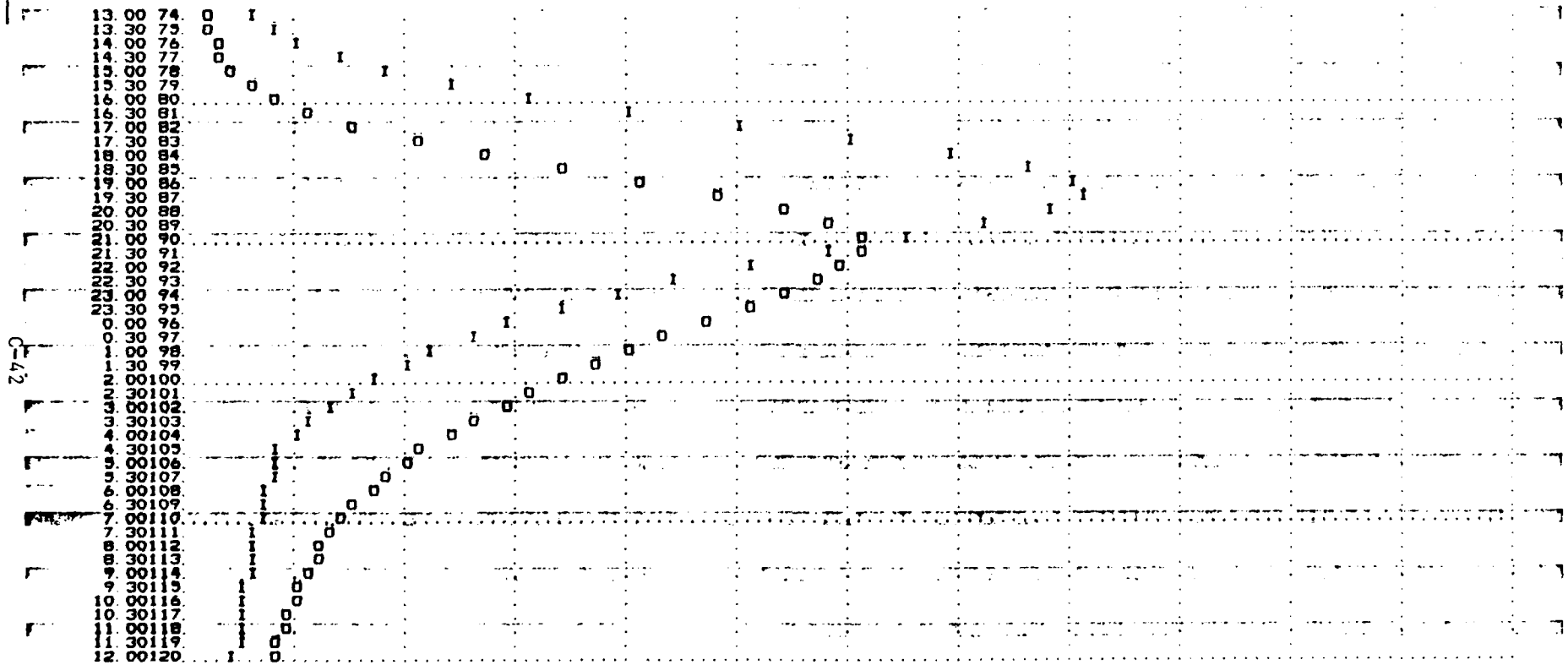


OVN

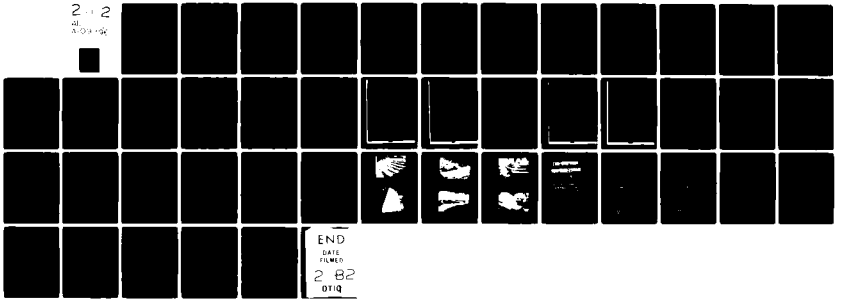
STATION 1; PLAN 1; RATIO 8

END-OF-PERIOD HYDROGRAPH ORDINATES

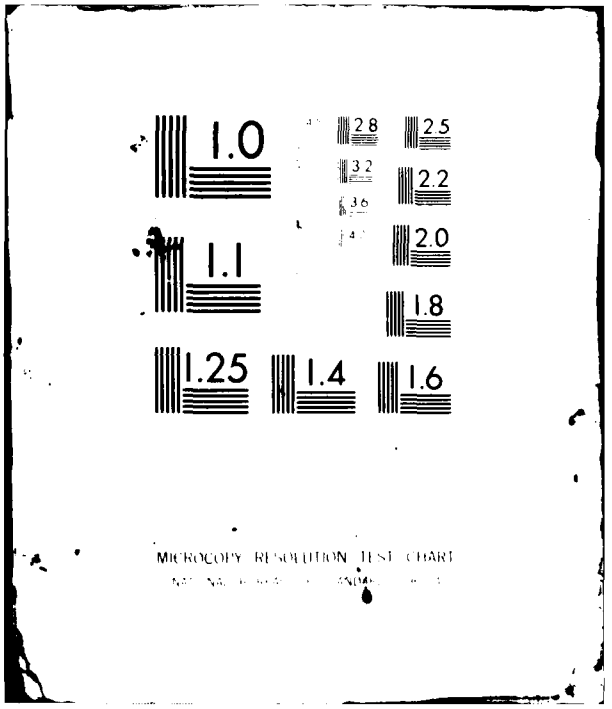
OUTFLOW

0. 1. 1. 1. 2. 2. 2. 2. 3. 3.

AD-A109 796 FLAHERTY-GIAVARA ASSOCIATES NEW HAVEN CT F/G 13/13
NATIONAL DAM SAFETY PROGRAM. LAKE LUDLOW CLUB DAM (INVENTORY NU--ETC(U)
SEP 81 H C FLAHERTY DACW51-81-C-0006
UNCLASSIFIED NL



END
DATE FILMED
2 82
DTIC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2.8
2.5
3.2
2.2
3.6
2.0
1.1
1.8
1.25
1.4
1.6
MICROCOPY RESOLUTION TEST CHART

3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	
3.	3.	3.	3.	3.	3.	3.	3.	3.	3.	
3.	3.	3.	3.	7.	11.	16.	21.	27.	34.	
39.	43.	47.	49.	51.	51.	51.	51.	50.	49.	
47.	46.	45.	43.	42.	41.	40.	40.	39.	39.	
39.	39.	40.	41.	44.	49.	55.	63.	73.	84.	
96.	108.	121.	135.	154.	178.	221.	302.	407.	541.	
752.	1023.	1383.	1790.	2244.	2744.	3240.	3682.	3950.	4044.	
3973.	3837.	3610.	3347.	3078.	2838.	2624.	2409.	2202.	2024.	
1856.	1694.	1548.	1414.	1286.	1167.	1062.	982.	911.	847.	
789.	736.	688.	645.	606.	573.	547.	522.	499.	477.	

STORAGE

0.	0.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	2.	2.	4.	5.	8.	11.	14.	17.
20.	22.	24.	26.	26.	27.	27.	26.	26.	25.
25.	24.	23.	22.	22.	21.	21.	20.	20.	20.
20.	20.	20.	21.	23.	25.	29.	33.	39.	45.
92.	59.	87.	79.	87.	103.	128.	156.	196.	248.
313.	392.	484.	585.	688.	785.	869.	930.	966.	979.
972.	951.	921.	884.	845.	804.	762.	720.	679.	639.
600.	562.	527.	492.	460.	430.	404.	380.	360.	341.
324.	308.	294.	282.	270.	260.	250.	240.	231.	223.

STAGE

1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0
1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0
1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0
1459.0	1459.0	1459.0	1459.0	1459.0	1459.1	1459.1	1459.1	1459.1	1459.2
1459.2	1459.2	1459.2	1459.2	1459.3	1459.3	1459.3	1459.3	1459.2	1459.2
1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.2
1459.2	1459.2	1459.2	1459.2	1459.2	1459.2	1459.3	1459.3	1459.4	1459.4
1459.5	1459.5	1459.6	1459.7	1459.8	1459.9	1460.1	1460.3	1460.6	1460.9
1461.4	1461.9	1462.6	1463.2	1463.9	1464.5	1465.1	1465.5	1465.7	1465.8
1465.7	1465.6	1465.4	1465.2	1464.9	1464.7	1464.4	1464.1	1463.9	1463.8
1463.3	1463.1	1462.8	1462.5	1462.4	1462.2	1462.0	1461.9	1461.7	1461.6
1461.5	1461.4	1461.3	1461.2	1461.1	1461.0	1460.9	1460.9	1460.8	1460.8

PEAK OUTFLOW IS 4044. AT TIME 45.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4044.	3401.	1574.	644.	77320.
CMS	115.	96.	45.	18.	2189.
INCHES		4.99	9.24	9.45	9.45
MM		126.76	234.59	240.13	240.13
AC-FT		1687.	3121.	3195.	3195.
THOUS CU M		2080.	3850.	3941.	3941.

