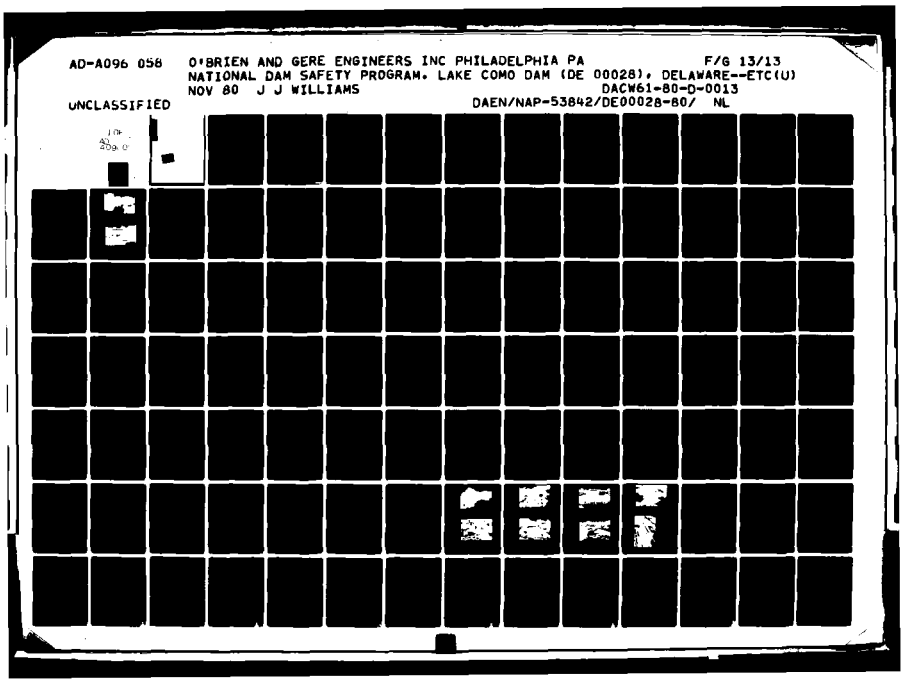
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O'BRIEN AND GERE ENGINEERS INC PHILADELPHIA PA F/G 13/13
NATIONAL DAM SAFETY PROGRAM. LAKE COMO DAM (DE 00028), DELAWARE--ETC(U)
NOV 80 J J WILLIAMS DACW61-80-D-0013
UNCLASSIFIED DAEN/NAP-53842/DE00028-80/ NL


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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: DAEN/NAP-53842/DE00028-80/11	2. GOVT ACCESSION NO. AD-A094 [illegible]
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7. AUTHOR(s): JOHN J. WILLIAMS, P.E.	8. CONTRACT OR GRANT NUMBER(s): DACW61-80-D-0013
9. PERFORMING ORGANIZATION NAME AND ADDRESS: O'Brien & Gere Engineers, Inc. Suite 1760 1617 J.F. Kennedy Blvd. Philadelphia, PA 19103	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: Nov 1980
	13. NUMBER OF PAGES: 65
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	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

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)

Dams	National Dam Safety Program
Embankments	Lake Como Dam, DE
Visual Inspection	Spillways
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.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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

IN REPLY REFER TO

NAPEN-N

LEVEL II

17 FEB 1981

Honorable Pierre S. DuPont
Governor of Delaware
Dover, Delaware 19901

Dear Governor DuPont:

Inclosed is the Phase I Inspection Report for Lake Como Dam in Kent County, Delaware 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, Lake Como Dam, a significant hazard potential structure, is judged to be in poor overall condition. Also, the spillway is considered inadequate since nine percent of the Spillway Design Flood (SDF) would cause the dam to be overtopped. (The SDF, in this instance, is one-half of the Probable Maximum Flood.) The dam's stability is considered questionable by personnel (Consulting Engineer's Staff, State and Federal Engineers) who inspected this structure. To ensure adequacy of the structure, the following actions, as a minimum are recommended:

a. Within thirty days from the date of approval of this report, the following remedial actions should be initiated:

(1) Ownership of and maintenance responsibility for the dam should be clarified.

(2) A registered professional engineer experienced in the design and construction of dams should be engaged by the owner to:

(a) Perform more detailed hydrologic and hydraulic analysis to determine what measures are required to provide adequate spillway discharge capacity and/or to protect the embankment from overtopping.

(b) Design and supervise construction of repairs to the existing embankment section.

(c) Design and supervise the construction of erosin protection for the upstream and downstream slopes of the dam and outlet channel.

(d) Provide guidance to the owner for removal of the trees and utility poles from the embankment and the backfilling of voids with suitable, thoroughly compacted material.

(e) Provide guidance to the owner for removal of the water and gas lines from the dam and their relocation.

b. The owner should maintain the reservoir elevation 3 feet below the spillway crest until permanent repairs are completed.

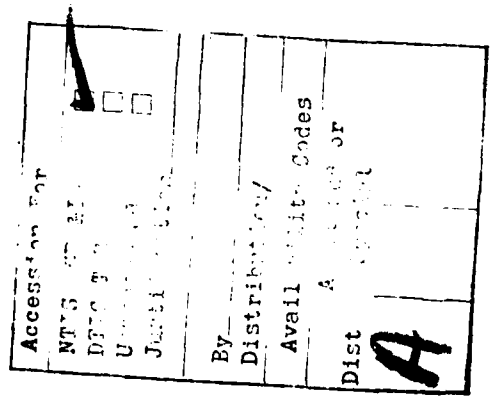
c. Continuous monitoring of reservoir levels during periods of heavy precipitation should be undertaken until permanent repairs are completed.

d. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the reconstructed facilities, within one year from the date of their completion.

e. An emergency action plan should be developed which outlines actions to be taken by the Owner to minimize the downstream effects of an emergency at the dam within six months from the date of approvel of this report.

A copy of the report is being furnished to Mr. John E. Wilson III, Delaware Department of Natural Resources and Environmental Control, 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 Thomas B. Evans. Under the provisions of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, thirty 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-N
Honorable Pierre S. Dupont

An important aspect of the Dam Inspection 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:
Mr. John E. Wilson III, Acting Secretary
Department of Natural Resources and
Environmental Control
Edward Tatnall Bldg.
Dover, DE 19901

Mr. Melvin H. Koster, Acting Director
Division of Soil & Water Conservation
Department of Natural Resources and
Environmental Control
Dover, DE 19901

Rept. no. DAEN/NAP-53842/DE00028-80/11

LAKE COMO DAM (DE00028)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 12 August 1980 by Corps and State personnel and by O'Brien and Gere Engineers, Inc., under contract to the U.S. Army Engineer Distict, Philadelphia, in accordance with the National Dam Inspection Act, Public Law 92-367.

