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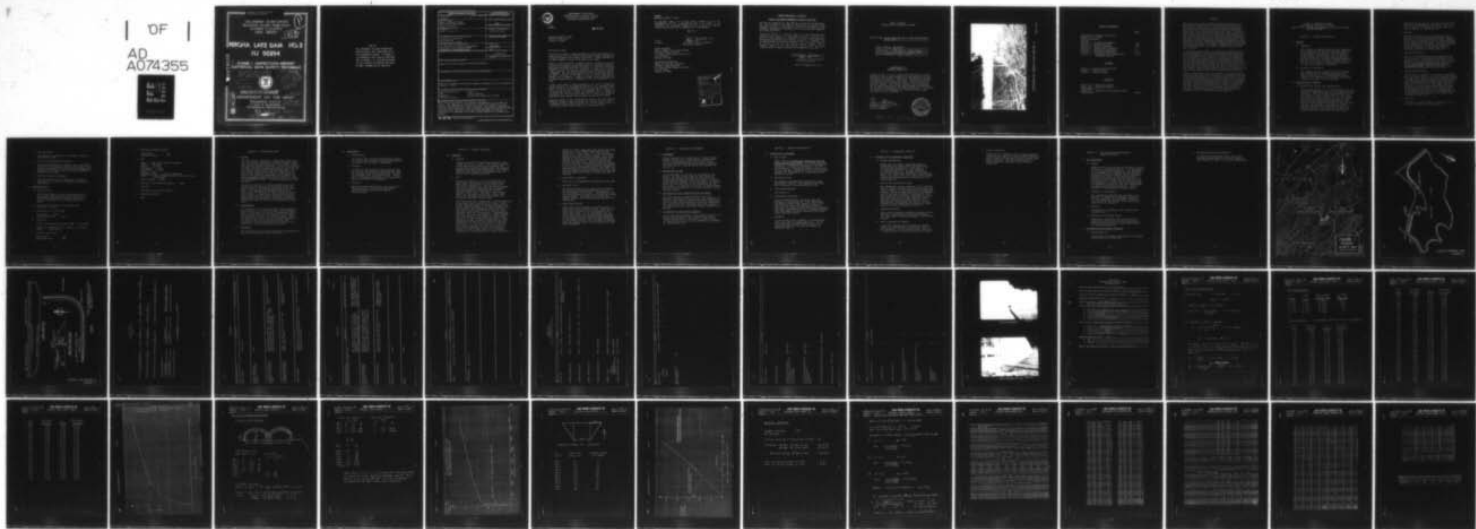
NATIONAL DAM SAFETY PROGRAM. PERONA LAKE DAM NUMBER 2 (NJ-00294--ETC(U)  
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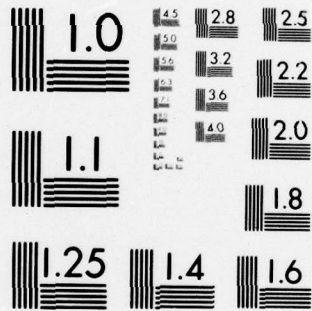
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# PERONA LAKE DAM NO. 2 NJ 00294

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## PHASE 1 INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM

Perona Lake Dam Number 2 (NJ-00294)  
Delaware River Basin, Pequest River,  
Tributary Sussex County, New Jersey.  
Phase 1 Inspection Report.



F. Keith /Jolls

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DEPARTMENT OF THE ARMY

52 p.

Philadelphia District  
Corps of Engineers  
Philadelphia, Pennsylvania

DACW61-79-G-0011

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER NJ00294	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Inspection Report National Dam Safety Program Perona Lake Dam No. 2 Sussex County, N.J.		5. TYPE OF REPORT & PERIOD COVERED  FINAL
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Jolls, F. Keith P.E.		8. CONTRACT OR GRANT NUMBER(s) DACW61-79-C-0011
9. PERFORMING ORGANIZATION NAME AND ADDRESS Louis Berger & Associates 100 Halstead Rd. East Orange, N.J. 07019		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, Philadelphia Custom House, 2d & Chestnut Streets Philadelphia, Pennsylvania 19106		12. REPORT DATE June 1979
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		13. NUMBER OF PAGES 35
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17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES  Copies are obtainable from National Technical Information Service, Springfield, Virginia, 22151.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Perona Lake Dam No. 2                      Safety Dams    Visual Inspection Embankments                                  National Dam Inspection Act Report Structural analysis		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.		



DEPARTMENT OF THE ARMY  
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS  
CUSTOM HOUSE—2 D & CHESTNUT STREETS  
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO

NAPEN-D

17 SEP 1979

Honorable Brendan T. Byrne  
Governor of New Jersey  
Trenton, NJ 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Perona Lake Dam No. 2 in Sussex County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Perona Lake Dam No. 2, initially listed as a high hazard potential structure, but reduced to a low hazard potential structure, as a result of this inspection, is judged to be in good overall condition. The spillway for Perona Lake is located at Dam No. 1 (NJ00295). The low hazard potential classification means that in the event of failure of the dam, no loss of life and only minimal economic loss is expected. Based on the dam's overall condition and low hazard classification, no remedial actions are recommended at this time.

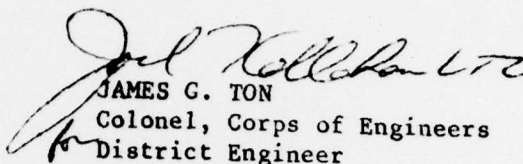
A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman James A. Courter of the Thirteenth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

NAPEN-D  
Honorable Brendan T. Byrne

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

  
JAMES G. TON  
Colonel, Corps of Engineers  
District Engineer

1 Incl  
As stated

Copies furnished:  
Dirk C. Hofman, P.E., Deputy Director  
Division of Water Resources  
N.J. Dept. of Environmental Protection  
P.O. Box CN029  
Trenton, NJ 08625

John O'Dowd, Acting Chief  
Bureau of Flood Plain Management  
Division of Water Resources  
N.J. Dept. of Environmental Protection  
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PERONA LAKE DAM NO. 2 (NJ00294)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 3 May 1979 by Louis Berger and Associates, Inc. under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Perona Lake Dam No. 2, initially listed as a high hazard potential structure, but reduced to a low hazard potential structure, as a result of this inspection, is judged to be in good overall condition. The spillway for Perona Lake is located at Dam No. 1 (NJ00295). The low hazard potential classification means that in the event of failure of the dam, no loss of life and only minimal economic loss is expected. Based on the dam's overall condition and low hazard classification, no remedial actions are recommended at this time.

APPROVED:

*James G. Ton*  
JAMES G. TON

Colonel, Corps of Engineers  
District Engineer

DATE: 14 September 1979

PHASE I REPORT  
NATIONAL DAM INSPECTION PROGRAM

Name of Dam Perona Lake Dam No. 2 FED ID# NJ 00294  
NJ ID #144

State Located New Jersey  
County Located Sussex  
Coordinates Lat. 4101.3 - Long. 7441.6  
Stream Unnamed Tributary of Pequest River  
Date of Inspection May 3, 1979

ASSESSMENT OF  
GENERAL CONDITIONS

Perona Dam No. 2 is in a sound and satisfactory overall condition and is recommended to be downgraded to a low hazard classification. Sufficient engineering data was available to assess its condition. Overtopping would not appreciably increase the danger of loss of life or property damage. No remedial actions are recommended as the owner continually provides adequate maintenance. The spillway capacity at the adjacent Dam No. 1 (NJ 00295) is adequate to accommodate the selected design flood (Dam No. 2 has no spillway).



F. Keith Jolls P.E.  
Project Manager



79 09 24 044



OVERVIEW OF PERONA LAKE DAM NO. 2

MAY, 1979

## TABLE OF CONTENTS

	<u>Page</u>
Assessment of General Conditions	
Overall View of Dam	
Table of Contents	
Preface	
Section 1 - Project Information	1-4
Section 2 - Engineering Data	5-6
Section 3 - Visual Inspection	7-8
Section 4 - Operational Procedures	9
Section 5 - Hydraulic/Hydrologic	10
Section 6 - Structural Stability	11-12
Section 7 - Assessments/Recommendations/ Remedial Actions	13-14

## FIGURES

- Figure 1 - Regional Vicinity Map
- Figure 2 - Plan of Lake
- Figure 3 - Details of Dam

## APPENDIX

- Check List - Visual Inspection
  - Check List - Engineering Data
  - Photographs
  - Check List - Hydrologic and Hydraulic Data
  - Computations
- A1-A17

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

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT  
NATIONAL DAM INSPECTION PROGRAM  
NAME OF DAM: PERONA LAKE DAM NO. 2 FED ID# NJ 00294  
AND NJ ID #144

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

This report is authorized by the Dam Inspection Act, Public Law 92-367, and has been prepared in accordance with Contract FPM-36 between Louis Berger & Associates, Inc. and the State of New Jersey and its Department of Environmental Protection, Division of Water Resources. The State, in turn, is under agreement with the U.S. Army Corps of Engineers, Philadelphia to have this inspection performed.

b. Purpose of Inspection

The purpose of this inspection is to evaluate the structural and hydraulic condition of Perona Lake Dam No. 2 and appurtenant structures, and to determine if the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

Perona Lake Dam No. 2 is a 915 foot long, 10 foot high earth embankment with a full length concrete corewall. The top of dam is at elevation 757.2. The corewall extends from elevation 756.2 down to bedrock or firm glacial till. In the center 700 feet of the dam, 10-foot lengths of interlocking steel sheeting have been driven to a depth nine feet below the bottom of the corewall. The face of the dam is protected by riprap between elevation 756.2 and the toe and a retaining wall has been erected to protect the owners property at the left end of the dam.