OVF STATION 1

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

		0.	1000.	2000.	3000.	4000.	5000.	6000.	0.	0.	0.	0.	0.	0.
0.30	11													
1.00	21													
1.30	31													

```
 2.00   41
 2.30   51
 3.00   61
 3.30   71
 4.00   81
 4.30   91
 5.00  101
 5.30  111
 6.00  121
 6.30  131
 7.00  141
 7.30  151
 8.00  161
 8.30  171
 9.00  181
 9.30  191
10.00  201
10.30  211
11.00  221
11.30  231
12.00  241
12.30  251
13.00  261
13.30  271
14.00  281
14.30  291
15.00  301
15.30  311
16.00  321
16.30  331
17.00  341
17.30  351
18.00  360I
18.30  370I
19.00  380I
19.30  390I
20.00  400I
20.30  410I
21.00  420I
21.30  430I
22.00  440I
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23.00  46.1
23.30  4710
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 0.30  4910
 1.00  501
 1.30  511
 2.00  521
 2.30  531
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 4.30  571
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 5.30  591
 6.00  601
 6.30  611
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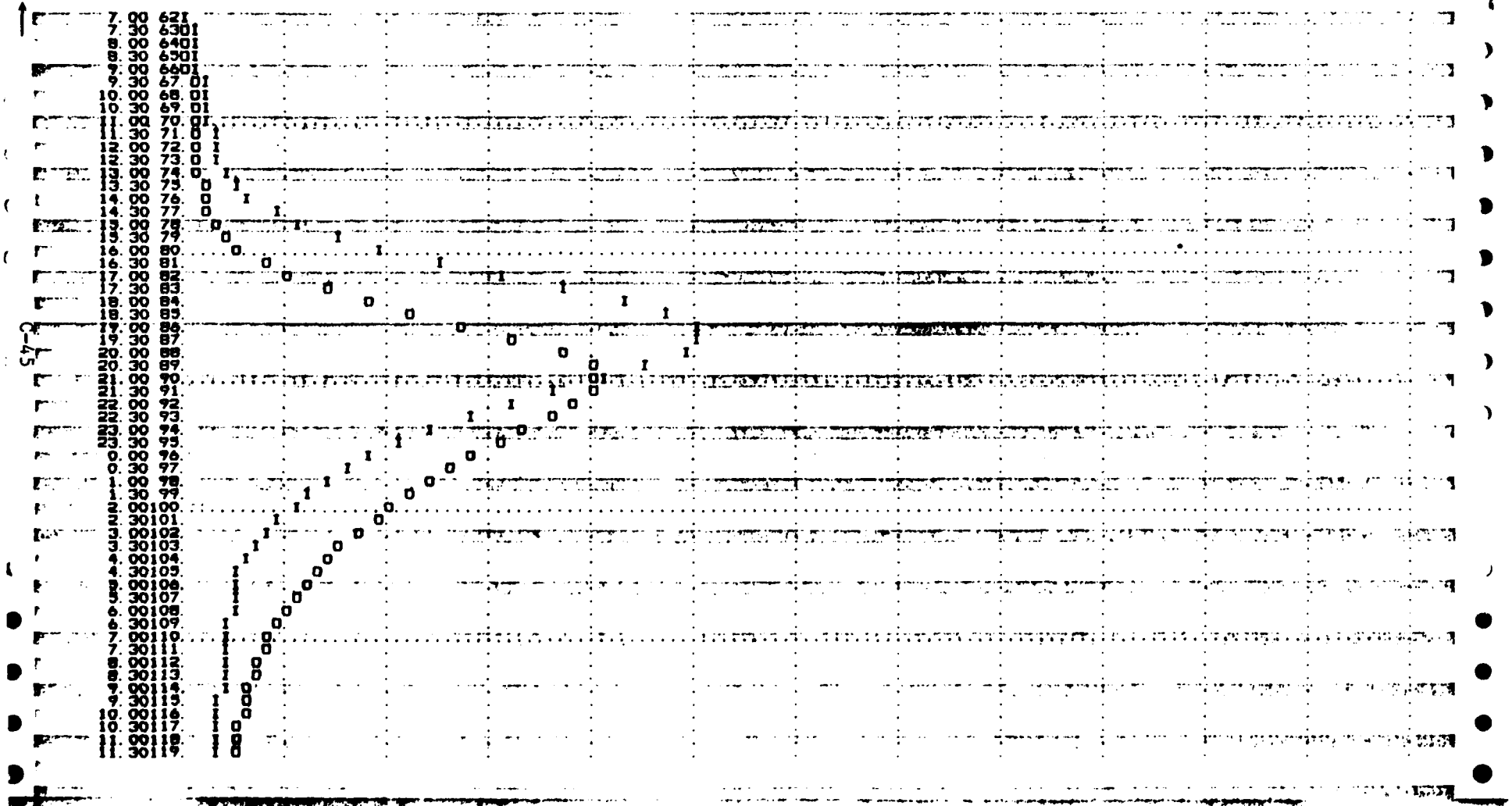
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12.00 72.O I
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22.30 93. O I
23.00 94. O I
23.30 95. O I
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0.30 97. O I
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1.30 99. O I
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11.00118. O I
11.30119. O I

12.00120...I.O.

OVN

STATION 1, PLAN 1, RATIO 9

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

1.	2.	3.	3.	4.	4.	5.	5.	5.	5.
6.	6.	6.	6.	6.	6.	6.	6.	6.	6.
6.	6.	6.	6.	6.	6.	6.	6.	6.	6.
6.	6.	7.	10.	15.	22.	32.	43.	55.	67.
77.	86.	92.	97.	100.	101.	101.	100.	99.	97.
94.	92.	89.	87.	85.	83.	81.	80.	79.	78.
78.	78.	80.	83.	89.	97.	109.	125.	142.	162.
183.	208.	249.	295.	352.	431.	540.	721.	973.	1333.
1816.	2485.	3430.	4719.	6112.	7303.	8211.	8780.	8982.	8852.
8468.	7914.	7263.	6579.	5899.	5261.	4679.	4169.	3753.	3371.
3035.	2765.	2526.	2292.	2085.	1910.	1753.	1618.	1508.	1409.
1319.	1238.	1164.	1097.	1038.	989.	943.	900.	859.	820.

STORAGE

0.	1.	1.	2.	2.	2.	2.	2.	3.	3.
3.	3.	3.	3.	3.	3.	3.	3.	3.	3.
3.	3.	3.	3.	3.	3.	3.	3.	3.	3.
3.	3.	3.	3.	7.	11.	16.	22.	29.	35.
41.	46.	50.	52.	54.	55.	55.	54.	54.	52.
51.	49.	48.	46.	45.	44.	43.	43.	42.	42.
41.	42.	42.	44.	48.	53.	60.	69.	80.	93.
106.	121.	136.	154.	175.	209.	247.	304.	378.	472.
591.	735.	896.	1059.	1208.	1332.	1426.	1484.	1505.	1491.
1452.	1395.	1328.	1257.	1186.	1118.	1054.	995.	940.	888.
838.	790.	743.	697.	653.	612.	576.	544.	516.	491.
468.	448.	429.	412.	397.	382.	369.	356.	344.	333.

STAGE

1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0
1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0
1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0	1459.0
1459.0	1459.0	1459.0	1459.0	1459.1	1459.1	1459.2	1459.2	1459.3	1459.3
1459.4	1459.4	1459.5	1459.5	1459.5	1459.5	1459.5	1459.5	1459.5	1459.5
1459.5	1459.5	1459.4	1459.4	1459.4	1459.4	1459.4	1459.4	1459.4	1459.4
1459.4	1459.4	1459.4	1459.4	1459.4	1459.5	1459.5	1459.6	1459.7	1459.8
1459.9	1460.0	1460.1	1460.3	1460.4	1460.6	1460.9	1461.3	1461.8	1462.3
1463.3	1464.2	1465.2	1466.3	1467.2	1467.9	1468.5	1468.8	1468.9	1468.8
1468.6	1468.3	1467.9	1467.5	1467.0	1466.6	1466.2	1465.7	1465.3	1465.2
1464.9	1464.6	1464.3	1464.0	1463.7	1463.4	1463.2	1463.0	1462.8	1462.6
1462.5	1462.3	1462.2	1462.1	1462.0	1461.9	1461.8	1461.7	1461.6	1461.5

PEAK OUTFLOW IS 8982. AT TIME 44.50 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	8982.	7446.	3206.	1312.	157438.
CMS	254.	211.	91.	37.	4458.
INCHES		10.92	18.82	19.25	19.25

MM	277.49	477.94	488.95	488.95
AC-FT	3692.	6359.	6506.	6506.
THOUS CU M	4554.	7844.	8025.	8025.

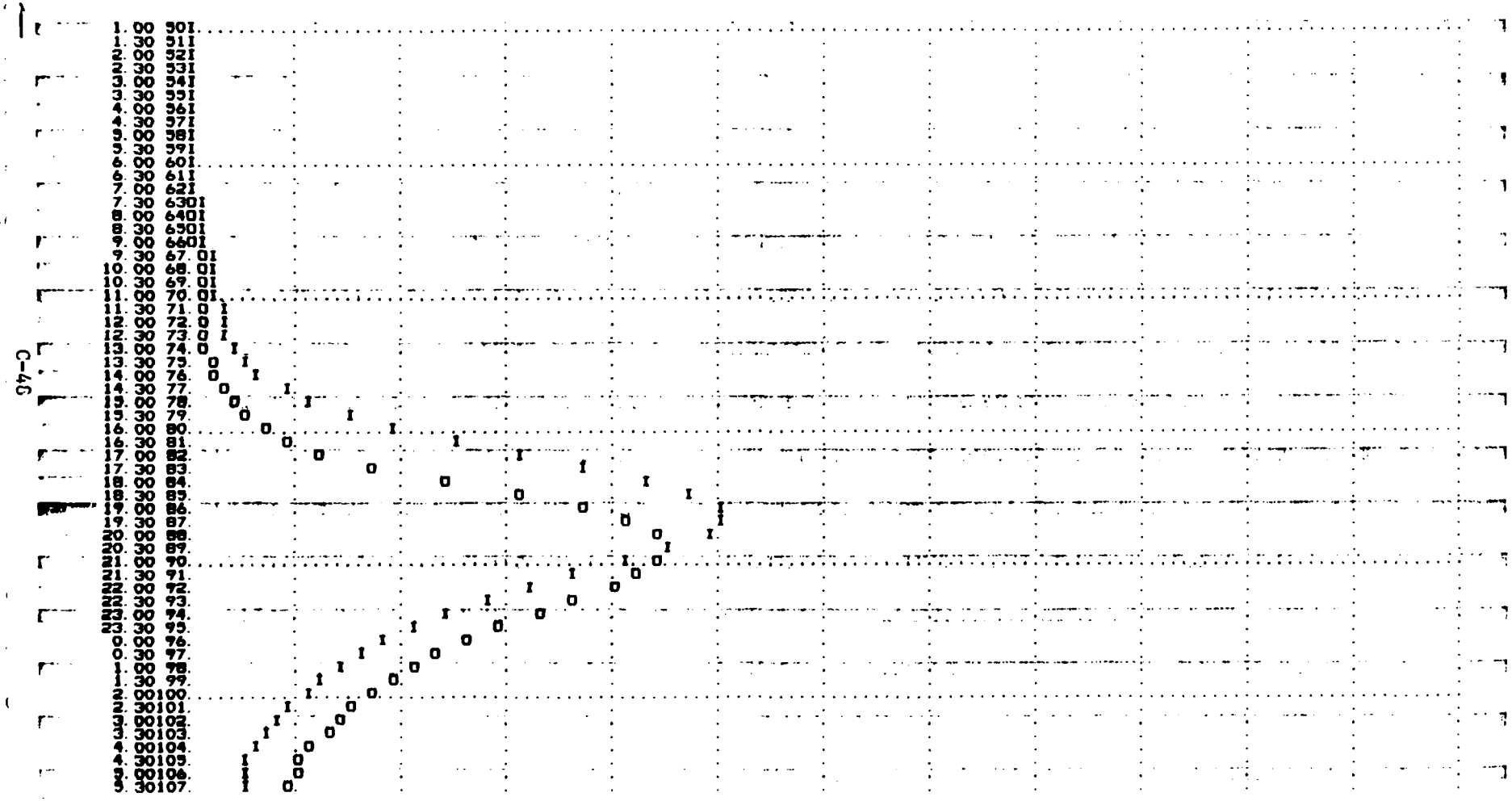
#OVF#

STATION 1

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

0 2000. 4000. 6000. 8000. 10000. 12000. 0. 0. 0. 0. 0. 0.

0.30	11
1.00	21
1.30	31
2.00	41
2.30	51
3.00	61
3.30	71
4.00	81
4.30	91
5.00	101
5.30	111
6.00	121
6.30	131
7.00	141
7.30	151
8.00	161
8.30	171
9.00	181
9.30	191
10.00	201
10.30	211
11.00	221
11.30	231
12.00	241
12.30	251
13.00	261
13.30	271
14.00	281
14.30	291
15.00	301
15.30	311
16.00	321
16.30	331
17.00	341
17.30	351
18.00	3601
18.30	3701
19.00	3801
19.30	3901
20.00	4001
20.30	4101
21.00	4201
21.30	4301
22.00	4401
22.30	4501
23.00	46.1
23.30	4710
0.00	4810
0.30	491


1.00 501
1.30 511
2.00 521
2.30 531
3.00 541
3.30 551
4.00 561
4.30 571
5.00 581
5.30 591
6.00 601
6.30 611
7.00 621
7.30 6301
8.00 6401
8.30 6501
9.00 6601
9.30 67.01
10.00 68.01
10.30 69.01
11.00 70.01
11.30 71.0 I
12.00 72.0 I
12.30 73.0 I
13.00 74.0 I
13.30 75. O I
14.00 76. O I
14.30 77. O I
15.00 78. O I
15.30 79. O I
16.00 80. O I
16.30 81. O I
17.00 82. O I
17.30 83. O I
18.00 84. O I
18.30 85. O I
19.00 86. O I
19.30 87. O I
20.00 88. O I
20.30 89. O I
21.00 90. O I
21.30 91. O I
22.00 92. O I
22.30 93. O I
23.00 94. O I
23.30 95. O I
0.00 96. O I
0.30 97. O I
1.00 98. O I
1.30 99. O I
2.00100. O I
2.30101. O I
3.00102. O I
3.30103. O I
4.00104. O I
4.30105. O I
5.00106. O I
5.30107. O I