The inspection of Lake Como Dam was requested by the State of Delaware in response to its overtopping on 29 July 1980. As a result of this inspection, Lake Como Dam, is judged to be in an UNSAFE, non-emergency condition until corrective measures are completed. This condition, erosion and partial failure of the downstream half of the embankment and the east outlet channel slope, if left uncorrected, could result in complete failure of the dam and further property damage. Until further study could determine the full extent of the problem and possible permanent corrective actions, immediate remedial recommendations were made to preclude further property damage. The Governor and his representative and the Delaware Division of Highways were notified of this condition and the recommended immediate remedial actions by telegram on 19 August 1980. (Also, a teletype report was submitted to the U.S. Army Engineer Division, North Atlantic, on 29 July 1980.) The representative of the town of Smyrna indicated that the lake will be maintained in a drawn down condition until corrective measures are completed.

Lake Como Dam, a significant hazard potential structure, is judged to be in poor overall condition. Also, the spillway is considered inadequate since nine percent of the Spillway Design Flood (SDF) would cause the dam to be overtopped. (The SDF, in this instance, is one-half of the Probable Maximum Flood.) The dam's stability is considered questionable by personnel (Consulting Engineer's Staff, State and Federal Engineers) who inspected this structure. To ensure adequacy of the structure, the following actions, as a minimum are recommended:

a. Within thirty days from the date of approval of this report, the following remedial actions should be initiated:

(1) Ownership of and maintenance responsibility for the dam should be clarified.

(2) A registered professional engineer experienced in the design and construction of dams should be engaged by the owner to:

(a) Perform more detailed hydrologic and hydraulic analysis to determine what measures are required to provide adequate spillway discharge capacity and/or to protect the embankment from overtopping.

(b) Design and supervise construction of repairs to the existing embankment section.

(c) Design and supervise the construction of erosin protection for the upstream and downstream slopes of the dam and outlet channel.

(d) Provide guidance to the owner for removal of the trees and utility poles from the embankment and the backfilling of voids with suitable, thoroughly compacted material.

(e) Provide guidance to the owner for removal of the water and gas lines from the dam and their relocation.

b. The owner should maintain the reservoir elevation 3 feet below the spillway crest until permanent repairs are completed.

c. Continuous monitoring of reservoir levels during periods of heavy precipitation should be undertaken until permanent repairs are completed.

d. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the reconstructed facilities, within one year from the date of their completion.

e. An emergency action plan should be developed which outlines actions to be taken by the Owner to minimize the downstream effects of an emergency at the dam within six months from the date of approvel of this report.

APPROVED: James G. Ton

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 17 Feb 1981

UNSAFE DAM
NATIONAL PROGRAM OF INSPECTION OF DAMS

a. NAME: Lake Como Dam

b. ID NO.: DE00028

c. LOCATION State: Delaware. County: Kent.
River or Stream: Mill Creek.
Nearest D/S City or Town: Smyrna.

d. HEIGHT: 12 feet

e. MAXIMUM IMPOUNDMENT CAPACITY: 312 ac. ft.

f. TYPE: Roadway Embankment.

g. OWNER: Unknown, Town of Smyrna and Delaware Division of Highways appear to have joint ownership.

h. DATE GOVERNOR NOTIFIED OF UNSAFE CONDITIONS: 19 Aug 80.

i. CONDITION OF DAM RESULTING IN UNSAFE ASSESSMENT: Dam was overtopped and suffered severe erosion of downstream embankment and outlet channel.

l. URGENCY CATEGORY: UNSAFE, Non-Emergency, Significant Hazard.

m. EMERGENCY ACTIONS TAKEN:
Embankment was sandbagged by local volunteers to prevent further erosion.

j. DESCRIPTION OF DANGER INVOLVED: Significant Hazard potential. Overtopping and failure of the dam poses significant hazard potential to loss of life and property downstream of dam at Route 13 Highway Bridge, small private luncheonette and sewage pumping plant.

n. REMEDIAL ACTIONS TAKEN:
Lake was drawn down until remedial measures are completed.

o. REMARKS: Delaware Highway Department is undertaking repair to the structure to reopen Main Street.

k. RECOMMENDATIONS GIVEN TO GOVERNOR:
Within 30 days of the date of the District Engineer's letter, the owner should do the following:
(1) Lower the lake level three feet.
(2) Engage the services of a qualified professional consultant to more accurately determine the spillway adequacy by using more detailed and sophisticated hydrologic and hydraulic analyses, and to recommend any remedial measures required to prevent overtopping of the dam.
(3) Develop a detailed emergency operation plan and downstream warning system. Provide around the clock surveillance during periods of unusually heavy precipitation.
(4) Monitor the dam and inspect for additional seepage or sloughing.
(5) Make soil borings and a topo-survey.
(6) Relocated gas and water lines from the embankment
(7) Design an adequate embankment section.

T.B. HEVERIN, Coordinator
Dam Inspection Program

DELAWARE RIVER BASIN

NAME OF DAM: LAKE COMO DAM
COUNTY AND STATE: KENT, DELAWARE
INVENTORY NUMBER: DE00028

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Prepared by:
O'BRIEN & GERE ENGINEERS, INC.

For

DEPARTMENT OF THE ARMY
Philadelphia District, Corps of Engineers
Custom House - 2nd & Chestnut Streets
Philadelphia, Pennsylvania 19106

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. 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 reasonable possible storm runoff), or fractions thereof. 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 REPORT

NATIONAL DAM INSPECTION PROGRAM

Name of Dam:	Lake Como Dam ID#/DE00028
State Located:	Delaware
County Located:	Kent
Stream:	Mill Creek
Coordinates:	Latitude 39^{o} 17.8', Longitude 75^{o} 36'
Date of Inspection:	August 12, 1980

ASSESSMENT

Based on visual observations made during the inspection (which followed overtopping and partial failure of the dam on July 29, 1980), information provided by the Town of Smyrna, and conversations with town officials, Lake Como Dam is considered to be in poor overall condition.

The dam is an earth embankment approximately 240 feet long with a maximum height of about 12 feet. The top width of the dam is about 60 feet and the upstream and downstream slopes are relatively steep. The spillway consists of five circular drop inlets, each with a diameter of 27 inches, which provide about 3 feet of freeboard between the spillway crest and the top of the dam.