The crest of the dam is nine feet wide and both slopes of the embankment are 2H:1V. Dam No. 2 is the second of two dams on Perona Lake and is east of Dam No. 1 (See Figure 2).

b. Location

The dam is located on an unnamed tributary of the Pequest River in Andover Township, Sussex County. It is approximately 3.3 miles southwest of the center of Sparta and 3.0 miles southeast of the Newton Town Boundary. This dam, together with Perona Dam No. 1 (NJ 00295) form the northerly boundary of Perona Lake which is situated just west of County Road 517.

c. Size Classification

Dam No. 2 at Perona Lake has a maximum height of 10 feet and a maximum storage capacity of 149 acre-feet. Accordingly, this dam is in the small size category as defined by the criteria in the Recommended Guidelines for Safety Inspection of Dams (storage less than 1,000 acre-feet and height less than 40 feet).

d. Hazard Classification

Perona Lake is located in an sparsely developed area of Sussex County. The only facility between this dam and a larger lake one mile downstream is a lightly travelled secondary road with the one home slightly above the downstream flood plain. Since the flood plain is very level and ill-defined, it is not anticipated that a failure at this dam would result in appreciable downstream damage or loss of life. Accordingly, it is recommended that Dam No. 2 be downgraded to a low hazard classification, (the same classification as Dam No. 1).

e. Ownership

This dam is owned by Edwin C. Perona, R.D. 1, Box 774, Newton, New Jersey 07860.

f. Purpose of Dam

The purpose of the dam is to impound a private recreational lake.

g. Design and Construction History

The dam was designed in 1929 by Snook and Hardin, Engineers and Surveyors, Newton, New Jersey. The design was approved in April 1929 and construction completed in October 1929 with final acceptance granted in July 1931.

h. Normal Operating Procedures

This dam functions as an auxiliary perimeter dike and has no outlets, spillways or operating facilities.

1.3 PERTINENT DATA

a. Drainage Area

Perona Lake Dam No. 2 has a drainage area of 0.11 square miles which consists primarily of undeveloped woodland and another small lake (to the southeast) with a surface area of 5 acres.

b. Total spillway capacity of maximum pool elevation - None

c. Elevations (ft. above MSL)

Top of dam - 757.2  
Recreational pool - 754.7

d. Reservoir

Length of maximum pool (top of dam) - 1,950 feet

Length of recreation pool (Dam No. 1 spillway crest) - 1,700 feet

e. Storage (acre-feet)

Top of dam - 149  
Recreation pool - 101

f. Reservoir Surface (acres)

Top of dam - 22  
Recreation pool - 17

g. Dam

Type - Earth with concrete corewall  
Length - 915 feet  
Height - 10 feet  
Top Width - 9 feet  
Side Slopes - 2H:1V  
Zoning - None  
Impervious Core - Concrete corewall  
Cutoff - Steel sheeting beneath center 700 feet  
of corewall  
Grout curtain - None

h. Diversion and Regulating Tunnel - None

i. Spillway

Located at Perona Lake Dam No. 1

j. Regulating Outlets

None

## SECTION 2 - ENGINEERING DATA

### 2.1 DESIGN

The only design information located for review were the two drawings prepared by Snook and Hardin which were filed with Dam Application 144 in 1929. These depicted the details of Dam No. 2 which is essentially an earth dike which proved necessary to construct at the time to fully contain the man-made lake. The full length concrete core wall is somewhat of an excessively conservative feature of the design in view of the height of embankment but followed the design standards adopted for Perona Dam No. 1 which is considerably taller. No design computations were available.

The dam is located in an area underlain by a thin recent alluvium deposit of stratified sands and gravels over a Pre-Cambrian-age Byram gneiss bedrock. This metamorphic basement-rock is very dense and forms much of the upland areas of north-west Jersey. It contains a well developed joint system combined with random fracturing. Glacial modification has resulted in numerous scoured-out depressions such as the one now occupied by Perona Lake.

### 2.2 CONSTRUCTION

No information was available except 1929 correspondence between the owner's Engineer and the Department of Conservation relating to additional steel sheet piling installed at foundation level (due to the presence of a layer of coarse gravel). From available photographs, the construction appeared to be carried out in a workmanlike fashion with Department engineers periodically inspecting and reporting on the prosecution of the work.

### 2.3 OPERATION

The dam appears to have been operating satisfactorily since its installation (see Section 4).

2.4 EVALUATION

a. Availability

In view of the size and hazard classification it is felt that sufficient engineering data is available for the Phase I assessment.

b. Adequacy

A review of the original plans indicate that the dam was conservatively designed and from the results of the field inspection, is built in accordance with the design plans. Hence, from a structural standpoint, the engineering data is believed to be adequate.

c. Validity

Based on field observations, the validity of the 1929 design is not challenged and is accepted without recourse to further investigations.

## SECTION 3 - VISUAL INSPECTION

### 3.1 FINDINGS

#### a. General

Visual inspection of Perona Lake Dam No. 2 was conducted on May 3, 1979. The overall condition of the dam was reviewed with its owners who pointed out localized problem areas and remedial measures that have been undertaken. The overall condition of the dam is satisfactory and in a stable, well established state.

#### b. Dam

Perona Lake Dam No. 2 is a "L"-shaped earthen dike whose 9 foot crest is about three feet wider than indicated on the original plans. Two rows of mature pine trees are growing along the entire length of the dam and a secondary road parallels the downstream toe of the longest (north) leg. The trees, which range from 9 to 12 inches in diameter, are planted along the backslope next to the roadway and along the back edge of the crest.

The embankment has a substantial, well-established grass cover which extends to the water's edge on the upstream slope, partially concealing the riprap slope protection. Two small eroded areas were noted on the embankment facing the lake, the first being about 240 feet from the right abutment while the second area is approximately 150 feet from the left abutment. Both sloughed areas are about 1.5 feet wide and extend from the crest to the normal reservoir edge. These appear to be due to muskrat burrowing into the embankment and are not the result of subgrade subsidence. A 100 foot long masonry and concrete retaining wall has been built along the face of the embankment at the left abutment. Beyond the toe in this area is an in-ground swimming pool (approximately at crest elevation).

There is a soft, damp area just beyond the downstream toe at the curved area near the dam centerline. While there is no flowing water or seepage, this zone, which is about 5 feet wide and 50 feet long, has a high water table which extends to the flat marshy region beyond the road at the dam's toe. Several burrows were noted on the downstream slope of the embankment in this vicinity. A light stockade-type barrier fence has been constructed across the middle of the dam from the water's edge to the road. The fence encloses the owner's property but does not preclude pedestrian traffic on the east side of the dam.

c. Appurtenant Structures

There are no appurtenant structures at this dam.

d. Reservoir Area

The lake and most of its shoreline is owned by two private individuals which has precluded any development in the past. Consequently, the area surrounding the lake is in a heavily wooded, natural state. In general the slopes rise rather steeply from the shoreline but are well stabilized.

e. Downstream Channel

Since there are no outlets at Perona Dam No. 2, there is no true channel as such. Most of the area below the dam is flat and swampy with a high water table. It is contiguous with the marshy area into which the discharge from Dam No. 1 empties well as several small downstream tributaries which feed into the upper reaches of the Pequest River. Only one home is located near the extreme limits of the flood plain high water elevation.

## SECTION 4 - OPERATIONAL PROCEDURES

### 4.1 PROCEDURES

Perona Lake Dam No. 2 functions as a dike across a natural saddle on the north shore of Perona Lake. It has no regulating outlet or spillway which obviates the necessity for operational procedures (the lake level is maintained by the spillway at Dam No. 1).

### 4.2 MAINTENANCE OF DAM

The maintenance of this dam is performed by the owner. At least once a year the lake level is lowered and repairs are made to the riprap face of the dam and adjacent retaining walls. The most common repair required is the elimination of muskrat nests dug into the face of the embankment at the water line. In addition to filling in these burrows and restoring the riprap, the owner performs routine grounds keeping.

### 4.3 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

No formal warning system exists at this site. However, the owner's home is only a few hundred feet from the left abutment and his property extends the entire length of the westerly leg of the embankment. The road to his home continues along the length of the dam and allows a continued cursory inspection of the dam.

### 4.4 EVALUATION OF OPERATIONAL ADEQUACY

Due to the passive nature of this dam's function, no operational procedures are required other than routine maintenance. The owner's annual program of maintenance is such that no additional procedures are deemed necessary.

## SECTION 5 - HYDRAULIC/HYDROLOGIC

### 5.1 EVALUATION OF FEATURES

#### a. Design Data

Based upon the Recommended Guidelines for the Safety Inspection of Dams, a 100 year flood was selected for hydraulic analysis and overtopping potential. As detailed in Section 5 of the Perona Dam No. 1 Inspection Report, the spillway at that dam had a capacity of 183 cfs which was adequate to accommodate the routed design discharge of 54 cfs.

#### b. Experience Data

No actual storm/discharge records have been maintained. Dam No. 1 was designed (in 1929) for a discharge of approximately 95 cfs.

#### c. Visual Observations

See Section 3.

#### d. Overtopping Potential

Since the H&H analysis indicates that the spillway at Perona Dam No. 1 can accommodate the design flood, there appears to be little likelihood of either dam being overtopped. Both are very nearly at the same crest elevation and should overtopping occur, it would discharge over both dams at several localized low spots along each dam's crest.

#### e. Drawdown

At the present time, drawdown is accomplished thru a 12" gate at Perona Dam No. 1. It is estimated that it would take 11 days to de-water the lake down to the pipe invert of Elevation 740.5.