```
  6.00108.    I  O
  6.30109.  I  O
  7.00110.  I  O
  7.30111.  I  O
  8.00112.  I  O
  8.30113.  I  O
  9.00114.  IO
  9.30115.  I  O
 10.00116.  I  O
 10.30117.  I  O
 11.00118.  IO
 11.30119.  IO
 12.00120.  IO

*OVN*
```

********** ********** ********** ********** **********

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO-ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 0.30	RATIO 2 0.35	RATIO 3 0.36	RATIO 4 0.37	RATIO 5 0.38	RATIO 6 0.39	RATIO 7 0.40	RATIO 8 0.50	RATIO 9 1.00
HYDROGRAPH AT	1	8.34	1	3022.	3525.	3626.	3727.	3828.	3928.	4029.	5036.	10072.
		(16.42)		(85.57)(	99.83)(	102.68)(	105.53)(	108.38)(	111.24)(	114.09)(	142.61)(	285.22)
ROUTED TO	1	8.34	1	2168.	2600.	2685.	2769.	2853.	2946.	3041.	4044.	8982.
		(16.42)		(61.33)(	73.63)(	76.03)(	78.42)(	80.80)(	83.41)(	86.10)(	114.51)(	254.35)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1459.00	1459.00	1464.70
STORAGE	0.	0.	809.
OUTFLOW	0.	0.	2864.

RATIO OF PMF	MAXIMUM RESERVOIR W.S. ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.30	1463.81	0.00	671.	2166.	0.00	45.50	0.00
0.35	1464.37	0.00	737.	2600.	0.00	45.50	0.00
0.36	1464.47	0.00	774.	2685.	0.00	45.50	0.00
0.37	1464.58	0.00	791.	2769.	0.00	45.50	0.00
0.38	1464.69	0.00	807.	2853.	0.00	45.50	0.00
0.39	1464.79	0.09	823.	2946.	1.50	45.50	0.00
0.40	1464.89	0.19	839.	3041.	2.00	45.50	0.00

0.50	1465.77	1.07	979.	4044.	4.50	43.00	0.00
1.00	1468.91	4.21	1505.	8982.	9.50	44.50	0.00

****
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
****

APPENDIX D

PREVIOUS INSPECTION REPORTS/AVAILABLE DOCUMENTS

DAM CONSTRUCTION PERMIT APPLICATION

3-28-24-1000 (6-1905)

STATE OF NEW YORK
DEPARTMENT OF
State Engineer and Surveyor
ALBANY

RECEIVED
OFFICE STATE ENG.
MAY 21 1925
REFD TO
ANS'D

Superseded 106-1119

Received _____ Dam No. 500 Susquehanna Watershed

Disposition Approved Jun 6-1925 Serial No. Ti Di 1-620

Foundation inspected _____

Structure inspected _____

Application for the Construction or Reconstruction of a Dam

Application is hereby made to the State Engineer, Albany, N. Y., in compliance with the provisions of Chapter LXV of the Consolidated Laws and Chapter 647, Laws of 1911, Section 22 as amended, for the approval of specifications and detailed drawings, marked The Lake Ludlow Club, Inc. Dam, Oxford, N. Y.

herewith submitted for the { construction / reconstruction } of a dam located as stated below. All provisions of law will be complied with in the erection of the proposed dam. It is intended to complete the work covered by the application about Septemoer 1st, 1925 (Date)

1. The dam will be on Ludlow Brook flowing into Chenango River in the town of McDonough, County of Chenango and 6 miles Northwest of Oxford, N. Y. (Give exact distance and direction from a well-know bridge, dam, village main cross-roads or mouth of a stream)

2. The name and address of the owner is Lake Ludlow Club, Inc., Oxford, N. Y.

3. The dam will be used for Increasing size of lake for recreation purposes

4. Will any part of the dam be built upon or its pond flood any State lands? No

5. The watershed at the proposed dam draining into the pond to be formed thereby is 6.5 square miles.

6. The proposed dam will have a pond area at the spillcrest elevation of 240 acres and will impound 42,000,000 cubic feet of water.

7. The lowest part of the natural shore of the pond is 18 feet vertically above the spillcrest, and everywhere else the shore will be at least 100 feet above the spillcrest.

8. The maximum known flow of the stream at the dam site was _____ cubic feet per second on _____ (Date)

9. State if any damage to life or to any buildings, roads or other property could be caused by any possible failure of the proposed dam Very small possiblility of any damage

10. The natural material of the bed on which the proposed dam will rest is (clay, sand, gravel, boulders, granite, shale, slate, limestone, etc.) clay

11. The material of the right bank, in the direction with the current, is clay; at the spillcrest elevation this material has a top slope of 12 inches vertical to a foot horizontal on the center line of the dam, a vertical thickness at this elevation of [illegible] feet, and the top surface extends for a vertical height of 200 feet above the spillcrest. (In deep natural valley)

12. The material of the left bank is clay; has a top slope of 8 inches to a foot horizontal, a thickness of [illegible] and a height of 100 feet.

13 State the character of the bed and the banks in respect to the hardness, perviousness, water bearing, effect of exposure to air and to water, uniformity, etc Bed is composed of hard impervious clay with some stones imbedded. Exposure to air and water have had no effect on bed and banks

14. If the bed is in layers, are the layers horizontal or inclined? not in layers If inclined what is the direction of the horizontal outcropping relative to the axis of the main dam and the inclination and direction of the layers in a plane perpendicular to the horizontal outcropping

15. What is the thickness of the layers?

16. Are there any porous seams or fissures? No

17. WASTES. The spillway of the above proposed dam will be 20 feet long in the clear; the waters will be held at the right end by an abutement the top of which will be 4 feet above the spillcrest, and have a top width of 1 feet; and at the left end by an abutement the top of which will be 4 feet above the spillcrest, and have a top width of 1 feet.

18. There will be also for flood discharge a pipe 24 inches inside diameter and the bottom will be 12 feet below the spillcrest, a sluice or gate 2 feet wide in the clear by 2 feet high, and the bottom will be 12 feet below the spillcrest.