The downstream half of the embankment eroded away by as much as five feet when the dam was overtopped on July 29, 1980. One section of the failure zone extends nearly through the embankment and has been backfilled with sandbags. A large section of the east outlet channel slope was also eroded away. A ruptured gas line and a water main were exposed in the erosion zone. Small trees were growing on the embankment and utility poles have been installed on the dam.

The selected Spillway Design Flood (SDF) for this "Small" size, "Significant" hazard dam is one-half of the Probable Maximum Flood (PMF). Examination of the results of the hydrologic and hydraulic analyses indicates that the spillway is capable of discharging approximately 8 percent of the SDF prior to overtopping of the embankment. Failure of the dam would cause appreciable property damage downstream. Therefore, the spillway is classified as "Inadequate", and the dam is classified as "Unsafe, non-emergency".

Recommendations and remedial measures which should be initiated immediately are as follows:

a. Facilities

1. Ownership and maintenance responsibility for the dam should be clarified.

A registered professional engineer experienced in the design and construction of dams should be engaged to:

1. Perform detailed hydrologic and hydraulic analyses to determine what measures are required to provide adequate spillway discharge capacity and/or to protect the embankment from overtopping.

2. Design and supervise construction of repairs to the existing embankment section.

3. Design and supervise the construction of erosion protection for the upstream and downstream slopes of the dam and outlet channel.

4. Provide guidance to the Owner for the removal of trees and utility poles from the embankment and backfilling of voids with suitable, thoroughly compacted material.

5. Provide guidance to the Owner for the removal of water and gas lines from the dam and their relocation.

b. Operation and Maintenance Procedures

1. The Owner should maintain the reservoir elevation 3 feet below the spillway crest until permanent repairs are completed.

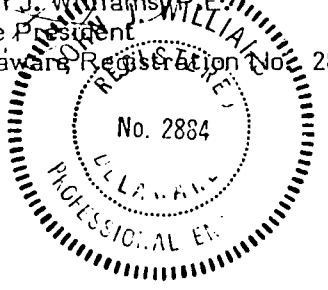
2. Continuous monitoring of reservoir levels during periods of heavy precipitation should be underaken until permanent repairs are completed.

3. The Owner should employ a professional engineer experienced in operation and maintanance of dams to develop written operating procedures and a periodic maintenance plan to insure the safety of the reconstructed facilities.

4. An emergency action plan should be developed which outlines actions to be taken by the Owner to minimize the downstream effects of an emergency.

John J. Williams

John J. Williams, P.E.
Vice President
Delaware Registration No. 2884



Date: 20 JAN. 1981

UPSTREAM OVERVIEW LOOKING TOWARDS LEFT ABUTMENT
(8/12/80)

DOWNSTREAM OVERVIEW SHOWING FAILURE ZONE AND SPILL-WAY OUTLET CONDUIT HEADWALL.
(8/12/80)

TABLE OF CONTENTS

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APPENDICES

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

LAKE COMO DAM

INVENTORY NUMBER - DE 00028

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 #DACW 61-80-D-0013 between O'Brien & Gere Engineers, Inc. and the United States Army Corps of Engineers, Philadelphia District.

b. Purpose of Inspection. The purpose of this inspection is to evaluate the structural and hydraulic condition of Lake Como Dam and appurtenant structures and to determine if the dam constitutes a hazard to human life or property.

1.2 Project Description (Based on information supplied by the Town of Smyrna, DE and supplemented by field observations.)

a. Description of Dam and Appurtenances. The following is a general description of the dam and appurtenances prior to its overtopping and partial failure on July 29, 1980. A detailed description of the structure after this event is given in Section 3, Visual Inspection. Lake Como Dam is an earth embankment approximately 240 feet long with a maximum height of about 12 feet. The top width of the embankment is about 60 feet and the upstream and downstream slopes are variable, ranging between 2H:1V and 1H:1V. A 30 feet wide asphalt concrete paved street is located along the entire embankment length.

The spillway consists of five 27-inch diameter concrete drop inlets provided with anti-vortex devices. Each drop inlet is connected to a 36-inch diameter reinforced concrete outlet pipe which terminates at a headwall at the downstream toe of the embankment. The outlet works consist of hand operated sluice gates situated upstream of two drop inlet structures. Access to the gate operators is across a timber bridge.

b. Location. Lake Como Dam is located on Mill Creek in the City of Smyrna, Delaware. The site is shown on USGS Quadrangle entitled "Smyrna, Del." at coordinates N39° 17.8', W75° 36'. A regional location map of Lake Como Dam is included as Figure 1 in Appendix E.

c. Size Classification. Lake Como Dam has a maximum height of 12 feet which places it in the "Small" size dam category since it is less than 40 feet high.

The maximum storage capacity of 312 acre-feet also places the structure within the "Small" size classification (less than 1,000 acre-feet). Lake Como Dam is therefore classified as a "Small" size dam.

d. Hazard Classification. A reinforced concrete bridge supporting U.S. Route 13 spans Mill Creek about 110 feet downstream of Lake Como Dam. Both the bridge deck and highway approach elevations are at or near the existing dam crest elevation. A restaurant is located adjacent to the right bank of Mill Creek between the dam and the highway bridge. The ground floor elevation of the restaurant is at the existing dam crest elevation. A sewage pumping station and treatment plant are located immediately downstream of the highway bridge within the potential floodplain. Since failure of the dam could result in appreciable property damage, Lake Como Dam is classified in the "Significant" hazard potential category.

e. Ownership. The owner of Lake Como Dam is unknown. According to Mr. Dean Phillips, Assistant Manager, Town of Smyrna, the Town has no record of ownership on file at their offices.

f. Purpose of Dam. The dam is used for recreation only.

g. Design and Construction History. Information is unavailable concerning the original design and construction of the dam. The only drawings made available for this report were those prepared by J.E. Haddaway Engineer dated March, 1941 which were prepared for reconstruction of the dam after its failure in 1940. The original date of construction is unknown.

l. Normal Operating Procedures. Records of operating procedures are unavailable for this site.

1.3 Pertinent Data

a. Drainage Area.

Square Miles	6.8

b. Discharge at Dam Site (cfs).

Spillway Capacity	184

c. Elevation (Feet above MSL).

Spillway Crest (Normal Pool)	14.6
Top of Dam (Maximum Pool)	17.6
Streambed at Downstream Toe of Dam	6.0

d. Reservoir Length (Feet).