## SECTION 6 - STRUCTURAL STABILITY

### 6.1 EVALUATION OF STRUCTURAL STABILITY

#### a. Visual Observation

Based upon the visual inspection and the single sheet of design plans available from the 1929 Dam Application, Perona Dam No. 2 is evaluated as being in a satisfactory structural condition. Because the dam has been in the continuous ownership of the Perona family who live at the site, their annual repair program has maintained the structure in very good condition.

#### b. Design and Construction Data

The embankment, being protected on the upstream face by riprap and containing a full height concrete corewall, is very conservatively designed. Further, the 2H:1V backslope over a considerable portion has been further strengthened by the local road which in effect, provides an 18 foot wide berm only several feet below dam crest. The Dam Application records indicate that it was properly constructed and there is little evidence of any deterioration except the small erosion gullies mentioned in Section 3.

#### c. Operating Records

There are no operating records inasmuch as this dam has no sluiceways or discharge conduits. The lake level is lowered annually to make minor repairs.

#### d. Post Construction Changes

There have been no post construction changes except the regrading of the approach road on the backslope. At the present time, there are no modifications being considered by the Owner.

e. Seismic Stability

Perona lake is located in Zone 1 and experience indicates that dams will have adequate stability under dynamic loading conditions if stable under static loadings. The dam is presently in a stable condition regarding static loading conditions.

SECTION 7 - ASSESSMENTS/RECOMMENDATIONS/  
REMEDIAL ACTIONS

7.1 DAM ASSESSMENT

a. Safety

Subject to the limitations of the Phase I visual inspection, Perona Lake Dam No. 2 is adjudged to be in a good overall condition. The embankment is constructed of an unknown composition but contains a concrete corewall and is adequately protected by riprap on its upstream face. Seepage through the dam does not appear to be a problem to the cutoff wall and dam stability is enhanced by its large width to height ratio. The discharge spillway of the lake impoundment is located at Perona Lake Dam No. 1 and is adequate to accommodate the design flood.

b. Adequacy of Information

The information gathered for the Phase I inspection is deemed to be adequate regarding the safe operation and structural stability. It is believed that little other engineering information is available.

c. Urgency

No urgency is attached to the findings contained herein.

d. Necessity for Further Study

Additional inspections are believed to be unnecessary as the dam does not constitute a hazard to human life or a significant danger to downstream property.

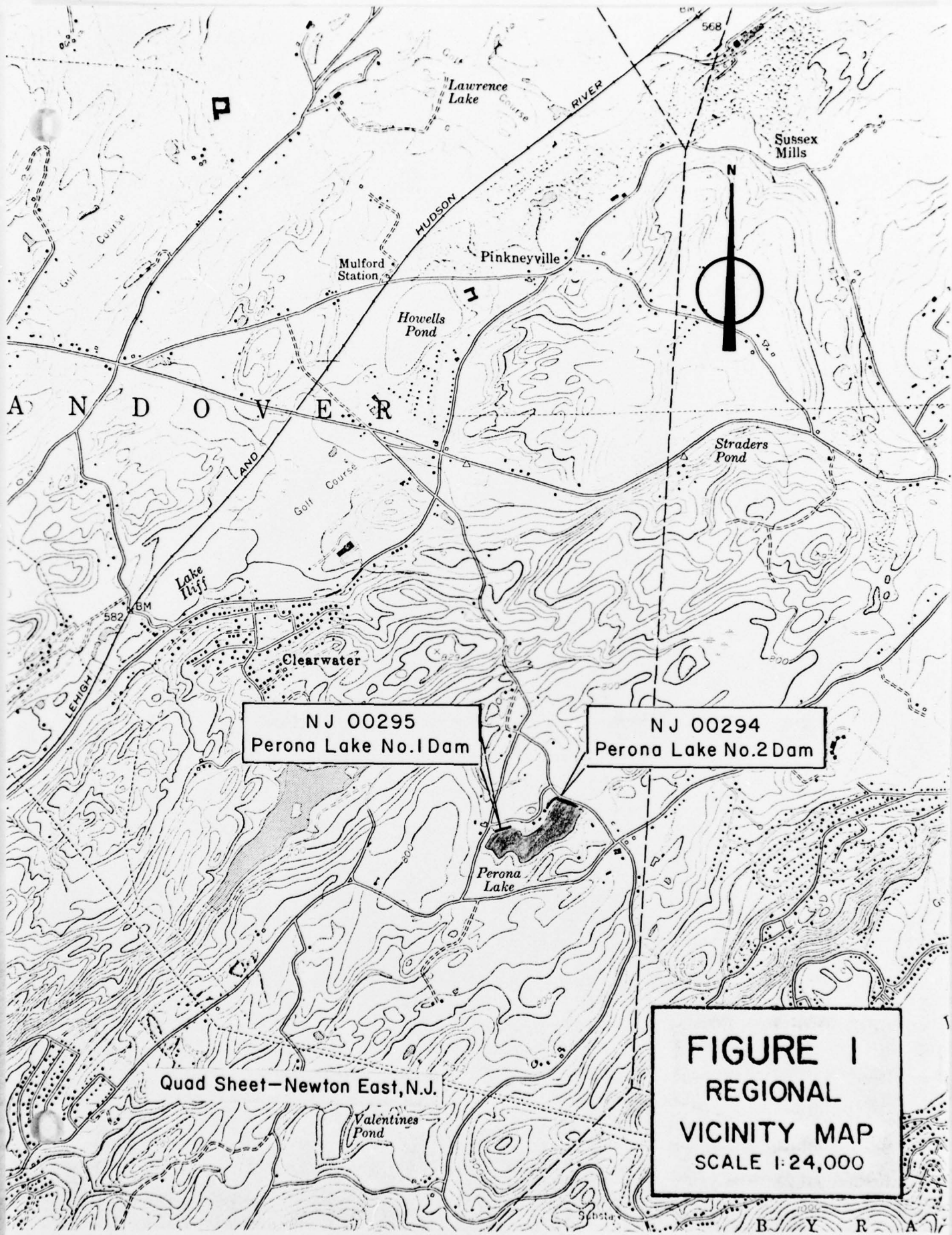
7.2 RECOMMENDATIONS/REMEDIAL MEASURES

a. Recommendations

On the basis of present conditions, no remedial improvements are envisioned.

b. O&M Maintenance and Procedures

No additional procedures other than those currently undertaken by the owner appear to be warranted in light of the above assessment.