19. APRON. Below the proposed dam there will be an apron built of paved spillway around end of dam feet long across the stream, feet wide and feet thick. The downstream side of the apron will have a thickness of feet for a width of feet.

20. PLANS. Each application for a permit of a dam over 12 feet in height must be accompanied by a location map and complete working drawings in triplicate of the proposed structure, one set of which will be returned if they are approved. Each drawing should have a title giving the parts shown, the name of the town and county in which the dam site is located, and the name of the owner and of the engineer.

The location map (U. S. Geological Quadrangle or other map) should show the exact location of the proposed dam; of buildings below the dam which might be damaged by any failure of the dam; of roads adjacent to or crossing the stream below the dam, giving the lowest elevation of the roadway above the stream bed and giving the shape,

the height and the width of stream openings; and of any embankments or steep slopes that any flood could pass over. Also indicate the character and use made of the ground below the dam.

The complete working drawings should give all the dimensions necessary for the calculations of the stability of the structure, and all the information asked for below under "Sketches." There may be attached to the application any written reports, calculations, investigations or opinions that may aid in showing the data and method used by the designer. State the assumed ice and uplift pressures and the conditions on which based.

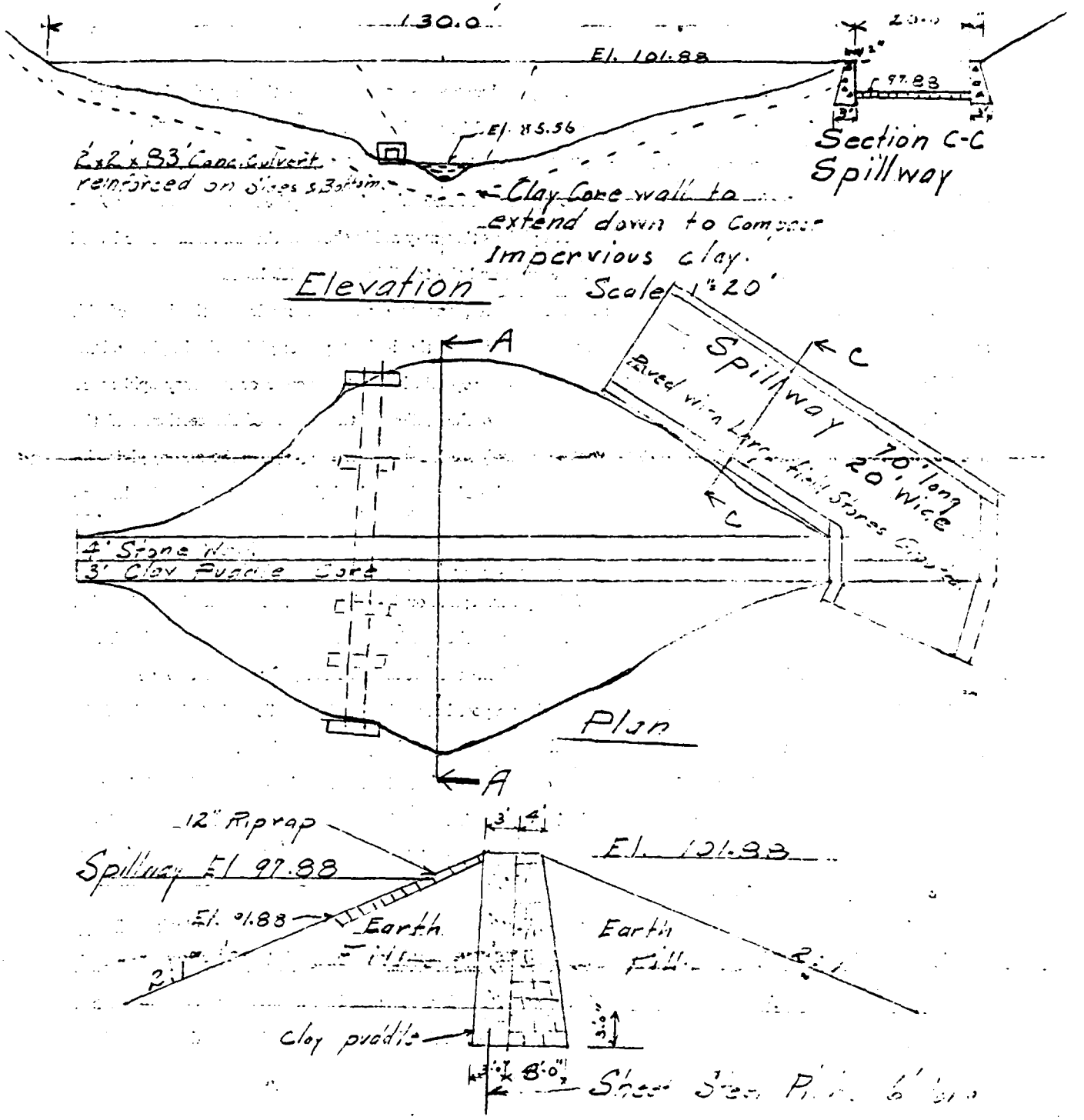
21. SKETCHES. For small and unimportant structures, if plans have not been made, on the back of this application make a sketch to scale for each different cross-section at the highest point; giving the height and the depth from the surface of the foundation, the bottom width, the top width (for a concrete or masonry spill at 18 inches below the crest), the elevation of the top in reference to the spillcrest, the length of the section, and the material of which the section is to be constructed; on the spillway section show a cross section of the apron, giving its width, thickness and material, and show the abutment or wash wall at the end of the spillway, giving its heights and thickness. Mark each section with a capital letter. Also sketch a plan; show the above sections by their top lines, giving the mark and the length of each; the openings by their horizontal dimensions; the abutments by their top width and top lengths from the upstream face of the spillcrest; and outline the apron. Also sketch an elevation of each end of the dam with a cross section of the banks, giving the depth and width excavated into the banks.

22. ELEVATIONS. Also give the elevations, if possible from the Mean Sea Level, of at least two permanent Bench Marks; of the spillcrest for any existing dam on the proposed dam site, at the middle and at the ends of the spill; of the spillcrest for the above proposed dam; and of the spillcrest of any adjacent dams.

23. SAMPLES. When so instructed, send samples of the materials to be used in the construction of the proposed dam, using shipping tags which will be furnished. For sand, one-half a cubic foot is desired (exclusive of any stone over ¼ inch in size mixed therewith); for cement, three pints; and for the natural bed, twenty cubic inches if of ledge and one-half a cubic foot if of soil.

24. INSPECTION. State how inspection is to be provided for during construction. The club will provide a competent inspector to insure proper construction

25. WATER SUPPLY. Are the waters impounded by the above dam to be used for a public water supply? No. Has an application under the provisions of Article IX of the Conservation Law for such use been made to the Water Control Commission, Albany, N. Y.?



The above information is correct to the best of my knowledge and belief.

Oxford, N. Y.
(Address of signer)

May 18, 1925
(Date)

The Lake Ludlow Club, Inc.

F. Tainter Cabin. Pres.
(A person signing for owner should indicate his title or authority)

DESIGN DATA

COMPUTATIONS USED IN THE DESIGN OF SPILLWAY-

LAKE LUDLOW CLUB DAM.

WATER SHED

Area 6.5 Sq. Miles. 10 Sq.Miles used in computations Turneaure & Russell 'Public Water Supplies table gives 10 in. per 24 hrs. as a maximum rainfall giving 268.9 cu.ft.per sec. per sq.mile,giving 2689 cu.ft.per sec.Maximum discharge over spillway.

Using data given in Amer.Civil Eng.Handbook on Mill Brook Reservoir Edmeston N.Y. with drainage area of 9.4 sq.mi. 241 cu.ft. sec. per sq.mile. which would give a comparative maximum discharge of 2410 cu.ft. sec. over the spillway.

LOCATION

The proposed site of the dam is located 1350 ft.below the present lake Ludlow containing about 80 acres in area. It is proposed to raise the level of the lake 6 ft. by constructing a dam on the site of an old dam which was washed out some years ago.There is left standing a dry laid up stone wall,and it is our intentions to complete the wall where it has been washed out and place a puddled clay core wall above, together with the earth fill above and below. We plan on constructing a heavy rein. concrete culvert with a gate on the upper end to take care of the water during constructing of the dam.This will also provide a means to drain the lake if at any time it should become necessary. It is planned to place several baffles on the outside of the culvert to obstruct any seepage of water along the outside of the concrete.

Design of Spillway
Lake Ludlow Club Dam

Spillway 20 ft. Wide 3' Deep 100 ft. Long.

Chezy Formula $V = c\sqrt{rs}$

c = a Coefficient

r = hydraulic radius

$= \frac{60}{26} = 2.3$

S = Sine of Slope

$= \frac{14}{100} = .14$

Kutters Formula

$$c = \frac{\frac{1.81}{n} + 41.65 + \frac{.0028}{S}}{1 + \frac{n\left(41.65 + \frac{.0028}{S}\right)}{\sqrt{r}}}$$