Normal Pool	4,400
Maximum Pool	6,000

e. Storage (Acre-Feet).

Normal Pool	138
Maximum Pool	312

f. Reservoir Surface Area (Acres).

Normal Pool	46
Maximum Pool	71

g. Dam Data.

Type	Earth
Length	240 Feet
Height	12 Feet
Top Width	60 Feet
Side Slopes (Upstream and Downstream)	Variable, 1H:1V Steepest
Zoning	None
Impervious Core	None
Cutoff	None
Grout Curtain	None

h. Spillway.

Type	5 Circular Drop Inlets
Crest Diameter	27 Inches
Crest Elevation	14.6
Outlet Diameter	36 Inches
Outlet Invert Elevation	6.0
Gates	None
Upstream Channel	None
Downstream Channel	Trapezoidal concrete and brick-lined channel to R/C bridge to Mill Creek

i. Outlet Works.

Type	2-36 inch diameter concrete pipes
Length	90 Feet
Closure	36"x44" sluice gates
Access	Timber-decked bridge
Regulating Facility	Hand-operated rising stems

SECTION 2

ENGINEERING DATA

2.1 Design.

a. Data Available. Information available for review is limited to drawings entitled "DROP INLET SPILLWAY, LAKE COMO" sheets 1 and 2, dated March, 1941 by J.E. Haddaway Engineer. No design data is available for this structure.

b. Design Features. The principal design features for this structure are discussed in Section 1.2a.

2.2 Construction.

Information is unavailable relative to the original construction or reconstruction of Lake Como Dam in 1941.

2.3 Operation.

No operational data is available for this site.

2.4 Evaluation.

a. Availability. All information made available was provided by the Town of Smyrna.

b. Adequacy. The information made available by the Town of Smyrna, conversations with city officials and observations made during the field investigations provided adequate data for a Phase 1 evaluation.

c. Validity. The drawings prepared by J.E. Haddaway Engineer are not a valid representation of the present structure. Refer to Section 1.2a for a description of the dam and appurtenances.

SECTION 3

VISUAL INSPECTION

3.1 Findings.

a. General. The field inspection of Lake Como Dam took place on August 12, 1980. At the time of inspection, the reservoir water surface was approximately 15 inches below the spillway crest elevation. No underwater areas were inspected. The observations and comments of the field inspection team are in the checklist which is Appendix B of this report. The emabnkment had experienced overtopping and partial failure on July 29, 1980.

b. Dam. The overtopping which occured on July 29, 1980, resulted in erosion of about five feet of the downstream half of the embankment. Large sections of the 40-foot wide concrete and asphalt street paving within the failure zone had collapsed and were lying on the embankment fill. The entire downstream slope had been eroded away. One section of the failure zone near the right abutment extended almost to the crest of the upstream slope and was backfilled with sandbags. A six-inch water main and ruptured four-inch diameter gas line were exposed within the dam failure zone. The upstream slope was not damaged even though it is unprotected by riprap or other slope protection. The embankment crest upstream of the street is grass covered except for a sidewalk. Two trees with trunk diameters of about six inches were growing on the dam crest. Two power utility poles have been installed in the dam crest upstream of the sidewalk. No seepage was observed flowing from the failure zone.

c. Appurtenant Structures. The five circular concrete drop inlets, the wooden access bridge and gate operators for the low-level outlet works were not damaged during the overtopping failure. The outlet conduits and headwall downstream of the dam were in fair condition. The operators for the low-level outlets were in serviceable condition and were being used to lower the reservoir level. The deck elevation of the access bridge is about 18 inches below the dam crest elevation.

d. Reservoir Area. The reservoir slopes are very gentle and are grass and tree covered. No indications of slope instability were observed.

e. Downstream Channel. A large section of the east slope of the stream channel downstream of the headwall between the dam and the highway bridge has been eroded away. The cascading concrete outlet apron extending downstream of the headwall was in good condition. The concrete and brick-lined west channel slope was severely damaged but had not allowed the occurrence of significant erosion.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedures

No formal operating procedures have been established for Lake Como Dam.

4.2 Maintenance of Dam

The grass on the embankment is cut on a regular basis during the growing season.

4.3 Maintenance of Operating Facilities

The operators for the low-level outlets are maintained in a serviceable condition.

4.4 Description of Any Warning System in Effect

No formal warning system exists for this site.

4.5 Evaluation of Operational Adequacy

A periodic inspection and maintenance program should be implemented and a formal warning system should be established.

SECTION 5

HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features

a. Design Data. No hydrologic or hydraulic data was available for review. Lake Como has a drainage area of 6.8 square miles. The spillway at Lake Como Dam has an estimated discharge capacity of 184 cfs.

For further information, refer to the calculations and computer printout included in Appendix C of this report.

b. Experience Data. No rainfall or reservoir level records are maintained at this site. The locally heavy rains which caused the overtopping of Lake Como Dam on July 29, 1980, were measured by the U.S. Weather Service to be in excess of 5 inches with 4 inches falling between 5:00 and 6:00 a.m. According to local newspapers, floodwaters overtopped the dam by as much as 4 feet and the total precipitation was reported as 7 inches. A letter dated August 15, 1980, from the Delaware Geological Survey to the Delaware Department of Transportation stated that preliminary calculations performed by the United States Geological Survey indicate a peak discharge of 1,250 cubic feet per second (cfs) in Mill Creek upstream of Lake Como. The peak flow downstream of the dam was computed to be about 2,520 cfs (a copy of the letter is included in Appendix E). Inspection of the dam after the overtopping indicated that the high water marks were about two feet above the dam crest. The embankment also collapsed in 1940 and was overtopped in 1913 according to town officials. Unverified accounts indicate that the dam has been overtopped on several occasions since its 1941 reconstruction. Further details concerning these events are unavailable.

c. Visual Observations. On the date of inspection the reservoir pool was about 15 inches below the spillway crest. The low level outlets were partially open allowing about 2 cfs to discharge into Mill Creek.

d. Overtopping Potential. The recommended Spillway Design Flood (SDF) range for a "Small" size, "Significant" hazard dam is from the 100-year flood to one-half of the Probable Maximum Flood (PMF). Since disruption of a major highway, a sewage treatment plant and pumping station caused by a dam failure would have a significant effect upon the community, the selected SDF is one-half of the PMF. The SDF was synthesized from one-half of the Probable Maximum Precipitation (PMP) using the SCS unit hydrograph for Lake Como. The inflow hydrograph was routed through Lake Como with the initial water surface elevation at the spillway crest. The peak inflow and outflow rates for the SDF were computed to be 6620 cfs and 6568 cfs, respectively. The spillway is capable of discharging approximately 8 percent of the SDF prior to overtopping of the embankment (refer to Appendix C for computations and the computer printout).

e. Spillway Adequacy. The Lake Como Dam spillway is incapable of passing one-half of the PMF and the dam is classified as a "Significant" hazard structure. Therefore, the Lake Como Dam spillway is classified as "Inadequate".