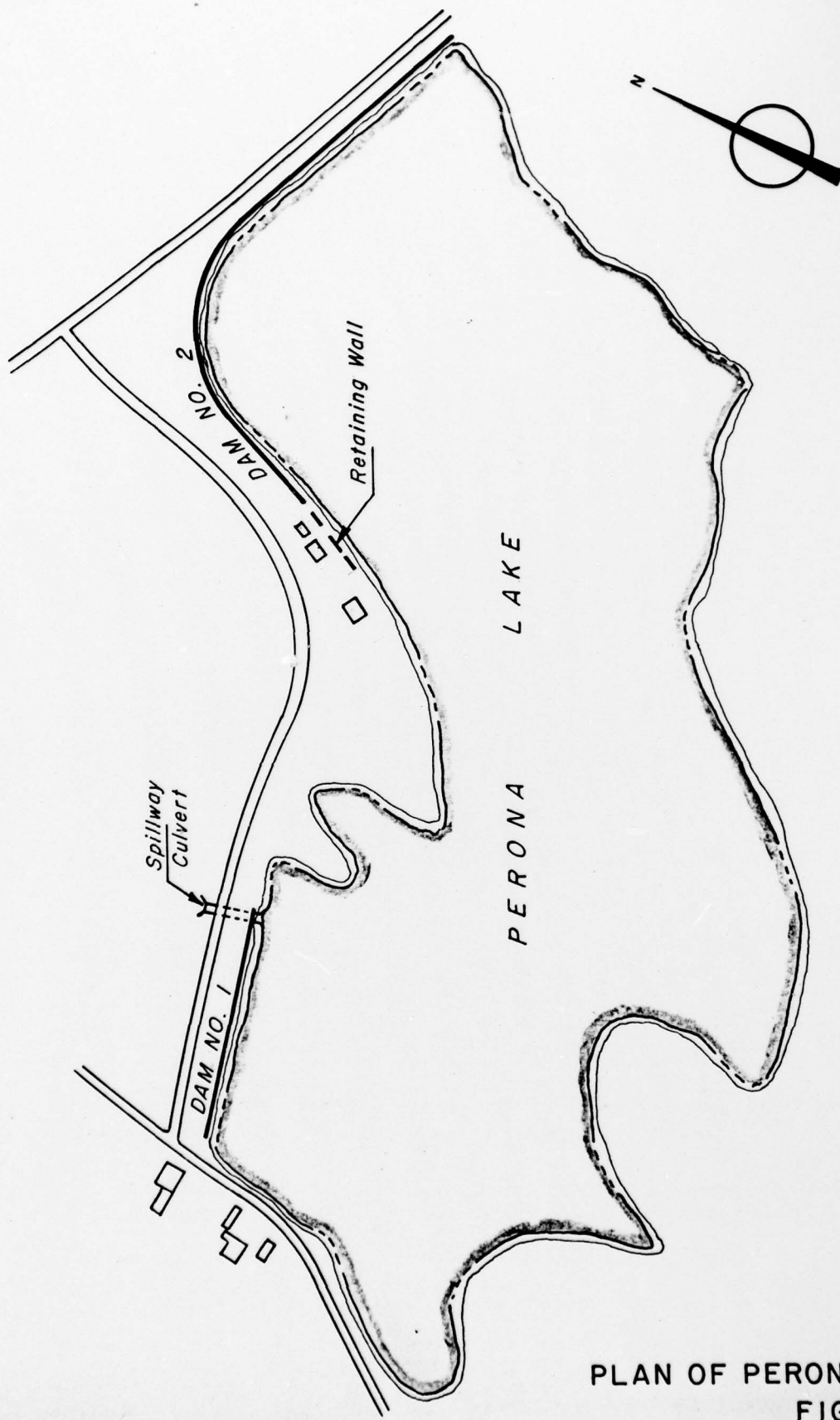


NJ 00295  
Perona Lake No.1 Dam

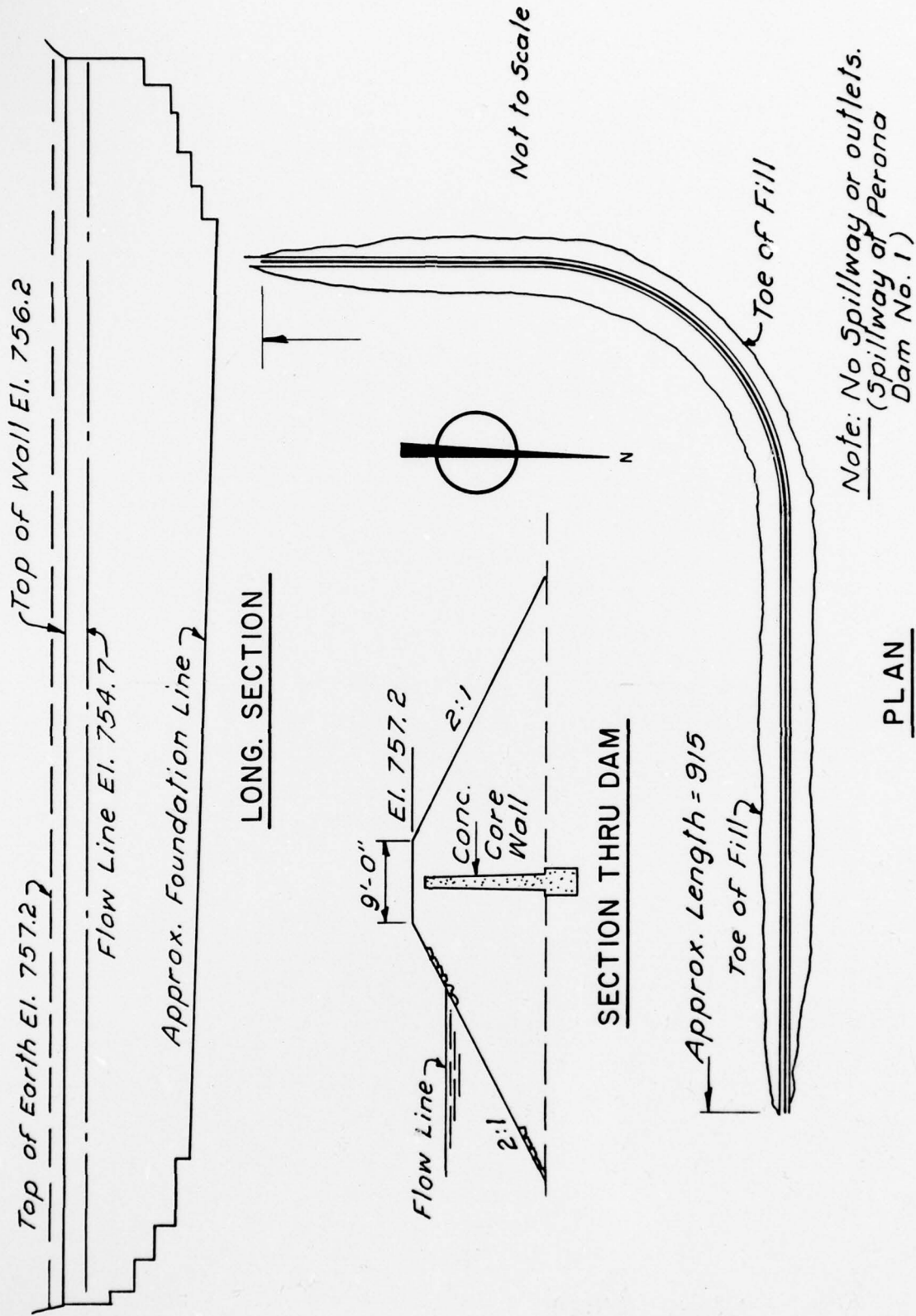
NJ 00294  
Perona Lake No.2 Dam

**FIGURE 1**  
**REGIONAL**  
**VICINITY MAP**  
SCALE 1:24,000

Quad Sheet - Newton East, N.J.



PLAN OF PERONA LAKE  
FIGURE 2



DETAILS OF DAM NO. 2  
 FIGURE 3

Check List  
Visual Inspection  
Phase 1

Name Dam Perona Dam #2 County Sussex State New Jersey Coordinators NJDEP

Date(s) Inspection 5/3/79 Weather Clearing Temperature 60°

Pool Elevation at Time of Inspection 754+ M.S.L. Tailwater at Time of Inspection N/A M.S.L.

Inspection Personnel:

T. Chapter R. Greenfield Edwin C. Perona (owner)  
D. Mulligan K. Jolls  
\_\_\_\_\_

T. Chapter Recorder

EMBANKMENT

REMARKS OR RECOMMENDATIONS

OBSERVATIONS

VISUAL EXAMINATION OF

SURFACE CRACKS

None noted

UNUSUAL MOVEMENT OR  
CRACKING AT OR BEYOND  
THE TOE

None

SLOUGHING OR EROSION OF  
EMBANKMENT AND ABUTMENT  
SLOPES

Small erosion gullies on upstream face caused by muskrats 240' from right abutment and 150' from left abutment. Some small animal burrows in backslope.

Actively maintained by owner.

VERTICAL AND HORIZONTAL  
ALIGNMENT OF THE CREST

Level - 9' wide - Row of pine trees along entire crest.

Trees should be left standing.

RIPRAP FAILURES

Upstream face covered with grass down to waterline. Riprap displaced at 2 erosion gullies by muskrats.

Owner is making repairs.

EMBANKMENT

REMARKS OR RECOMMENDATIONS

OBSERVATIONS

VISUAL EXAMINATION OF

EXCESSIVE SHRUB GROWTH, TREES, ETC.

Owner removes shrubbery and heavy growth periodically. Do not recommend removing these trees.

Two rows of trees from 9"-24" dia. One row along junction of crest and backslope. Second row along base of toe. Occasional shrubbery on face.

JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM

Embankment grades smoothly into rising natural terrain of right abutment and seawall at left abutment. Difficult to tell where dam begins at left abutment.

ANY NOTICEABLE SEEPAGE

None visible although area beyond road along toe is soft and damp.

Probably part of marsh conditions which extend to the north.

STAFF GAGE AND RECORDER

None

DRAINS

None

RESERVOIR

VISUAL EXAMINATION OF

OBSERVATIONS

REMARKS OR RECOMMENDATIONS

SLOPES

Generally steep slopes - well wooded - undeveloped

SEDIMENTATION

None noted

CHECK LIST  
ENGINEERING DATA  
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Avail. - NJDEP - Division of Water Resources - Bureau of Flood Plain Management
REGIONAL VICINITY MAP	Avail. - USGS Quad - Newton East, N.J.
CONSTRUCTION HISTORY	Avail - NJDEP - Div. Wtr. Res. - Bur. Fld. Pln. Mngmt - Trenton, N.J.
TYPICAL SECTIONS OF DAM	" " " " " " " " " " " "
HYDROLOGIC/HYDRAULIC DATA	None Available
OUTLETS - PLAN	Outlet information for Perona Dam No. 1 available - NJDEP
- DETAILS	" " " " " " " " " " " "
-CONSTRAINTS	None available
-DISCHARGE RATINGS	
RAINFALL/RESERVOIR RECORDS	None available

ITEM	REMARKS
------	---------

SPILLWAY PLAN	Spillway information for Perona Dam No. 1 available from NJDEP
---------------	--

SECTIONS	"
----------	---

DETAILS	"
---------	---

OPERATING EQUIPMENT PLANS & DETAILS	N/A
--	-----

ITEM REMARKS

DESIGN REPORTS None Avail

GEOLOGY REPORTS " "

DESIGN COMPUTATIONS None Avail  
 HYDROLOGY & HYDRAULICS " "  
 DAM STABILITY " "  
 SEEPAGE STUDIES " "

MATERIALS INVESTIGATIONS None Avail  
 BORING RECORDS " "  
 LABORATORY " "  
 FIELD " "

POST-CONSTRUCTION SURVEYS OF DAM None Avail

BORROW SOURCES. None Avail

ITEM REMARKS

MONITORING SYSTEMS None Available

"

"

MODIFICATIONS

"

"

HIGH POOL RECORDS

"

"

POST CONSTRUCTION ENGINEERING  
STUDIES AND REPORTS

"

"

PRIOR ACCIDENTS OR FAILURE OF DAM  
DESCRIPTION  
REPORTS

"

"

REPORTS

"

"

MAINTENANCE  
OPERATION  
RECORDS

"

"

RECORDS



View of Embankment

May, 1979



View of Backslope of Dam

May, 1979

CHECK LIST  
HYDROLOGIC AND HYDRAULIC DATA  
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 0.11 square miles

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 754.7 (101 Ac. Ft.)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): N/A

ELEVATION MAXIMUM DESIGN POOL: 756.2

ELEVATION TOP DAM: 757.2 (149 Ac. Ft.)