$$= \frac{\frac{1.81}{.017} + 41.65 + \frac{.0028}{.14}}{1 + \frac{.0017\left(41.65 + \frac{.0028}{.14}\right)}{\sqrt{2.3}}} = \frac{148.17}{1.465}$$

$= 101$

$V = 101\sqrt{2.3 \times .14}$

$= 57.5$ C.F.S.

$Q = 60 \times 57.5$

$= 3450.0$ C.F.S.

It was decided to use a 20 ft. Spillway paved with Large stone and securely grouted.

SOILS ANALYSES

COPY FOR MR. MC:.IM:

July 23, 1925.

Dam 500 Susquehanna,
Sand.

Mr. F. Taintor Corbin,
President, Lake Ludlow Club, Inc.,
Oxford, N. Y.

Dear Sir:

The receipt of your letter of July 6th, 1925, in regard to the dam which you proposed to build, is acknowledged. The sand mentioned in your letter from the Winsor bank has been examined by the State Highway Commission in 1923 and accepted for use in concrete and should give good results in the work which you are undertaking. The use of this sand meets with the approval of this department.

The reason for requesting a sample of sand proposed for use was to insure that only good sand be used in the concrete. It is suggested that, as the nature of the sand obtained from the bank at the present time may be different from that obtained in 1923, you send a sample to our testing laboratory for a check test.

Yours very truly,

Roy G. Finch,
State Engineer.

By

Assistant Deputy.

TLW/ECH

STATE OF NEW YORK
STATE ENGINEER AND SURVEYOR
ALBANY

ROY G. FINCH
STATE ENGINEER
FRANK R. LANAGAN
DEPUTY
THOS. L. WATKINS
ASSISTANT DEPUTY

ADDRESS ALL COMMUNICATIONS TO
ROY G. FINCH, STATE ENGINEER

August 13, 1925.

Hon. Roy G. Finch,
State Engineer,
Albany, N. Y.

Dear Sir:-

We have tested and examined a sample of material submitted by Dr. A. R. Morse, Vice President of the Lake Ludlow Club, Inc., of Oxford, N. Y., and proposed for use as core in the dam at Lake Ludlow.

"The contract calls for a clay core of blue clay or a substitute equally as good ----- ." This is quoted from the letter from Dr. Morse in transmitting the sample.

Tests show that the sample graded as follows:-

Passing Sieve No.	Sample as received	Sample free from gravel (above ¼")
4	73 %	
6	70	96 %
10	67	92
20	62	83
30	59	81
40	57	78
60	52	72
100	48	66
200	35	48

This material mixed into a very good plastic mass and should prove to be a satisfactory core material.

Yours very truly,
Russell S. Greenman
Sen. Asst. Engineer
in charge of Tests.

PREVIOUS INSPECTION REPORTS

WM. W. CRONIN, DIVISION ENGINEER

STATE OF NEW YORK
DEPARTMENT OF STATE ENGINEER AND SURVEYOR
MIDDLE DIVISION
WEIGH LOCK BUILDING
SYRACUSE

SUBJECT: DAM NO. 500 Sus
OXFORD - SUSQUEHANNA

July 27, 1925.

Mr. Wm. W. Cronin,
Division Engineer,
Syracuse, N.Y.

Dear Sir:

On July 24th I visited the site of the dam under construction at the lower end of Ludlow Pond, owned by the Lake Ludlow Club of Oxford.

This dam is located in a very rough country, about seven miles by road northwest of the village of Oxford. The pond is to be raised by this dam about 10 ft. above present elevation. On the site of this new dam there are portions of an old dry stone dam very nearly the height of the present dam. The existing portions of this dam are to be left in place to serve as a protection against any possibility of muskrats boring through the new earthen structure.

The center portion of the stream valley, where the old dam has been carried out, is to be enclosed by a line of steel sheet piling driven well into the clay hardpan. The existing portions of the old masonry are not water tight, but the plan is to bank this up with a 3 ft. layer of clay puddle, against which an earth fill, also made of clay soil, will be placed.

On the northeastern end of the dam the spillway is to be constructed. This spillway is to consist of a paved channel 33 ft. in width, separated from the earthen portion of the dam by a concrete wall 5½ ft. in height. The underlying material here is a very dense clay hardpan, and with the paving, as plans provide, should probably furnish a safe spillway.

On the plans under which the contractor is working no cut-off wall was provided at the crest of the spillway section. I suggested that such a cut-off wall be provided by excavating a trench to the same depth as the side walls in the spillway channel; that is, 2½ ft. below the top of the paving, and filling this with concrete up to the top elevation of the paving at its highest point.

The President of the Lake Ludlow Club, who was with me, agreed with me that this was a reasonable precaution and instructed the contractor, while I was there, to put in such a cut-off.

The reinforced concrete culvert for drawing down the lake, in case it is desirable, has been constructed and appears to be of really good quality concrete. One wall for the spillway channel has been built and the trench for the other wall is now being dug.

I examined the bed of clay which will be used in making the puddle core wall for the dam and it appears to be of the best material; a very dense

blue clay containing a considerable percentage of small stones.

A portion of the stone paving had been placed, but not grouted, near the lower end of the spillway channel. This was fully 12" in depth, but did not consist of very large stones. This, however, would not be of serious consequence after the paving is grouted.

Respectfully submitted,

Foster B. Crosby
Asst. Engr.

FBC:ALG

DAM CONSTRUCTION PERMIT APPLICATION

Form E-61
9-11-34-500 (11E-1836)

STATE OF NEW YORK

DEPARTMENT OF PUBLIC WORKS

DIVISION OF ENGINEERING

ALBANY

Received May 21, 1937 Dam No. 106 - 1119

Disposition June 16, 1937 Watershed Susquehanna

Foundation inspected

Structure inspected

Application for the Construction or Reconstruction of a Dam