The two gated 36-inch diameter low-level conduits are capable of draining the normal pool storage capacity to Elevation 6.2 within about 15 hours.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. It is evident from the overtopping and partial failure of the embankment on July 29, 1980, that Lake Como Dam cannot withstand significant overtopping for an extended period of time. Leakage or rupture of the water main if left within the embankment could cause piping of sand and fine-grained soil from the dam. The unprotected upstream slope exposes the dam to erosion by wave action. The trees and utility poles in the embankment present potential hazards to the structural integrity of the dam. The root systems of the trees create seepage paths through the embankment. Dislodging of the trees or utility poles during severe wind conditions could remove portions of the embankment.

b. Design and Construction Data. No construction data is available. The design data is limited to two drawings prepared for reconstruction of the dam in 1941.

c. Operating Records. No operating records are maintained at this site.

d. Post Construction Changes. There are no records of post construction changes. Representatives of the Delaware Department of Natural Resources and Environmental Control, the Army Corps of Engineers and O'Brien & Gere inspected Lake Como Dam following the July 29, 1980 overtopping, and the following "immediate remedial actions" were recommended (copy of the teletype letter from the Corps of Engineers to DE Governor DuPont is included on pages 8 and 9 of Appendix E):

1. Gas lines and water lines should be removed from the embankment and relocated.

2. A professional engineer, experienced in the design and construction of dams, should be engaged to design an adequate spillway and embankment section for the dam.

3. Borings should be taken through the embankment and foundation to determine soil types, in-place densities and other soil properties.

4. A detailed topographic survey of the embankment from the upstream slope to the Highway 13 bridge should be made.

5. The reservoir should be maintained 3 feet below the crest of the spillway pipe risers until permanent repairs have been made.

6. The embankment should be inspected periodically by an experienced engineer for signs of seepage or additional sloughing until permanent repairs are made.

7. Until permanent repairs are completed, continuous monitoring of the lake levels should be made during periods of heavy rainfall so that increases in the lake levels can be minimized.

e. Seismic Stability. Lake Como Dam is in a state of partial failure and its stability under static loading conditions is uncertain. Therefore, an accurate assessment of Lake Como Dam for earthquake loading conditions is not possible.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment

a. Safety. The visual observations and review of available information indicate that Lake Como Dam is in poor condition. The deficiencies and problem areas noted in Sections 3.1B, 3.1c, 5.1b, 5.1e, and 6.1a indicate an inadequate original design.

The selected SDF for this structure is one-half of the PMF. The spillway is capable of discharging approximately 8 percent of the SDF prior to overtopping of the embankment. The dam is classified as a "Significant" hazard structure since failure would cause appreciable property damage. The spillway is classified as "Inadequate", and the dam is classified as "Unsafe, non-emergency".

b. Adequacy of Information. The information provided by the Town of Smyrna, conversations with town officials and observations made during the field investigations provided adequate data for a Phase 1 evaluation.

c. Urgency. The recommendations and remedial measures described in Section 7.2 should be initiated immediately.

d. Necessity for Further Evaluation. Further investigations should be performed in accordance with Section 7.2, Item 1.

7.2 Recommendations and Proposed Remedial Measures

a. Facilities

1. Ownership of and maintenance responsibility for the dam should be clarified.

A registered professional engineer experienced in the design and construction of dams should be engaged to:

1. Perform detailed hydrologic and hydraulic analyses to determine what measures are required to provide adequate spillway discharge capacity and/or to protect the embankment from overtopping.

2. Design and supervise construction of repairs to the existing embankment section.

3. Design and supervise the construction of erosion protection for the upstream and downstream slopes of the dam and outlet channel.

4. Provide guidance to the Owner for removal of the trees and utility poles from the embankment and the backfilling of voids with suitable, thoroughly compacted material.

5. Provide guidance to the Owner for removal of the water and gas lines from the dam and their relocation.

b. Operation and Maintenance Procedures.

1. The Owner should maintain the reservoir elevation 3 feet below the spillway crest until permanent repairs are completed.

2. Continuous monitoring of reservoir levels during periods of heavy precipitation should be undertaken until permanent repairs are completed.

3. The Owner should employ a professional engineer experienced in operation and maintenance of dams to develop written operating procedures and a periodic maintenance plan to insure the safety of the reconstructed facilities.

4. An emergency action plan should be developed which outlines actions to be taken by the Owner to minimize the downstream effects of an emergency.

APPENDIX

A

Check List Engineering Data
Design, Construction, Operation
Phase I

CHECK LIST
VISUAL INSPECTION
PHASE I

Name Dam Lake Como Dam County Kent State Delaware National ID # DE00028

Type of Dam Earth Hazard Category Significant

Date(s) Inspection 8/12/80 Weather Partly Cloudy Temperature 85°

Pool Elevation at Time of Inspection 13.3 M.S.L. Tailwater at Time of Inspection 6.3 M.S.L.

Inspection Personnel:

John J. Williams Lee DeHeer Steve Snider

S.H. Snider Recorder

Remarks:
Mr. Brian Heverin and Mr. Brian Mulvenna, Phila. Corps of Engineers, Mr. Krishna Patel, DE Dept. of Natural Resources and Environmental Control and Mr. Harry Odren, City Manager, City of Smyrna were also present. A complete list of attendees during the visual inspection is included on Sheet 1a.

DISPOSITION FORM

For use of this form, see AR 340-15, the proponent agency is TAGCEN.

REFERENCE OR OFFICE SYMBOL	SUBJECT
NAPEN	Trip Report of Phase I Inspection of Lake Como Dam and meeting with Delaware D.O.T.

TO Files FROM Chief Gen. Des. Sec. DATE 18 August 1980 CMT 1
MULVENNA/ja/4756

1. The undersigned and Brian Mulvenna, General Design Section, travelled to Smyrna, Delaware on 12 August 1980 to meet with representatives of the Delaware Department of Natural Resources, the Delaware Department of Transportation and the City of Smyrna and conduct a Phase I inspection of the Lake Como Dam which was overtopped on 28 July 1980. This inspection was requested by the State in a letter dated ~~August 1980~~.