Spillway located at Perona Lake Dam No. 1

CREST: Twin arch culverts under private road bridge

- a. Elevation 754.7
- b. Type 12" wide concrete slab laid on bedrock
- c. Width 2 @ 8' each
- d. Length 2 @ 30" each
- e. Location Spillover Right abutment
- f. Number and Type of Gates None

OUTLET WORKS: Outlet works located at Perona Lake Dam No. 1

- a. Type Gate operated 12" dia. C.I. pipe
- b. Location 150' from left abutment
- c. Entrance inverts 741.5
- d. Exit inverts 740.5
- e. Emergency draindown facilities Same

HYDROMETEOROLOGICAL GAGES: None

- a. Type \_\_\_\_\_
- b. Location \_\_\_\_\_
- c. Records \_\_\_\_\_

MAXIMUM NON-DAMAGING DISCHARGE: 183 cfs. @ Perona Dam No. 1

BY D. J. M. DATE 5-79  
CHKD. BY \_\_\_\_\_ DATE \_\_\_\_\_  
SUBJECT \_\_\_\_\_

LOUIS BERGER & ASSOCIATES INC.  
PERONA LAKE DAMS 1 & 2

SHEET NO. A1 OF \_\_\_\_\_  
PROJECT C234

Time of concentration:

Overland flow  $L = 0.2$  miles  $H \approx 50'$

Slope = 4.7%

Assume velocity of  $4 \text{ ft s}^{-1}$

$$\text{gives } t_c = \frac{0.2 \times 5280}{4 \times 60} = 4.4 \text{ minutes}$$

By California culverts equation:

$$t_c = \left( \frac{11.9 \times 0.2^3}{50} \right)^{0.385} = 5.4 \text{ minutes}$$

Use 5 minutes for  $t_c$ .

to find  $t_p$ , use increment of  $D = 5$  mins (In other words, no points on the ascending portion of the unitgraphs will be given. Only the peak and descending portion will be obtained).

$$t_p = \frac{0.08}{2} + 0.6 \times 0.08 = 0.09$$

$$Q_p = \frac{484 \times 0.11}{0.09} = 580.8 \text{ say } 581 \text{ cfs}$$

← Drainage Area.

BY D.J.M. DATE 5-79

**LOUIS BERGER & ASSOCIATES INC.**

SHEET NO. A2 OF

CHKD. BY \_\_\_\_\_ DATE \_\_\_\_\_

PERONA LAKE DAMS 1 & 2

PROJECT C234

SUBJECT \_\_\_\_\_

Unit hydrograph :

<u>T</u> <u>hours</u>	<u>T/Tp</u>	<u>Dimensionless</u> <u>ordinate (D.O)</u>	<u>Q (cfs)</u> <u>(=Qp x D.O)</u>
0.083	0.922	0.980	569
0.167	1.856	0.390	227
0.250	2.778	0.100	58
0.333	3.700	0.028	16
0.417	4.633	0.008	5

Precipitation : (see depth-duration curve on page A5)

<u>Time</u> <u>(mins)</u>	<u>Precipitation</u> <u>(inches)</u>	<u>Δ</u> <u>(inches)</u>	<u>Rearrange Δ</u> <u>(inches)</u>
5	0.80	0.80	0.02
10	1.28	0.48	0.02
15	1.70	0.42	0.02
20	1.94	0.24	0.02
25	2.17	0.23	0.02
30	2.40	0.23	0.02
35	2.54	0.14	0.02
40	2.67	0.13	0.02
45	2.80	0.13	0.02
50	2.90	0.10	0.02
55	3.00	0.10	0.02
60	3.10	0.10	0.02
65	3.20	0.10	0.03
70	3.30	0.10	0.02
75	3.40	0.10	0.03
80	3.50	0.10	0.03
85	3.60	0.10	0.03
90	3.70	0.10	0.03
95	3.76	0.06	0.03
100	3.81	0.05	0.03

BY D. J. M. DATE 5-79

LOUIS BERGER &amp; ASSOCIATES INC.

SHEET NO. A3 OF

CHKD. BY \_\_\_\_\_ DATE \_\_\_\_\_

PERONA LAKE DAMS 1 &amp; 2

PROJECT C234

SUBJECT \_\_\_\_\_

<u>Time</u> <u>(mins)</u>	<u>Precipitation</u> <u>(inches)</u>	<u>Δ</u> <u>(inches)</u>	<u>Rearrange Δ</u> <u>(inches)</u>
105	3.86	0.05	0.03
110	3.91	0.05	0.04
115	3.96	0.05	0.04
120	4.00	0.04	0.04
125	4.04	0.04	0.05
130	4.08	0.04	0.05
135	4.12	0.04	0.10
140	4.16	0.04	0.10
145	4.19	0.03	0.10
150	4.22	0.03	0.10
155	4.25	0.03	0.10
160	4.28	0.03	0.13
165	4.31	0.03	0.23
170	4.34	0.03	0.24
175	4.37	0.03	0.48
180	4.40	0.03	0.80
185	4.43	0.03	0.42
190	4.46	0.03	0.23
195	4.49	0.03	0.14
200	4.52	0.03	0.13
205	4.55	0.03	0.10
210	4.58	0.03	0.10
215	4.60	0.02	0.10
220	4.62	0.02	0.10
225	4.64	0.02	0.06
230	4.67	0.03	0.05
235	4.69	0.02	0.05
240	4.71	0.02	0.04
245	4.74	0.03	0.04
250	4.76	0.02	0.03
255	4.78	0.02	0.03
260	4.80	0.02	0.03

BY D. J. M. DATE 5-79

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. A4 OF

CHKD. BY \_\_\_\_\_ DATE \_\_\_\_\_

PERONA LAKE DAMS 1 & 2

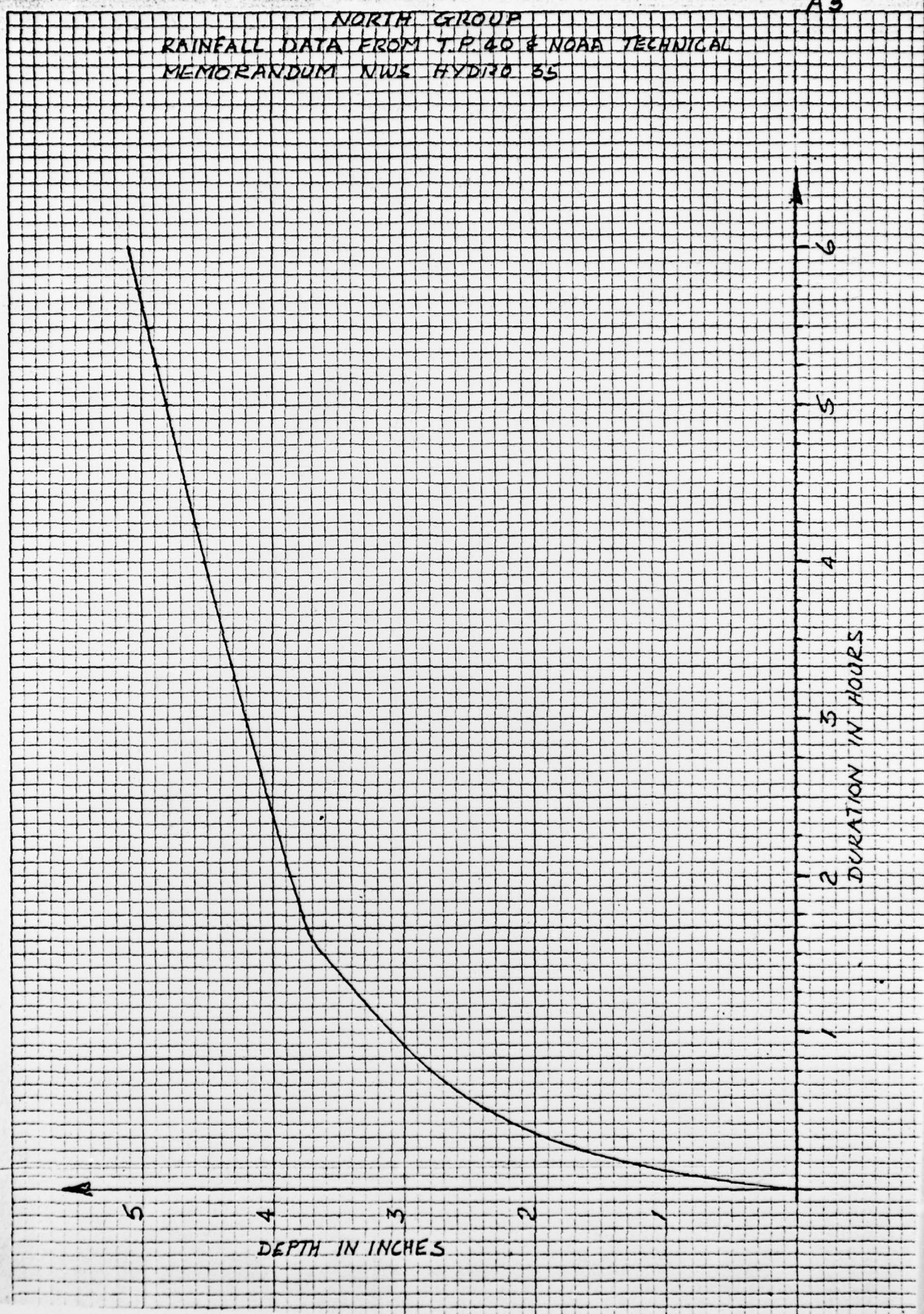
PROJECT C234

SUBJECT \_\_\_\_\_

<u>Time</u> <u>(mins)</u>	<u>Precipitation</u> <u>(inches)</u>	<u><math>\Delta</math></u> <u>(inches)</u>	<u>Rearrange <math>\Delta</math></u> <u>(inches)</u>
265	4.82	0.02	0.03
270	4.84	0.02	0.03
275	4.86	0.02	0.03
280	4.88	0.02	0.03
285	4.90	0.02	0.02
290	4.92	0.02	0.02
295	4.94	0.02	0.02
300	4.96	0.02	0.03
305	4.98	0.02	0.02
310	5.00	0.02	0.02
315	5.02	0.02	0.02
320	5.04	0.02	0.02
325	5.06	0.02	0.02
330	5.08	0.02	0.02
335	5.10	0.02	0.02
340	5.12	0.02	0.02
345	5.14	0.02	0.02
350	5.16	0.02	0.02
355	5.18	0.02	0.02
360	5.20	0.02	0.02

A5

NORTH GROUP  
RAINFALL DATA FROM T.P. 40 & NOAA TECHNICAL  
MEMORANDUM NWS HYDRO 35



46 0706

K&E 10 X 10 TO THE INCH • 7 X 10 INCHES  
KEUFFEL & ESSER CO. MADE IN U.S.A.