Application is hereby made to the Superintendent of Public Works, Albany, N. Y., in compliance with the provisions of Section 948 of the Conservation Law (see last page of this application) for the approval of specifications and detailed drawings, marked Dam for Lake Ludlow Club. Oxford, New York. herewith submitted for the { construction / reconstruction } of a dam herein described. All provisions of law will be complied with in the erection of the proposed dam. It is intended to complete the work covered by the application about September 1st, 1937. (Date)

1. The dam will be on Ludlow Brook flowing into Chenango River in the town of McDonough, County of Chenango and 300 ft. south of Ludlow Club House (give exact distance and direction from a well-known bridge, dam, village main cross-roads or mouth of a stream)

2. Location of dam is shown on the Oxford, quadrangle of the United States Geological Survey.

3. The name of the owner is The Lake Ludlow Club Inc.,

4. The address of the owner is Oxford, New York,

5. The dam will be used for Maintaining level of Lake Ludlow

6. Will any part of the dam be built upon or its pond flood any State lands? No.

7. The watershed above the proposed dam is 6.32 square miles.

8. The proposed dam will create a pond area at the spillcrest elevation of 100 acres and will impound 21,780,000 cubic feet of water.

9. The maximum height of the proposed dam above the bed of the stream is 16 feet ____ inches.

10. The lowest part of the natural shore of the pond is 15 feet vertically above the spillcrest, and everywhere else the shore will be at least 25 feet above the spillcrest.

11. State if any damage to life or to any buildings, roads or other property could be caused by any possible failure of the proposed dam Very small possibility of any damage.

12. The natural material of the bed on which the proposed dam will rest is (clay, sand, gravel, boulders, granite, shale, slate, limestone, etc.) Clay

13. Facing down stream, what is the nature of material composing the right bank? Clay

14. Facing down stream, what is the nature of the material composing the left bank? Same

15. State the character of the bed and the banks in respect to the hardness, perviousness, water bearing, effect of exposure to air and to water, uniformity, etc. Hard impervious clay with some stones imbedded. Exposed to air and water have had no effect.

16. Are there any porous seams or fissures beneath the foundation of the proposed dam? No.

17. WASTES. The spillway of the above proposed dam will be 70 feet long in the clear; the waters will be held at the right end by a Core wall and crib the top of which will be 5 feet above the spillcrest, and have a top width of 5 feet; and at the left end by a same as right end the top of which will be 5 feet above the spillcrest, and have a top width of 5 feet.

18. The spillway is designed to safely discharge 1000 cubic feet per second.

19. Pipes, sluice gates, etc., for flood discharge will be provided through the dam as follows:

None

20. What is the maximum height of flash boards which will be used on this dam? None

21. APRON. Below the proposed dam there will be an apron built of Cribing and cut off wall 50 feet long across the stream, 50 feet wide and 2 feet thick.

22. Does this dam constitute any part of a public water supply? No.

SECTION 948 OF THE CONSERVATION LAW

§ 948. **Structures for impounding water; inspection of docks; penalties.** No structure for impounding water and no dock, pier, wharf or other structure used as a landing place on waters shall be erected or reconstructed by any public authority or by any private person or corporation without notice to the superintendent of public works, nor shall any such structure be erected, reconstructed or maintained without complying with such conditions as the superintendent of public works may by order prescribe for safeguarding life or property against danger therefrom. No order made by the superintendent of public works shall be deemed to authorize any invasion of any property rights, public or private, by any person in carrying out the requirements of such order. The superintendent of public works shall have power, whenever in his judgment public safety shall so require, to make and serve an order directing any person, corporation, officer or board, constructing, maintaining or using any structure hereinbefore referred to, remove, repair or reconstruct the same within such reasonable time and in such manner as shall be specified in such order, and it shall be the duty of every such person, corporation, officer or board, to obey, observe and comply with such order and with the conditions prescribed by the superintendent of public works for safeguarding life or property against danger therefrom, and every person, corporation, officer or board failing, omitting or neglecting so to do, or who hereafter erects or reconstructs any such structure hereinbefore referred to without submitting to the superintendent of public works and obtaining his approval of plans and specifications for such structures when required so to do by his order or who hereafter fails to remove, erect or to reconstruct the same in accordance with the plans and specifications so approved shall forfeit to the people of this state a sum not to exceed five hundred dollars to be fixed by the court for each and every offense; every violation of any such order shall be a separate and distinct offense, and, in case of a continuing violation, every day's continuance thereof shall be and be deemed to be a separate and distinct offense. This section shall not apply to a dam where the area draining into the pond formed thereby does not exceed one square mile, unless the dam is more than ten feet in height above the natural bed of the stream at any point or unless the quantity of water which the dam impounds exceeds one million gallons; nor to a dock, pier, wharf or other structure under the jurisdiction of the department of docks, if any, in a city of over one hundred and seventy-five thousand population. This section as hereby amended shall not impair the effect of an order heretofore made by the conservation commission or commissioner under this section prior to the taking effect of chapter four hundred and ninety-nine of the laws of nineteen hundred and twenty-one, nor require the approval by the superintendent of public works of plans and specifications heretofore approved by such commission or commissioner under this section.