2. Following is a list of those present during the inspection of Lake Como Dam:

NAME	REPRESENTING
Brian Heverin	USACE
Brian Mulvenna	USACE
Lee Deheer	O'Brien & Gere
Jay Williams	O'Brien & Gere
Krishna Patel	DDNR & EC
Darwin Kates	Del. D.O.T.
Gary Homewood	Del. D.O.T.
Jim Moore	Del. D.O.T.
Paul Martin	Del. D.O.T.
James W. Simpson	Del. D.O.T.
Charles Bostick	Del. D.O.T.
Thomas N. Jarman	Town of Smyrna
Harry M. Odren	Town of Smyrna
Skip Rebar	Councilman - Smyrna
Dean Phillips	Asst. Mgr. Smyrna
STEVE SNIDER	O'BRIEN & GERE

3. Upon completion of the visual inspection of the dam, discussion ensued with officials of the City of Smyrna and the Delaware Department of Transportation regarding possible courses of action for repair of the dam and any recommendations the Corps may have regarding what repairs should be undertaken. The State and City officials also asked if the Corps could fund the repairs and a negative reply was furnished.

4. It was also reported to the state and local officials that the Corps' consultant, O'Brien & Gere, would develop some interim technical recommendations for repair once they have reviewed the existing data on the dam and conducted some preliminary hydrological calculations. These recommendations are expected to be ready approximately one week from the inspection date.

DA FORM 1 FEB 62 2496 REPLACES DD FORM 96, WHICH IS OBSOLETE.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	Surface cracks were evident around the periphery of the failure zone.	Repair Embankment
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	The downstream toe had been entirely washed away.	Repair Embankment
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	The entire half of the downstream slope was eroded away.	Repair Embankment
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	The embankment crest had been reduced by as much as five feet in some locations.	Repair Embankment
RIPRAP FAILURES	No riprap	Provide erosion protection

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Hydraulic erosion extends into the left abutment	This area should be repaired along with embankment.
ANY NOTICEABLE SEEPAGE	None observed	
STAFF GAGE AND RECORDER	None	
DRAINS	None	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None observed	
INTAKE STRUCTURE	No problems observed	Access bridge below dam crest elevation limits access during high reservoir stages.
OUTLET STRUCTURE	No problems observed	
OUTLET CHANNEL	The right channel slope entirely eroded away.	Repair and provide slope protection.
EMERGENCY GATE	None	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	5 circular drop inlets	Insufficient discharge capacity.
APPROACH CHANNEL	NONE	
DISCHARGE CHANNEL	An R/C bridge carrying U. S. route 13 is located 110 feet d/s of dam. Span is about 40 feet and vertical opening about 9 feet.	
BRIDGE AND PIERS	NOT APPLICABLE	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Very gently sloping, grass and forest covered. No indications of instability.	
SEDIMENTATION	None observed.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Beyond the Rt. 13 bridge the channel opens into a wide flat flood plain.	
SLOPES	Channel slope is less than 1% to confluence with Smyrna River	
APPROXIMATE NO. OF HOMES AND POPULATION	No homes downstream of dam. A restaurant and sewage pump station are within the potential floodplain.	

APPENDIX

B

Checklist
Visual Inspection
Phase I

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM L. Como Dam

ID # DE 00028

ITEM	REMARKS
AS-BUILT DRAWINGS	NONE AVAILABLE
REGIONAL VICINITY MAP	Refer to Appendix E, Fig. 1
CONSTRUCTION HISTORY	Original date of construction unknown. Dam reconstructed in 1941 after wash-out.
TYPICAL SECTIONS OF DAM	Refer to Appendix E.
OUTLETS - PLAN	Refer to Appendix E.
DETAILS	
CONSTRAINTS	
DISCHARGE RATINGS	NONE AVAILABLE
RAINFALL/RESERVOIR RECORDS	NONE AVAILABLE

ITEM	REMARKS
DESIGN REPORTS	NONE AVAILABLE
GEOLOGY REPORTS	NONE AVAILABLE
DESIGN COMPUTATIONS	NO DATA AVAILABLE
HYDROLOGY & HYDRAULICS	NO DATA AVAILABLE
DAM STABILITY	NO DATA AVAILABLE
SEEPAGE STUDIES	NO DATA AVAILABLE
MATERIALS INVESTIGATIONS	NO INFORMATION AVAILABLE
BORING RECORDS	
LABORATORY	
FIELD	
POST-CONSTRUCTION SURVEYS OF DAM	NONE
BORROW SOURCES	No Records Available

ITEM	REMARKS
MONITORING SYSTEMS	None
MODIFICATIONS	The dam was rebuilt in 1941 after a collapse during overtopping in 1940. The dam reportedly failed earlier in the century, but no documentation is available.
HIGH POOL RECORDS	Numerous overtoppings have occurred. Details are unavailable.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	The dam failed in 1940 and sometime between 1913 and 1940.
MAINTENANCE OPERATION RECORDS	None available.

APPENDIX

C

Hydrologic & Hydraulic Data

O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
LAKE COMO DAM				

APPENDIX C

HYDROLOGIC & HYDRAULIC DATA

TABLE OF CONTENTS

O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
LAKE COMO DAM - H&H	1	SHS	8/13/80	1800.006.109

HYDROLOGIC CALCULATIONS

Drainage Area - 6.8 sq.mi. (Planimetered from USGS Quad Sheets)

Reservoir Surface Area:

Storage By HEC-1 Program:

Normal Pool - El. 14.6 = 46 acres — 138 acre-feet

Top of Dam - El. 17.6 = 71 acres — 312 acre-feet

El. 22.6 = 124 acres — 794 acre-feet

PMP COMPUTATIONS: HMR 33

Watershed is in Zone 6 of PMP ALL SEASON ENVELOPE

24 hr., 200 sq.mi. RAINFALL = 24 inches

HR.	%	Rainfall
6	113	27.1"
12	124	29.8"
24	132	31.7"
48	142	34.1"

SCS UNIT HYDROGRAPH: Lag Time

The upper 8,000 ft. of drainage basin is considered to be overland flow.

Travel Time = $\frac{8000}{V}$ $V \simeq 0.4$ fps. (SCS Upland Method, Cultivated)

= 5.6 hrs.