BY D.J.M. DATE 5-79

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. A6 OF

CHKD. BY DATE

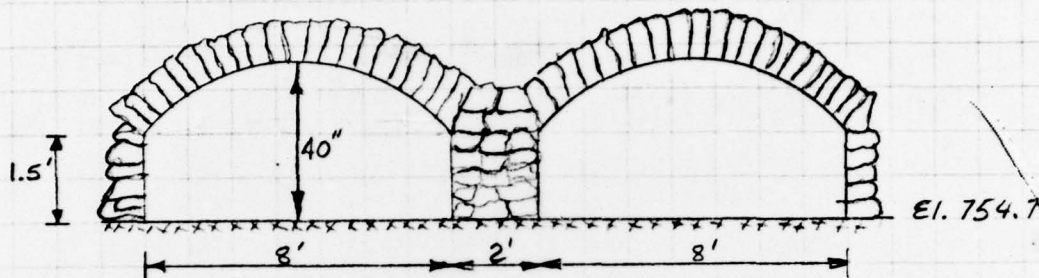
PERONA LAKE DAM #1

PROJECT C.234

SUBJECT

Spillway discharge calculations:

2 masonry arch spillways



Flow through arches

Weir flow  $L = 16'$

Conduit flow

$$C = 0.5 a \sqrt{2g} r^2$$

Elev	H	C	Q	H	Q
754.7	0	3.0			
755.7	1	3.0	48		
756.2	1.5	3.0	88		
757.2	2.5	2.9	183		
758.2				3.5	330
759.2				4.5	374

For flow over dams:

Perona # 2 dam is 915' long - crest El. = 757.2  $C = 2.7$

Perona # 1 dam has 2' wall on top except for 35' breach  
 in wall  $\therefore$  length = 35' @ El. 757.2  $C = 2.9$   
 length = 705' @ El. 759.2  $C = 2.9$

BY D. J. M. DATE 5-79  
 CHKD. BY \_\_\_\_\_ DATE \_\_\_\_\_  
 SUBJECT \_\_\_\_\_

LOUIS BERGER & ASSOCIATES INC.  
 PERONA LAKE DAMS

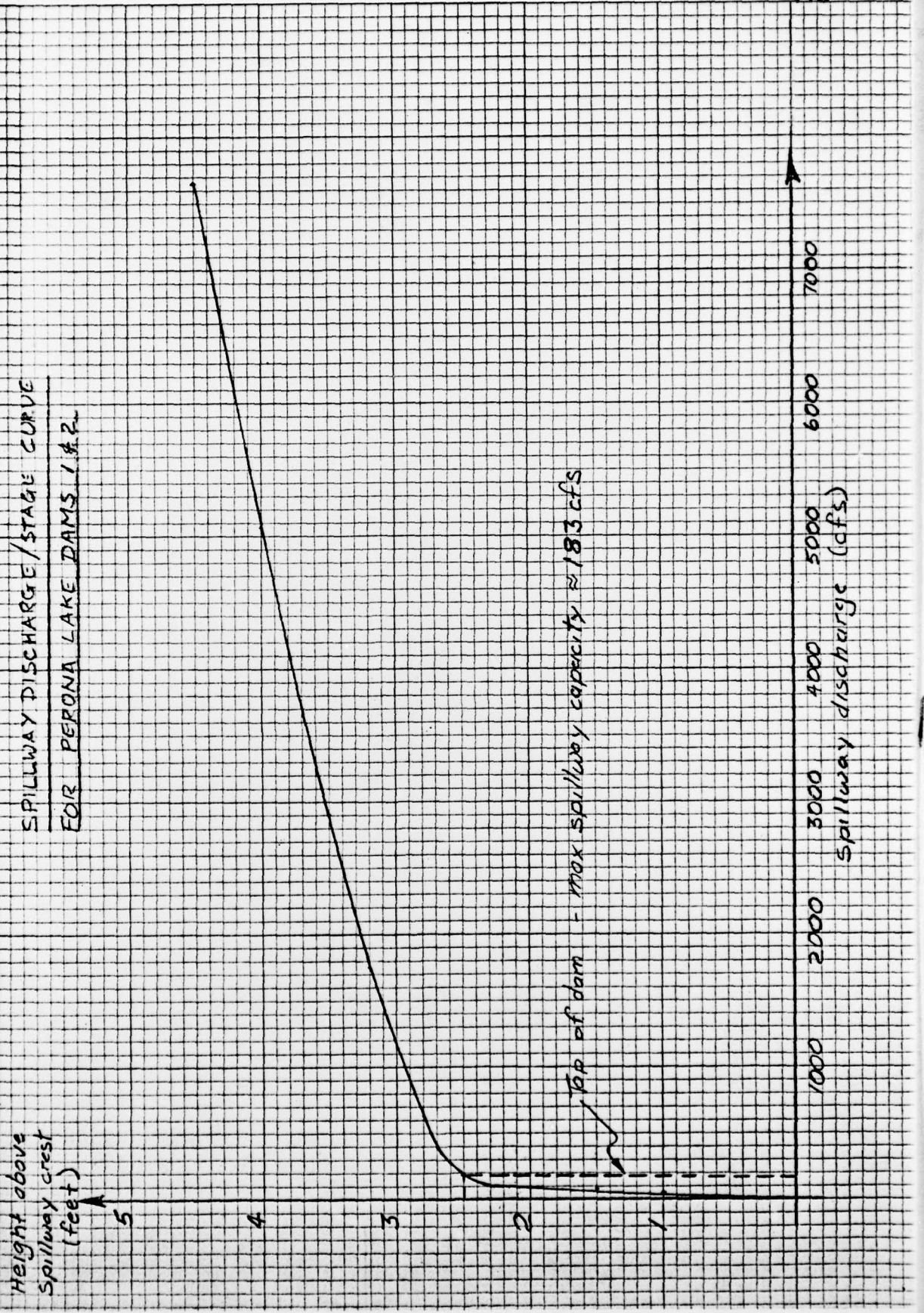
SHEET NO. A7 OF \_\_\_\_\_  
 PROJECT C234

flow over Perona # 1 L = 35'				flow over Perona # 2 L = 915'		
Elev.	H	C	Q	H	C	Q
757.2	0	2.9	0	0		
758.2	1	2.9	102	1	2.7	2471
759.2	2	2.9	287	2	2.7	6988

Elev.	H	Q
754.7	0	0
755.7	1	48
756.2	1.5	88
757.2	2.5	183
758.2	3.5	2903
759.2	4.5	7649

Both Perona dams lie on the same lake, therefore both are considered in this hydraulic/hydrologic appendix. Perona dam #2 has no spillway therefore only dam overtopping is considered for this dam in the overall hydraulics

SPILLWAY DISCHARGE / STAGE CURVE  
FOR PERONA LAKE DAMS I & 2

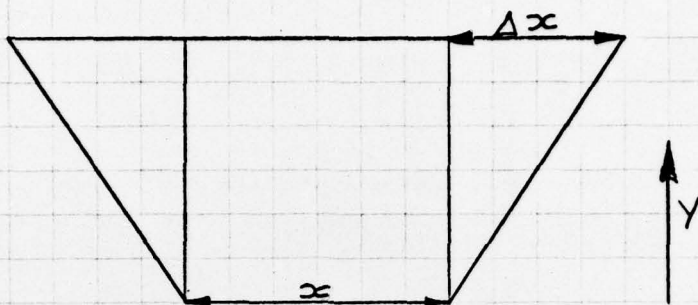


BY D J M DATE 5-79  
 CHKD. BY \_\_\_\_\_ DATE \_\_\_\_\_  
 SUBJECT \_\_\_\_\_

LOUIS BERGER & ASSOCIATES INC.