The foregoing information and accompanying plans and specifications are correct to the best of my knowledge and belief.

Lake Ludlow Club Inc., Owner

By F Tainter Cabin, Pres., authorized agent of owner.

Address of signer Oxford, New York. Date May 13th, 1937.

PREVIOUS INSPECTION REPORTS

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DAM INSPECTION REPORT
(By Visual Inspection) Ludlow Lake Club

Dam Number	River Basin	Town	County	Hazard Class*	Date & Inspector
106-1119	Susq	McDonough	Chenango	B	4/17/75

Type of Construction

- [x] Earth w/concrete spillway
- [ ] Earth w/drop inlet pipe
- [ ] Earth w/stone or riprap spillway
- [ ] Concrete
- [ ] Stone
- [ ] Timber

Use

- [ ] Water Supply
- [ ] Power
- [x] Recreation
- [ ] Fish and Wildlife
- [ ] Farm Pond
- [ ] No Apparent Use-Abandoned

Estimated Impoundment Size

- [ ] 1-5 acres
- [ ] 5-10 acres
- [x] Over 10 acres

Estimated Height of Dam above Streambed

- [ ] Under 10 feet
- [x] 10-25 feet
- [ ] Over 25 feet

Condition of Spillway

- [x] Service satisfactory
- [ ] In need of repair or maintenance

none

- [x] Auxiliary satisfactory
- [ ] In need of repair or maintenance

Explain: _____

Condition of Non-Overflow Section

- [x] Satisfactory
- [ ] In need of repair or maintenance Explain: _____

Condition of Mechanical Equipment

- [ ] Satisfactory

none

- [ ] In need of repair or maintenance Explain: _____

Evaluation (From Visual Inspection)

- [x] No defects observed beyond normal maintenance
- [ ] Repairs required beyond normal maintenance

*Explain Hazard Class, if Necessary large impoundment

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ASSOCIATES, P.C.

ONE COLUMBUS PLAZA
NEW HAVEN, CONN. 06510
203/789-1260

HUGH C. FLAHERTY, P.E., L.S.
S. GIAVARA, P.E.

March 30, 1981

Department of the Army
New York District
Corps of Engineers
26 Federal Plaza
New York, New York 10007

Attention: Mr. Thomas F. Costanzo
Civil Projects Management Branch
Room 2123

Re: Initial Screening
Lake Ludlow Club Dam
Dam NY 350
DACW 51-81-C-0006
FGA No. 80 121 10

Dear Mr. Costanzo:

In accordance with the subject contract, an initial screening of the downstream hazard potential of Lake Ludlow Club Dam (NY 350) located in McDonough, New York (Chenango County) was conducted.

The site was visited on December 16, 1980 for the purpose of determining existing development in the area that would be affected by a dam failure flood wave and verifying existing dam inventory data (i.e, height, crest length, etc.). In addition, FGA contacted the firm of Stetson-Dale who had originally classified the dam as having a "high" downstream hazard potential (D/S Hazard - 1). Stetson-Dale was required to select a hazard classification for the dam during their contract to update and complete the Inventory of Non-Federal Dams for the New York District.

The dam is 22 feet high, with a crest length of 130 feet and a spillway width of 70 feet (see photos no. 1,2 and 3). The initial flood wave impact area is located approximately one mile downstream of the dam (see attached Flood Impact Map, sheet 1 of 2). Approximately 3 to 4 houses would be affected (see photos no. 4,5 and 6). The secondary impact area is the borough of Tyner which is located about 3.5 miles downstream of the

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dam (see attached Flood Impact Map, sheet 2 of 2). Several buildings and a church are located in this area. The flood wave would continue down Bowman Creek in a narrow steep-sided valley until spreading out on a broad floodplain in South Oxford just before entering the Chenango River. Several dwellings are located in this floodplain.

Mr. Terry Hardin of Stetson-Dale related that the primary reason for classifying the dam "High Hazard" was that the Lake Ludlow Dam had failed in the flood of 1935 and had killed several people downstream in Tyner. FGA obtained original newspaper accounts appearing in the July 11, 1935 edition of "The Oxford Review-Times", copies of which are attached. These reports indicated that in the early morning of July 8, 1935, after very heavy rains and initial flooding, the Lake Ludlow Dam failed and its waters "coursed down through the valley".

When the water struck Tyner, the old Universalist Church and four buildings including a portion of the old Tyner cheese factory were destroyed. Several bridges were washed out and all the lowlands down in the valley were rock strewn, gutted or entirely washed out. Quantities of hay and crops, the value of which could not be estimated, were ruined. The destruction included the entire reach from Lake Ludlow to the Chenango River. Three lives were lost as a result of the flooding.

In accordance with the Recommended Corps of Engineers Guidelines, in order to classify a dam as having a "high" downstream hazard potential it must be located in an area "where failure may cause serious damage to homes, extensive agricultural, industrial and commercial facilities, important public utilities, main highways or railroads", or that more than a few lives would be lost.