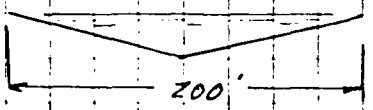
O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
LAKE COMO DAM – H&H	2	SHS	8/13/80	1800.006.109

The remainder of T_c can be obtained by computing a velocity based upon average channel characteristics using Manning's Equation.

$$S = \frac{70-12}{30{,}000}$$

$S \simeq 0.002$ ft/ft.



$n = 0.040$

$A = 500\ \square'$

$wp \simeq 201$

$R = 2.49$

$$V = \frac{1.49\, R^{2/3} S^{1/2}}{n} = \frac{1.49\,(2.49)^{0.67}\,(0.002)^{0.5}}{0.040}$$

$V = 3.1$ fps.

Channel Length = 22,000 ft.

$$\text{Travel Time} = \frac{22{,}000'}{3.1\,(3600)} = 2.0 \text{ hrs.}$$

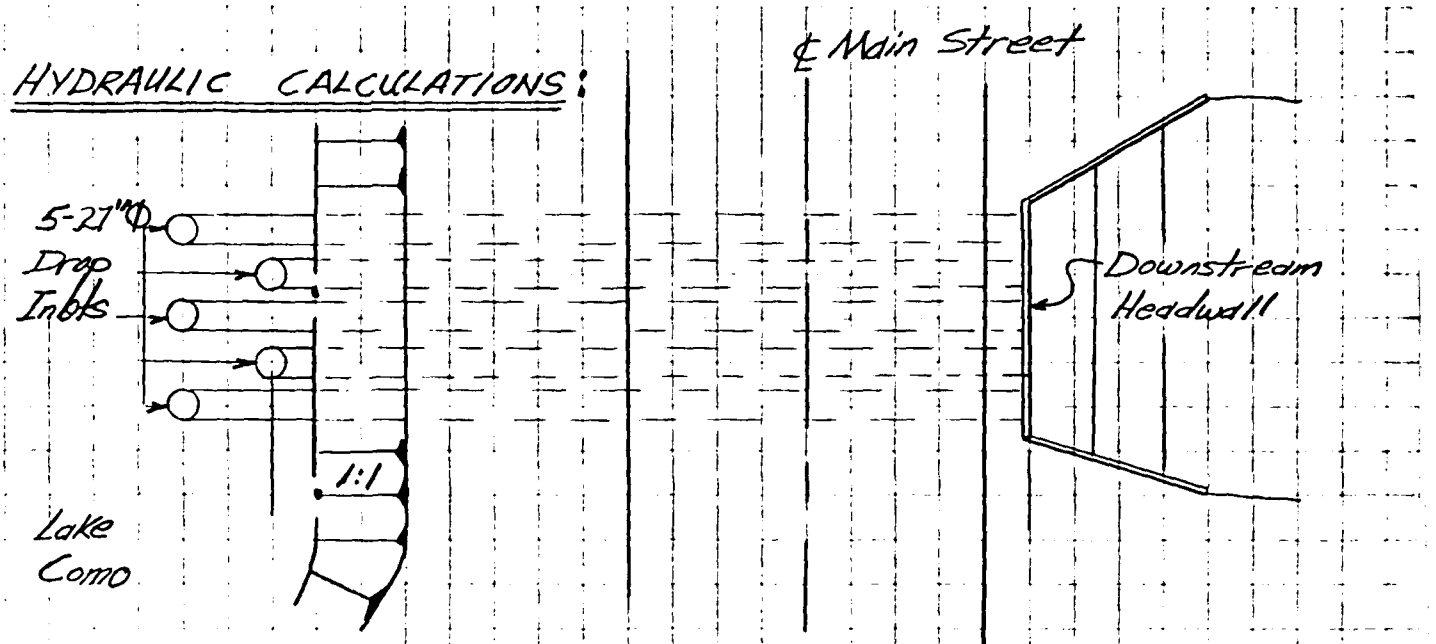
$\therefore T_c = 7.6$ hours. $= 5.6 + 2.0$

& Lag $= 0.6\, T_c =$ **4.5 hrs.**

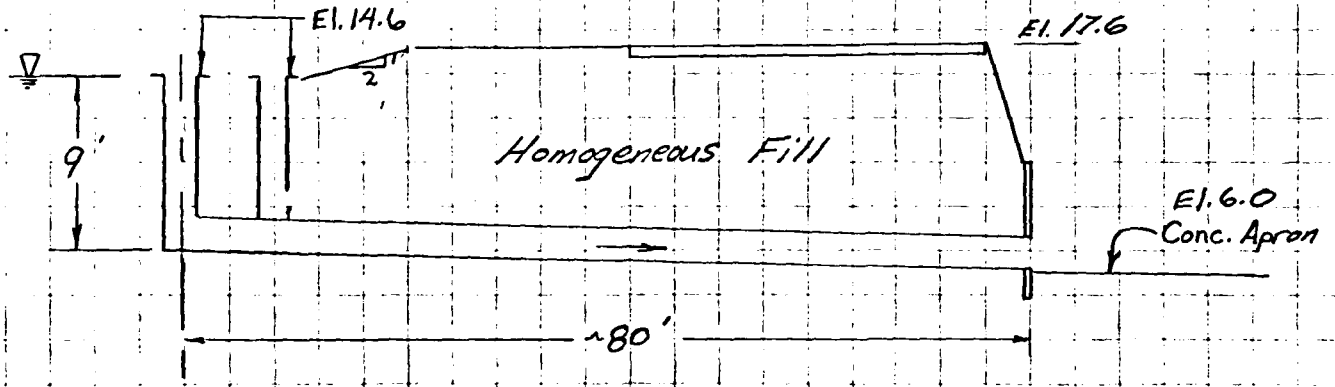
O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
LAKE COMO DAM - H&H	3	SHS	8/13/80	1800.006.109

HYDRAULIC CALCULATIONS:



SPILLWAY
PLAN SKETCH
N.T.S.



SPILLWAY
CROSS SECTION
N.T.S.

O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
LAKE COMO DAM - H&H	4	SHS	8/13/80	1800.006.109

Discharge through a "morning-glory" spillway can be calculated by dividing the stage-discharge relationship into two segments as follows: Ref. DESIGN OF SMALL DAMS

1. Weir Crest Control: $Q = C_w L H^{3/2}$ $L = 5 \pi 2.25 = 35.3'$
   Although orifice control is present, the weir coefficient can be adjusted using this eqn. to obtain Q.

2. *Orifice Control: $Q = CA\sqrt{2gH}$ $C \simeq 0.50$
   Does not begin until after dam over-topping.
   *Assume free discharge at spillway outlet.