PERONA LAKE DAMS

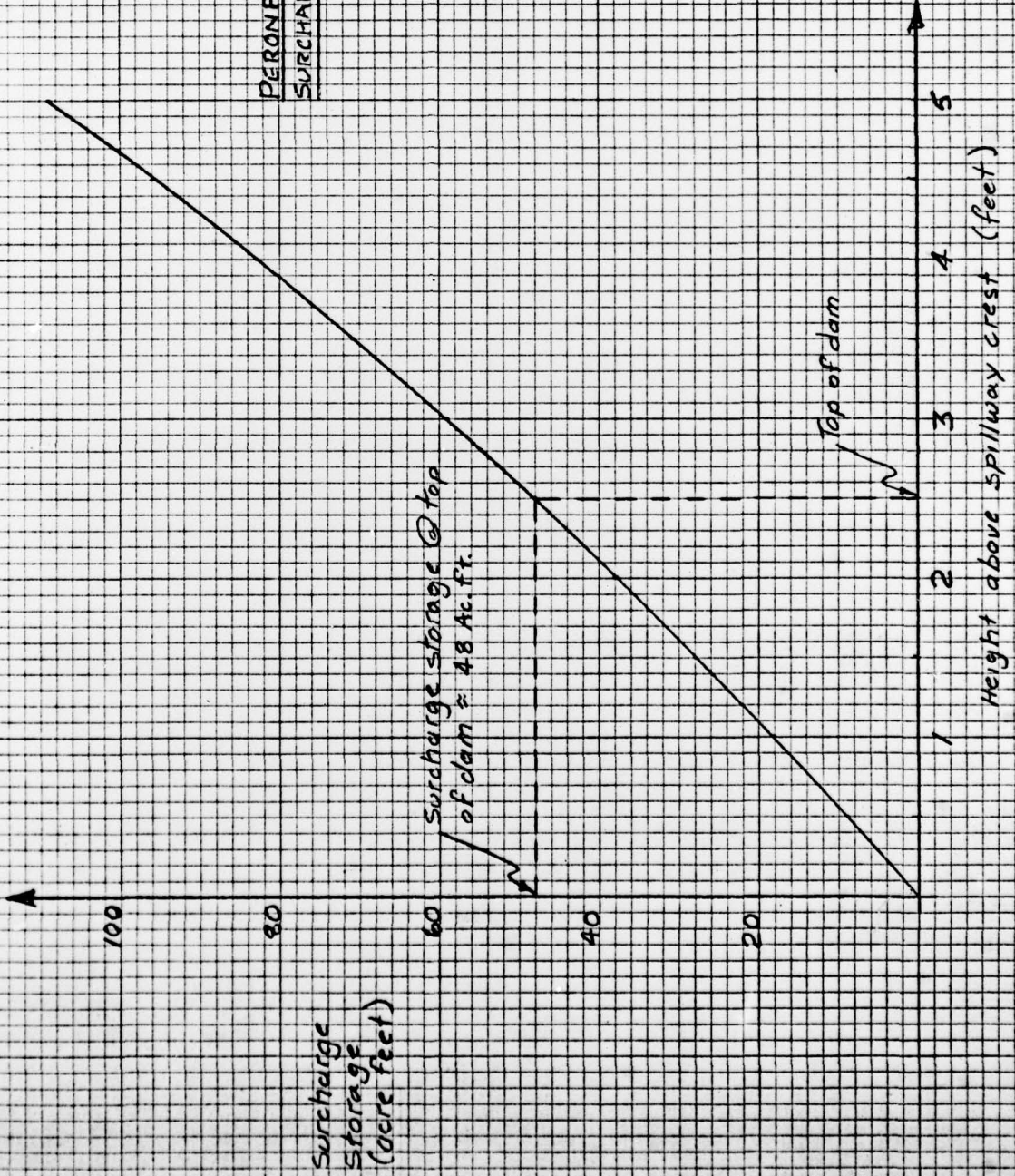
SHEET NO. A9 OF \_\_\_\_\_  
 PROJECT C 234



Increment in volume  $\Delta V = y(x + \Delta x)$

Elev. (M.S.L)	Height above spillway crest	surcharge storage (acre feet)
754.7	0	0
755.2	0.5	9
755.7	1.0	18
756.2	1.5	28
756.7	2.0	38
757.2	2.5	48
757.7	3.0	59
758.2	3.5	71
758.7	4.0	83
759.2	4.5	96
759.7	5.0	109

PERONA LAKE DAMS 1 & 2  
SURCHARGE STORAGE/STAGGS CURVE



BY D. J. M. DATE 5-79

CHKD. BY \_\_\_\_\_ DATE \_\_\_\_\_

SUBJECT \_\_\_\_\_

LOUIS BERGER & ASSOCIATES INC.

PERONA LAKE DAM # 2

SHEET NO. A11 OF

PROJECT C234

GENERAL SUMMARY:

Length of dam = 915'  
No spillway

Spillway capacity at top of dam El. 757.2 = 0

Surcharge storage @ top of dam = 48 Ac. ft.  
storage @ normal pool = 101 Ac. ft.

∴ Maximum storage @ top of dam = 149 Ac. ft.

Lake area @ normal pool El. 754.7 = 17 Ac.  
Lake area @ top of dam El. 757.2 = 22 Ac.

BY D. J. M. DATE 5-79

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. A12 OF

CHKD. BY DATE

PERONA LAKE DAMS

PROJECT C234

SUBJECT Approximate drawdown time for Perona Lake

Volume of lake @ El. 754.7  $\approx$  101 acre feet

Exit invert of pipe El. = 740.5 12" pipe  
take head from top of pipe (El. 741.5)

Drawdown in three stages assuming vertical sides to lake

i)  $H = 11$   $Q = 7$  cfs

$$\text{time} = \frac{101 \times 43560}{3 \times 7 \times 3600} = 58 \text{ hours}$$

ii)  $H = 6.6$   $Q = 5.3$

$$\text{time} = \frac{101 \times 43560}{3 \times 5.3 \times 3600} = 76.7 \text{ hours}$$

iii)  $H = 2.2$   $Q = 3$  cfs

$$\text{time} = \frac{101 \times 43560}{3 \times 3 \times 3600} = 132.8 \text{ hours}$$

$$\Sigma \text{time} = (132.8 + 76.7 + 58) \text{ hours} \text{ say } 11 \text{ days}$$

Q computed using the following formula for pipe flow:-

$$Q = \sqrt{\frac{100 H_T}{\left( \frac{2.5204(1+K_e)}{D^4} + \frac{466.18 n^2 L}{D^{16/3}} \right)}}$$

where:  $n = 0.024$   $L = 73'$   
 $K_e = 0.5$   $H_T = \text{head}$   
 $D = \text{diameter of pipe}$

Assumes no inflow and no tailwater

BY D.J.M. DATE 6-79  
 CHKD. BY \_\_\_\_\_ DATE \_\_\_\_\_  
 SUBJECT \_\_\_\_\_

**LOUIS BERGER & ASSOCIATES INC.**  
PERONA LAKE DAMS 1&2

SHEET NO. A13 OF  
 PROJECT C234

SCALE 1" = 10' HORIZ

450

PERONA LAKE DAMS 1&2 INSPECTION C234  
 BY D.J.MULLIGAN  
 JUNE 4 1979

JOB SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
150	0	5	0	0	0	0	0	0	0
		JOPER		NWT					
		3		0					

SUR-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH FOR 100-YEAR FREQUENCY EVENT

ISTAD	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
1	0	0	0	0	0	1

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
0	-1	0.11	0.0	0.11	0.0	0.0	0	0	0

PRECIP DATA

NP	STORM	DAJ	DAK
72	0.0	0.0	0.0

PRECIP PATTERN

0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
0.02	0.02	0.03	0.02	0.03	0.03	0.03	0.03	0.03	0.03
0.03	0.04	0.04	0.04	0.05	0.05	0.10	0.10	0.10	0.10
0.10	0.13	0.23	0.24	0.48	0.80	0.42	0.23	0.14	0.13
0.10	0.10	0.10	0.10	0.06	0.05	0.05	0.04	0.04	0.03
0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.03
0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
0.02	0.02								

LOSS DATA

STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0.0	0.0	1.00	0.0	0.0	1.00	0.25	0.10	0.0	0.0

GIVEN UNIT GRAPH, NUHQ= 5

569.      227.      58.      16.      5.  
 UNIT GRAPH TOTALS      875. CFS OR 1.03 INCHES OVER THE AREA

RECESSION DATA

STRTO= 0.0      GRCSN= 0.0      RTIOR= 1.00

END-OF-PERIOD FLOW

TIME	RAIN	EXCS	COMP Q
1	0.02	0.00	0.
2	0.02	0.00	0.
3	0.02	0.00	0.
4	0.02	0.00	0.
5	0.02	0.00	0.

Approved by U.S.A.

BY DJM DATE 6-79

CHKD. BY \_\_\_\_\_ DATE \_\_\_\_\_

SUBJECT \_\_\_\_\_

# LOUIS BERGER & ASSOCIATES INC.

## PERONA LAKE DAMS 1 & 2

SHEET NO. A14 OF \_\_\_\_\_

PROJECT C-234

SCALE 4:1

450

201 Printed in U.S.A.

6	0.02	0.00	0.
7	0.02	0.00	0.
8	0.02	0.00	0.
9	0.02	0.00	0.
10	0.02	0.00	0.
11	0.02	0.00	0.
12	0.02	0.00	0.
13	0.03	0.01	8.
14	0.02	0.01	10.
15	0.03	0.02	16.
16	0.03	0.02	18.
17	0.03	0.02	19.
18	0.03	0.02	19.
19	0.03	0.02	19.
20	0.03	0.02	19.
21	0.03	0.02	19.
22	0.04	0.03	25.
23	0.04	0.03	27.
24	0.04	0.03	27.
25	0.05	0.04	33.
26	0.05	0.04	36.
27	0.10	0.09	65.
28	0.10	0.09	76.
29	0.10	0.09	79.
30	0.10	0.09	80.
31	0.10	0.09	80.
32	0.13	0.12	97.
33	0.23	0.22	161.
34	0.24	0.23	191.
35	0.48	0.47	336.
36	0.80	0.79	575.
37	0.42	0.41	446.
38	0.23	0.22	274.
39	0.14	0.13	164.
40	0.13	0.12	123.
41	0.10	0.09	93.
42	0.10	0.09	83.
43	0.10	0.09	81.
44	0.10	0.09	80.
45	0.06	0.05	57.
46	0.05	0.04	43.
47	0.05	0.04	38.
48	0.04	0.03	31.
49	0.04	0.03	29.
50	0.03	0.02	22.
51	0.03	0.02	20.
52	0.03	0.02	19.
53	0.03	0.02	19.
54	0.03	0.02	19.
55	0.03	0.02	19.
56	0.03	0.02	19.
57	0.02	0.01	13.
58	0.02	0.01	11.
59	0.02	0.01	10.
60	0.03	0.02	16.
61	0.02	0.01	12.
62	0.02	0.01	11.
63	0.02	0.01	10.
64	0.02	0.01	10.
65	0.02	0.01	10.
66	0.02	0.01	10.