Based on our site visit, inspection of existing downstream conditions, review of the results of initial flooding and an actual dam failure flood wave (1935), we believe that the downstream hazard classification should remain "high". We recommend that the dam receive a Phase I Dam Inspection.

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We trust this is the information you require at this time. Please let me know if we should proceed with the Phase I investigation of the Lake Ludlow Club Dam.

Very truly yours,

FLAHERTY GIAVARA ASSOCIATES, P.C.

Robert C. Smith

Robert C. Smith, P.E.
Project Manager

/car

Enclosures

cc: Mr. George Koch
New York State Department of
Environmental Conservation

PHOTO #1: Downstream face of dam

PHOTO #2: Crest of dam looking toward right abutment

PHOTO #3: Downstream channel conditions

PHOTO #4: Upstream view from bridge (See Flood Impact Map - sheet 2 of 2)

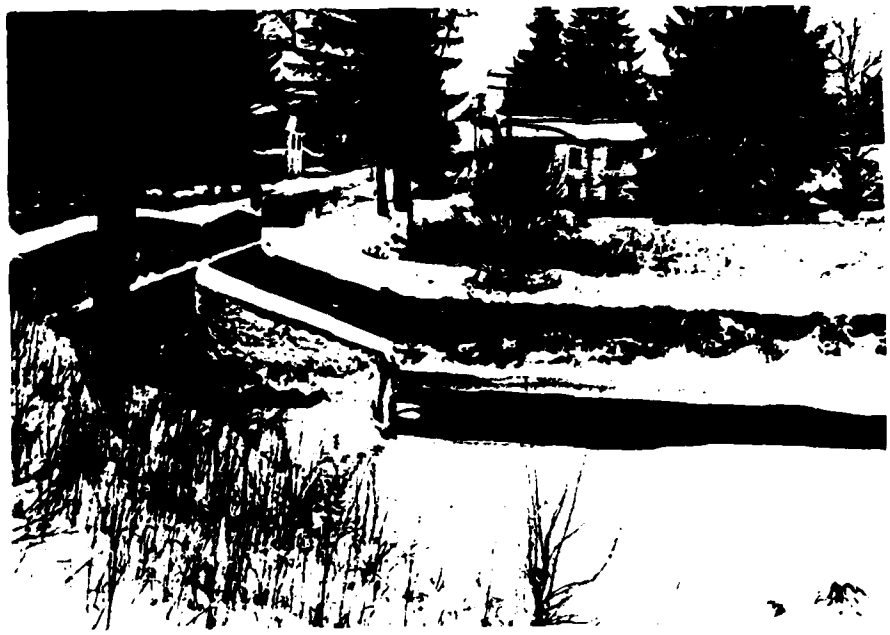


PHOTO #5: Upstream face of bridge (See Flood Impact Map - sheet 2 of 2)

PHOTO #6: Downstream view from bridge (See Flood Impact Map - sheet 2 of 2)

THE OXFORD
NEWS-TIMES

OXFORD, NEW YORK, THURSDAY MORNING, JULY 11, 1935

Mr. and Mrs. Fred Robbins and McWilliams Boy Carried Away by Bowman Creek

All Buildings of Pleasant Homestead at South Oxford Wiped Out Between 3 and 4 a. m. Monday Morning from Repeated Storms

Death, destruction and desolation were spread throughout the town of Oxford and this part of New York state Sunday night and Monday morning as a result of repeated cloudbursts during the night which spread eight inches of water over the land, the majority of it within two or three hours. Damages in the township will probably amount to half a million dollars or more.

The only ones known to have lost their lives here were Mr. and Mrs. Fred Robbins who lived in the old Powers house on the south side of Bowman creek. Their house, barn and other farm buildings were swept before the angry waters descending the gorge between 3 and 4 o'clock Monday morning.

Clayton Soules, who lives across the creek and on the same side of the highway from the Robbins home, reported seeing a light in the Robbins house as late as 2 a. m. When they arose at 4 o'clock not a building on their neighbor's place was left.

Ludlow Damaged; Bowman Creek is Great Destroyer

Three Lives, Dozen Buildings, Numerous Bridges, Fields, Crops, Destroyed by Terrific Water Force.

Church at Tyner Goes; Four Buildings Go In

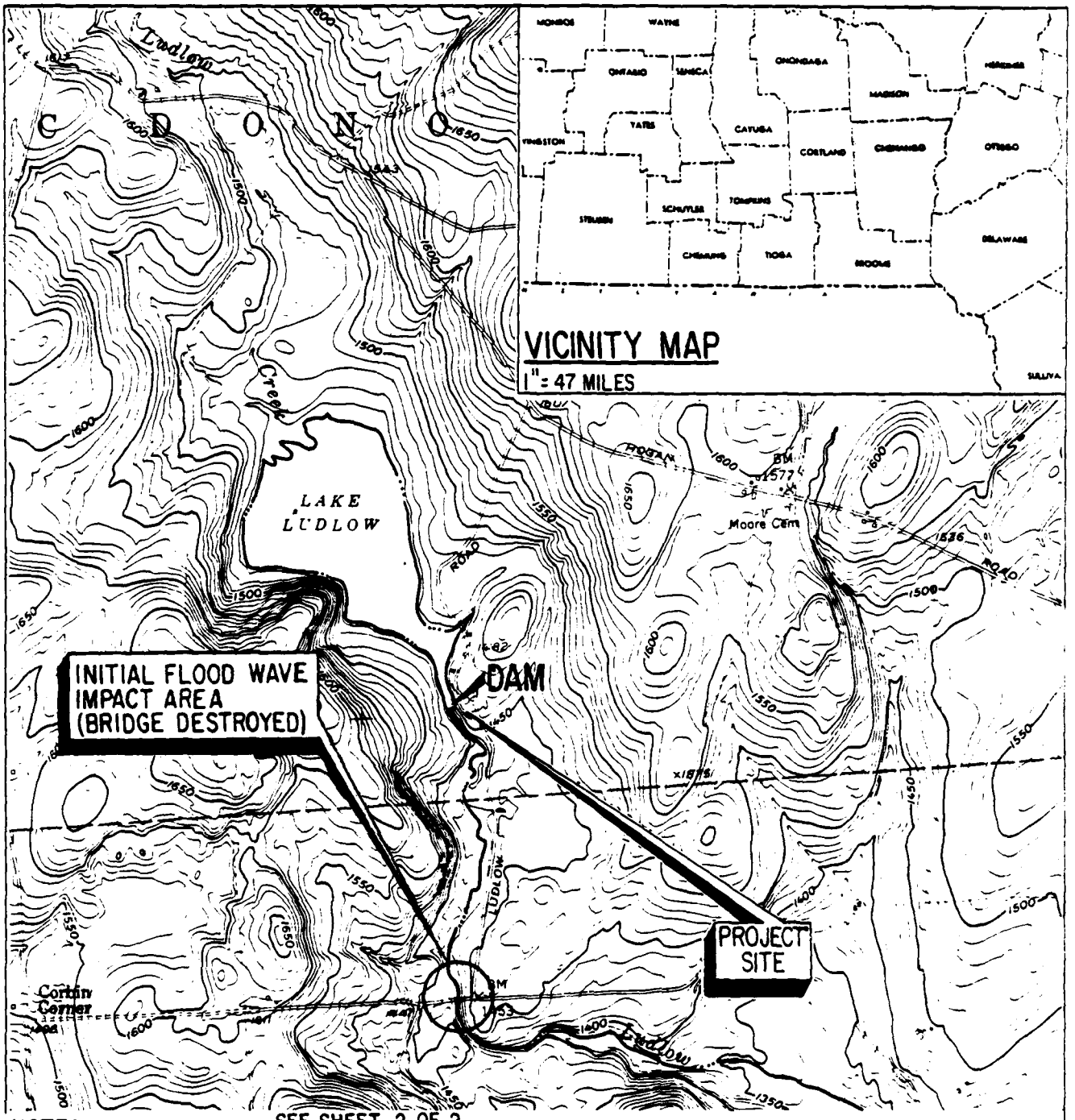
Part of Cheese Factory is Torn Off; Upper Bridge Goes Out with No Trace of Girders or Timbers.

Bowman creek was probably the fiercest of the streams which caused havoc in this section Sunday night and Monday morning. Added to the raging torrents from the cloudbursts was the water from Lake Ludlow which coursed down through the valley when the dam below the clubhouse failed to withstand the great pressure behind it.

As the water from Richmond brook struck Tyner, four buildings and a part of the old Tyner cheese factory were carried off their foundations, crushed into bits and hurled along down the valley to add to the force of the stream which wiped out the Robbins buildings at South Oxford.

The old Universalist church on the north road out of Tyner was the first structure to go. As it floated off its foundations, it gathered speed and crashed into the Grange hall where it was partially smashed. Veering off from here it gradually went to pieces as it sailed down the valley.

The old house and barn on the former Annis Hall place, now owned by Mrs. Nord Landers, were both carried away as was the barn belonging to Clifford Stiles and a portion of the cheese factory, also his property. The upper bridge was carried away despite its remarkable height above the normal stream, and the bridge at Ralph Sharpe's was also wiped out. Not a trace of the upper bridge has been found.



NOTE:

SEE SHEET 2 OF 2

PROPERTY DAMAGE RESULTING FROM THE LAKE LUDLOW CLUB DAM FAILURE ON JULY 8, 1935 IS INDICATED ABOVE.

FLOOD IMPACT MAP

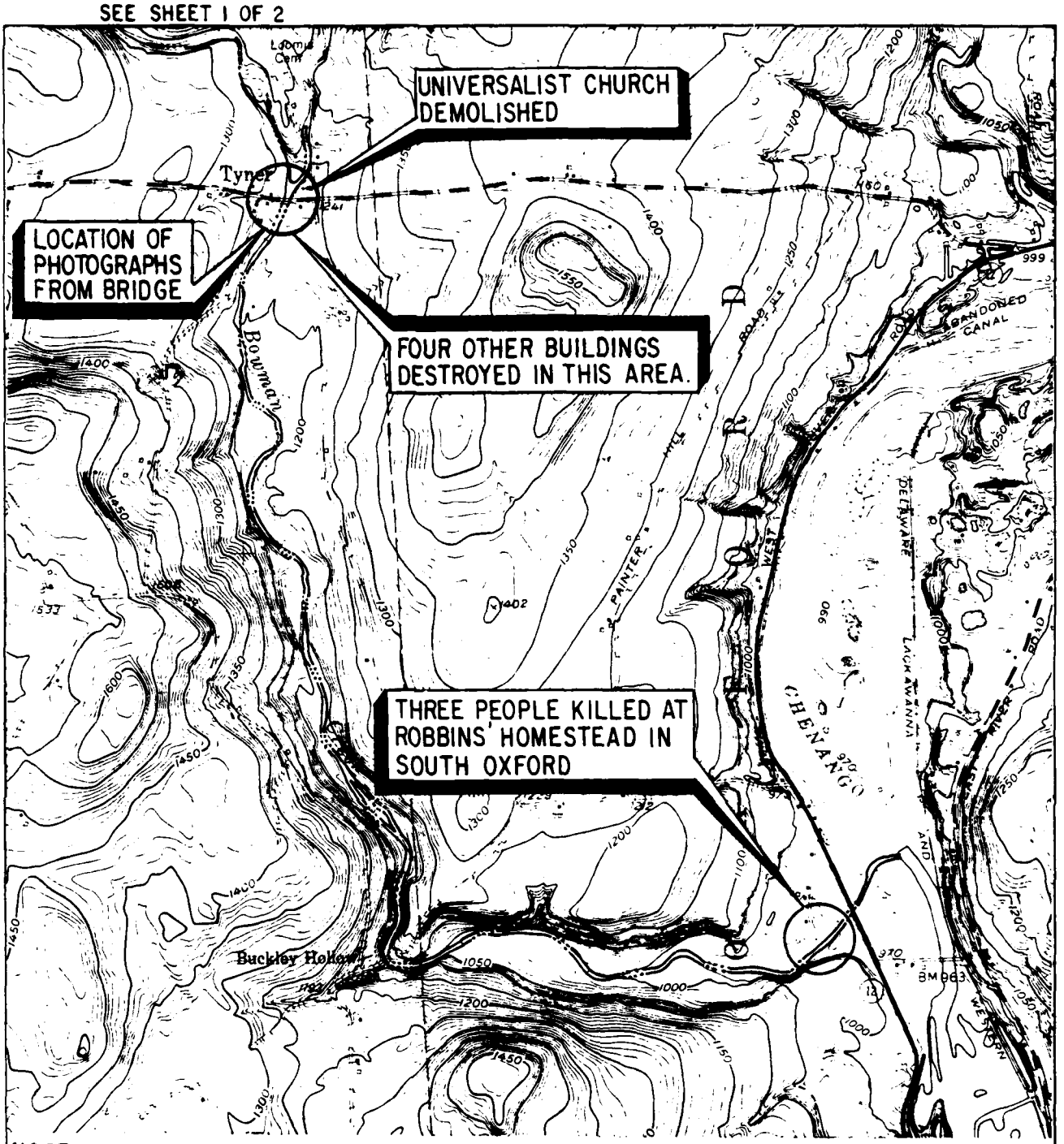
LAKE LUDLOW CLUB DAM
INVENTORY No. NY 350

SUSQUEHANNA RIVER BASIN
CHENANGO COUNTY
Mc DONOUGH, NEW YORK

SHEET 1 OF 2

FLAHERTY · GIAVARA ASSOCIATES, P.C.

SEE SHEET 1 OF 2



NOTE:

LOSS OF LIFE AND PROPERTY DAMAGE RESULTING FROM THE LAKE LUDLOW CLUB DAM FAILURE ON JULY 8, 1935 IS INDICATED ABOVE.

N

0 2000 4000

SCALE IN FEET

FLOOD IMPACT MAP

LAKE LUDLOW CLUB DAM

INVENTORY No. NY 350

SUSQUEHANNA RIVER BASIN
CHENANGO COUNTY
McDONOUGH, NEW YORK

SHEET 2 OF 2

FLAHERTY · GIAVARA ASSOCIATES, P.C.

APPENDIX E

STRUCTURAL STABILITY ANALYSIS

(No STRUCTURAL STABILITY ANALYSIS was required for this dam)

APPENDIX F

REFERENCES

REFERENCES

1. Chow, Ven Te, Editor - Handbook of Applied Hydrology. McGraw-Hill Book Company, New York, New York, 1964.

2. Hydrologic Engineering Center, U.S. Army Corps of Engineers, HEC-1 Flood Hydrograph Package, Users Manual. Davis, California, January 1973.

3. Hydrologic Engineering Center, U.S. Army Corps of Engineers, Flood Hydrograph Package (HEC-1), Users Manual for Dam Safety Investigations, Davis, California, September 1978.

4. King, Horace and Brater, Ernest. Handbook of Hydraulics, 5th Edition. McGraw-Hill Book Company, New York, New York, 1963.

5. Riedel, J.T., Appleby, J.F. and Schloemer, R.W. Seasonal Variation of the Probable Maximum Precipitation East of the 105th Meridian for Areas from 10 to 1000 Square Miles and Durations of 6, 12, 24, and 48 Hours (Hydrometeorological Report No. 33) U.S. Department of Commerce - Weather Bureau and U.S. Department of the Army - Corps of Engineers, Washington, D.C., April 1956

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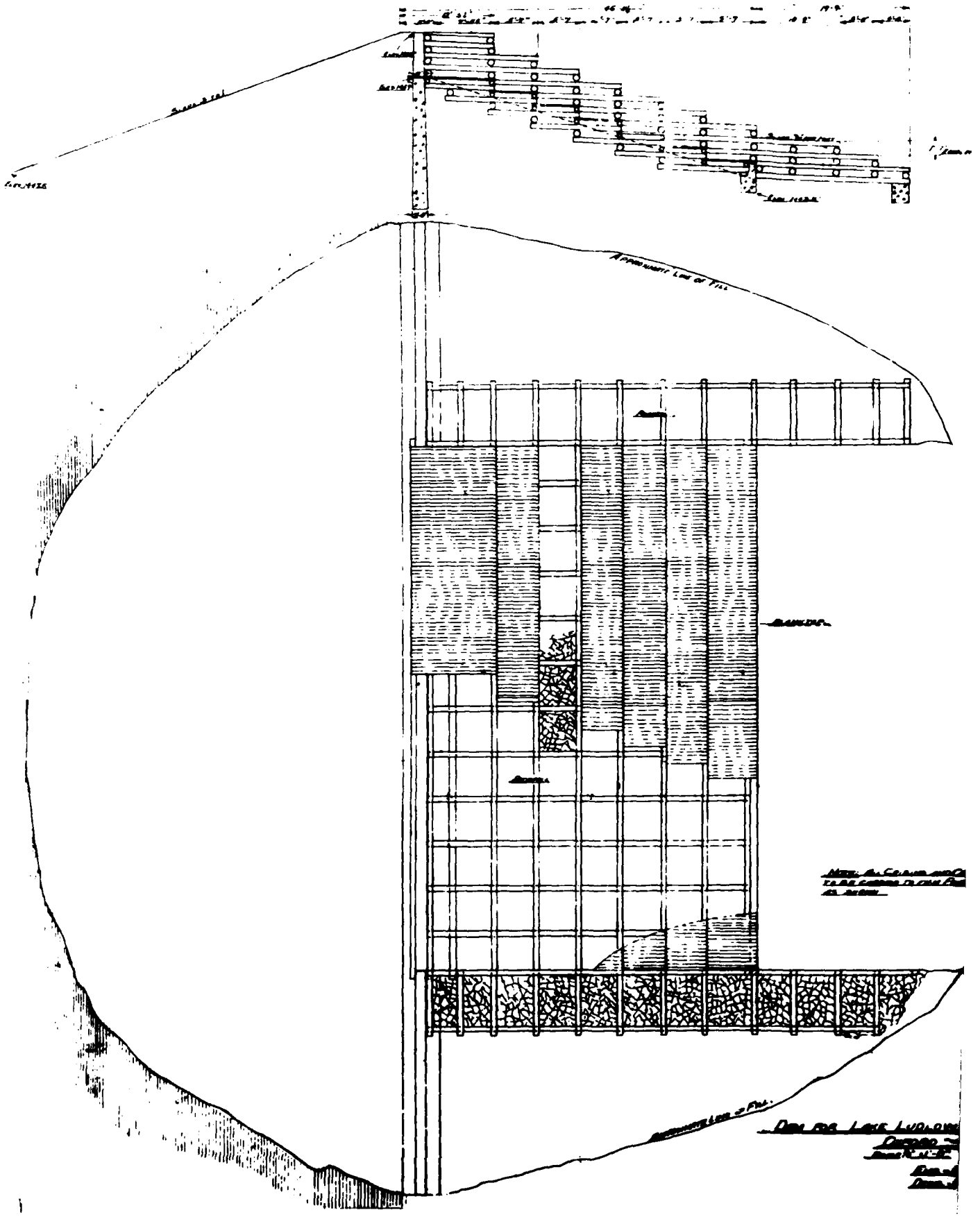
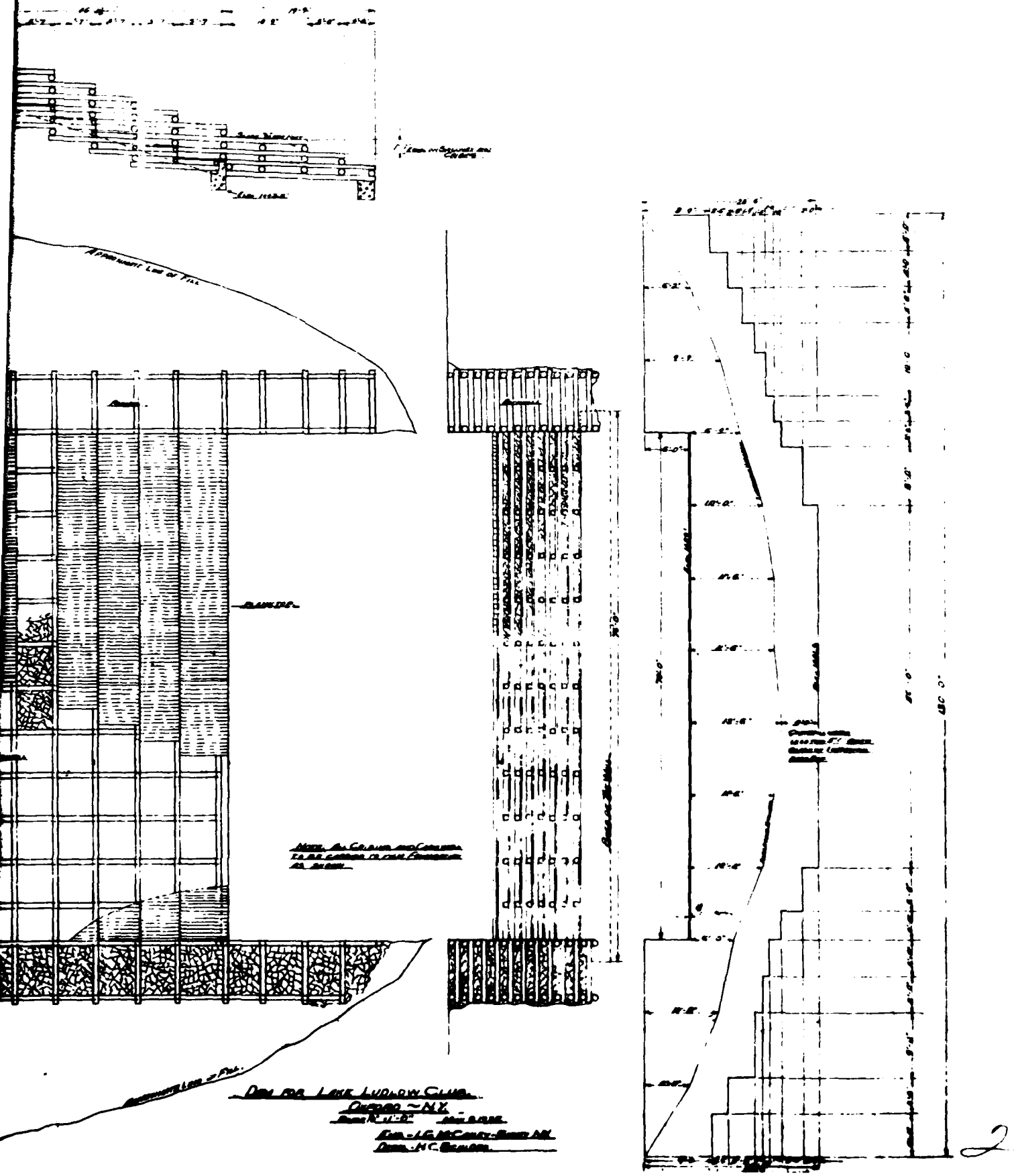
APPENDIX G

DRAWINGS





G-1