67	0.02	0.01	10.
68	0.02	0.01	10.
69	0.02	0.01	10.
70	0.02	0.01	10.
71	0.02	0.01	10.
72	0.02	0.01	10.
73	0.0	0.0	4.
74	0.0	0.0	1.
75	0.0	0.0	0.
76	0.0	0.0	0.
77	0.0	0.0	0.
78	0.0	0.0	0.
79	0.0	0.0	0.
80	0.0	0.0	0.
81	0.0	0.0	0.
82	0.0	0.0	0.
83	0.0	0.0	0.
84	0.0	0.0	0.
85	0.0	0.0	0.
86	0.0	0.0	0.
87	0.0	0.0	0.
88	0.0	0.0	0.
89	0.0	0.0	0.
90	0.0	0.0	0.
91	0.0	0.0	0.
92	0.0	0.0	0.
93	0.0	0.0	0.
94	0.0	0.0	0.
95	0.0	0.0	0.
96	0.0	0.0	0.
97	0.0	0.0	0.
98	0.0	0.0	0.
99	0.0	0.0	0.
100	0.0	0.0	0.
101	0.0	0.0	0.
102	0.0	0.0	0.
103	0.0	0.0	0.
104	0.0	0.0	0.
105	0.0	0.0	0.
106	0.0	0.0	0.
107	0.0	0.0	0.
108	0.0	0.0	0.
109	0.0	0.0	0.
110	0.0	0.0	0.
111	0.0	0.0	0.
112	0.0	0.0	0.
113	0.0	0.0	0.
114	0.0	0.0	0.
115	0.0	0.0	0.
116	0.0	0.0	0.
117	0.0	0.0	0.
118	0.0	0.0	0.
119	0.0	0.0	0.
120	0.0	0.0	0.
121	0.0	0.0	0.
122	0.0	0.0	0.
123	0.0	0.0	0.
124	0.0	0.0	0.
125	0.0	0.0	0.
126	0.0	0.0	0.
127	0.0	0.0	0.

BY D.J.M. DATE 6-79  
 CHKD. BY \_\_\_\_\_ DATE \_\_\_\_\_  
 SUBJECT \_\_\_\_\_

**LOUIS BERGER & ASSOCIATES INC.**  
PERONA LAKE DAMS #2

SHEET NO. A-15 OF  
 PROJECT C-234

SOURCE 4 X 4 TO THE INCH

128	0.0	0.0	0.0
129	0.0	0.0	0.0
130	0.0	0.0	0.0
131	0.0	0.0	0.0
132	0.0	0.0	0.0
133	0.0	0.0	0.0
134	0.0	0.0	0.0
135	0.0	0.0	0.0
136	0.0	0.0	0.0
137	0.0	0.0	0.0
138	0.0	0.0	0.0
139	0.0	0.0	0.0
140	0.0	0.0	0.0
141	0.0	0.0	0.0
142	0.0	0.0	0.0
143	0.0	0.0	0.0
144	0.0	0.0	0.0
145	0.0	0.0	0.0
146	0.0	0.0	0.0
147	0.0	0.0	0.0
148	0.0	0.0	0.0
149	0.0	0.0	0.0
150	0.0	0.0	0.0
SUM	5.20	4.35	3892.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	575.	54.	26.	26.	3896.
INCHES		4.58	4.58	4.58	4.58
AC-FT		27.	27.	27.	27.

\*\*\*\*\*  
 HYDROGRAPH ROUTING

ROUTING THROUGH RESERVOIR

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
11	1	0	0	0	0	1

ROUTING DATA

GLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.0	0.0	1	0

NSTPS	NSTD	LAG	AMSKK	X	TSK	STORA
1	0	0	0.0	0.0	0.0	0.

STORAGE=	0.	18.	28.	38.	48.	59.	71.	96.
OUTFLOW=	0.	48.	88.	131.	183.	1180.	2903.	7649.

TIME	EOP	STOR	AVG IN	EOP OUT
1	0.	0.	0.	0.
2	0.	0.	0.	0.
3	0.	0.	0.	0.
4	0.	0.	0.	0.
5	0.	0.	0.	0.
6	0.	0.	0.	0.
7	0.	0.	0.	0.
8	0.	0.	0.	0.
9	0.	0.	0.	0.
10	0.	0.	0.	0.

Printed in U.S.A.

BY D.J.M. DATE 6-79  
 CHKD. BY \_\_\_\_\_ DATE \_\_\_\_\_  
 SUBJECT \_\_\_\_\_

**LOUIS BERGER & ASSOCIATES INC.**  
**PERONA LAKE DAMS 1 & 2**

SHEET NO. A-16 OF  
 PROJECT C-234

SCALE 1" = 40'

450

11	0.	0.	0.	72	14.	10.	38.
12	0.	0.	0.	73	14.	7.	37.
13	0.	4.	0.	74	14.	2.	37.
14	0.	9.	0.	75	14.	1.	36.
15	0.	13.	0.	76	13.	0.	35.
16	0.	17.	1.	77	13.	0.	35.
17	0.	18.	1.	78	13.	0.	34.
18	1.	19.	1.	79	13.	0.	34.
19	1.	19.	2.	80	12.	0.	33.
20	1.	19.	2.	81	12.	0.	32.
21	1.	19.	2.	82	12.	0.	32.
22	1.	22.	3.	83	12.	0.	31.
23	1.	26.	3.	84	11.	0.	31.
24	1.	27.	4.	85	11.	0.	30.
25	2.	30.	4.	86	11.	0.	30.
26	2.	35.	5.	87	11.	0.	29.
27	2.	50.	5.	88	11.	0.	28.
28	2.	70.	7.	89	10.	0.	28.
29	3.	78.	8.	90	10.	0.	27.
30	3.	80.	9.	91	10.	0.	27.
31	4.	80.	11.	92	10.	0.	26.
32	4.	89.	12.	93	10.	0.	26.
33	5.	129.	14.	94	10.	0.	25.
34	6.	176.	17.	95	9.	0.	25.
35	8.	264.	22.	96	9.	0.	25.
36	11.	456.	29.	97	9.	0.	24.
37	14.	511.	38.	98	9.	0.	24.
38	17.	360.	44.	99	9.	0.	23.
39	18.	219.	47.	100	9.	0.	23.
40	18.	143.	49.	101	8.	0.	22.
41	19.	108.	51.	102	8.	0.	22.
42	19.	88.	52.	103	8.	0.	22.
43	19.	82.	53.	104	8.	0.	21.
44	19.	81.	54.	105	8.	0.	21.
45	20.	69.	54.	106	8.	0.	20.
46	19.	50.	54.	107	8.	0.	20.
47	19.	40.	54.	108	7.	0.	20.
48	19.	35.	53.	109	7.	0.	19.
49	19.	30.	52.	110	7.	0.	19.
50	19.	25.	52.	111	7.	0.	19.
51	19.	21.	51.	112	7.	0.	18.
52	18.	19.	50.	113	7.	0.	18.
53	18.	19.	49.	114	7.	0.	18.
54	18.	19.	48.	115	6.	0.	17.
55	18.	19.	48.	116	6.	0.	17.
56	18.	19.	47.	117	6.	0.	17.
57	17.	16.	47.	118	6.	0.	16.
58	17.	12.	46.	119	6.	0.	16.
59	17.	11.	45.	120	6.	0.	16.
60	17.	13.	45.	121	6.	0.	16.
61	17.	14.	44.	122	6.	0.	15.
62	16.	12.	44.	123	6.	0.	15.
63	16.	11.	43.	124	6.	0.	15.
64	16.	10.	42.	125	5.	0.	14.
65	16.	10.	42.	126	5.	0.	14.
66	15.	10.	41.	127	5.	0.	14.
67	15.	10.	41.	128	5.	0.	14.
68	15.	10.	40.	129	5.	0.	13.
69	15.	10.	40.	130	5.	0.	13.
70	15.	10.	39.	131	5.	0.	13.
71	14.	10.	39.	132	5.	0.	13.

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BY D. J. M DATE 6-79  
 CHKD. BY \_\_\_\_\_ DATE \_\_\_\_\_  
 SUBJECT \_\_\_\_\_

LOUIS BERGER & ASSOCIATES INC.  
 PERONA LAKE DAMS 1 & 2

SHEET NO. A-17 OF  
 PROJECT C-234

133	5.	0.	12.	
134	5.	0.	12.	
135	5.	0.	12.	
136	4.	0.	12.	
137	4.	0.	12.	
138	4.	0.	11.	
139	4.	0.	11.	
140	4.	0.	11.	
141	4.	0.	11.	
142	4.	0.	11.	
143	4.	0.	10.	
144	4.	0.	10.	
145	4.	0.	10.	
146	4.	0.	10.	
147	4.	0.	10.	
148	4.	0.	9.	
149	3.	0.	9.	
150	3.	0.	9.	
SUM			3404.	
PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	54.	37.	23.	3404.
INCHES	3.15	4.00	4.00	4.00
AC-FT	18.	23.	23.	23.

RUNOFF SUMMARY, AVERAGE FLOW						
	PEAK	6-HOUR	24-HOUR	72-HOUR	AREA	
HYDROGRAPH AT	1	54.	37.	26.	26.	0.11
ROUTED TO.	11	54.	37.	23.	23.	0.11