Discharge over the dam can be described by: $Q = CLH^{3/2}$; $C = 2.8$
Dam Length - 240', Right Abutment @ Same EL. - 260' ∴ $L \simeq 500'$

STAGE - DISCHARGE TABULATION

W.S.E. (MSL)	$H_{spillway}$	Weir		Orifice		Dam		(cfs) ΣQ
		C_w	Q	H	Q	H	Q	
14.6	0	-	-	-		-	-	0
15.1	0.5	3.2	40	-		-	-	40
15.6	1.0	2.8	99	-		-	-	99
16.6	2.0	1.6	160	-		-	-	160
17.6	3.0	1.0	184	-		-	-	184
18.1	3.5	1.0	231	-		0.5	495	726
18.6	4.0	1.0	283	-		1.0	1400	1683
19.6	5.0	-	-	13.0	288	2.0	3960	4248
20.6	6.0	-	-	14.0	299	3.0	7275	7574
21.6	7.0	-	-	15.0	309	4.0	11,200	11,509
22.6	8.0	-	-	16.0	319	5.0	15,652	15,971

```
**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
 LAST MODIFICATION  26 FEB 79
**********************************
      1             A1              NATIONAL DAM INSPECTION PROGRAM
      2             A2                        LAKE COMO DAM
      3             A3                     HYDROLOGIC ANALYSIS
      4             B    300      0     10      0      0      0      0      0     -3      0
      5             B1     5
      6             J      1      4      1
      7             J1  0.02   0.03   0.04   0.05   0.10   0.15   0.25   0.50    1.0
      8             K      0  INFLO                                    1
      9             K1                      INFLOW TO LAKE COMO DAM
     10             M      1      2    6.8                                          1
     11             P      0     24    113    124    132    142
     12             T                                                 1.0    .05
     13             W2           4.5
     14             X   -1.5   -.05      2
     15             K      1  OUTFLO                                   1
     16             K1                     OUTFLOW FROM LAKE COMO DAM
     17             Y                              1      1
     18             Y1     1                                        -14.6     -1
     19             Y4  14.6   15.1   15.6   16.6   17.6   18.1   18.6   19.6   20.6   21.6
     20             Y4  22.5
     21             Y5     0     40     99    160    184    726   1683   4248   7574  11509
     22             Y5 15971
     23             $A     0     40     71    124
     24             $E   5.6   14.6   17.6   22.6
     25             $$  14.6
     26             $D  17.5
     27             K     99

                       PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

                             RUNOFF HYDROGRAPH AT        INFLOW
                             ROUTE HYDROGRAPH TO         OUTFLO
                             END OF NETWORK
```

Sh. 5

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

RUN DATE= 80/09/16.
TIME= 06.03.24.

NATIONAL DAM INSPECTION PROGRAM
LAKE COMO DAM
HYDROLOGIC ANALYSIS

JOB SPECIFICATION

NO	NMH	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	10	0	0	0	0	0	-3	0

IOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 9 LRTIO= 1
RTIOS= .02 .03 .04 .05 .10 .15 .25 .50 1.00

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

SUB-AREA RUNOFF COMPUTATION

INFLOW TO LAKE COMO DAM

	ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
INFLOW		0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	6.80	0.00	6.80	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	24.00	113.00	124.00	132.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .400

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TC= 0.00 LAG= 4.50

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 137 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= 4.50 VOL= 1.00

8.	16.	26.	44.	63.	83.	107.	130.	160.	191.
222.	264.	305.	349.	399.	448.	494.	535.	577.	609.
638.	666.	682.	697.	710.	712.	715.	715.	712.	710.

Sh. 6

697.	682.	666.	648.	630.	611.	590.	569.	546.	520.	
494.	464.	432.	401.	375.	349.	325.	307.	288.	272.	
256.	240.	227.	214.	201.	191.	182.	172.	163.	153.	
144.	137.	129.	121.	113.	105.	100.	95.	90.	84.	
79.	75.	71.	67.	63.	59.	55.	52.	49.	47.	
44.	41.	38.	36.	35.	33.	31.	29.	27.	25.	
24.	23.	21.	20.	19.	18.	17.	16.	15.	14.	
13.	13.	12.	11.	10.	10.	9.	9.	8.	8.	
8.	7.	7.	7.	6.	6.	6.	5.	5.	5.	
4.	4.	4.	4.	3.	3.	3.	2.	2.	2.	
2.	1.	1.	1.	1.	0.	0.				

Q MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLOW COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.10	1	.00	0.00	.00	10.	1.02	1.10	151	.02	.01	.01	162.
1.01	.20	2	.00	0.00	.00	9.	1.02	1.20	152	.02	.01	.01	154.
1.01	.30	3	.00	0.00	.00	8.	1.02	1.30	153	.02	.01	.01	147.
1.01	.40	4	.00	0.00	.00	8.	1.02	1.40	154	.02	.01	.01	140.
1.01	.50	5	.00	0.00	.00	7.	1.02	1.50	155	.02	.01	.01	135.
1.01	1.00	6	.00	0.00	.00	7.	1.02	2.00	156	.02	.01	.01	130.
1.01	1.10	7	.00	0.00	.00	6.	1.02	2.10	157	.02	.01	.01	126.
1.01	1.20	8	.00	0.00	.00	6.	1.02	2.20	158	.02	.01	.01	122.
1.01	1.30	9	.00	0.00	.00	5.	1.02	2.30	159	.02	.01	.01	119.
1.01	1.40	10	.00	0.00	.00	5.	1.02	2.40	160	.02	.01	.01	116.
1.01	1.50	11	.00	0.00	.00	5.	1.02	2.50	161	.02	.01	.01	117.
1.01	2.00	12	.00	0.00	.00	4.	1.02	3.00	162	.02	.01	.01	117.
1.01	2.10	13	.00	0.00	.00	4.	1.02	3.10	163	.02	.01	.01	117.
1.01	2.20	14	.00	0.00	.00	4.	1.02	3.20	164	.02	.01	.01	118.
1.01	2.30	15	.00	0.00	.00	4.	1.02	3.30	165	.02	.01	.01	119.
1.01	2.40	16	.00	0.00	.00	3.	1.02	3.40	166	.02	.01	.01	121.
1.01	2.50	17	.00	0.00	.00	3.	1.02	3.50	167	.02	.01	.01	123.
1.01	3.00	18	.00	0.00	.00	3.	1.02	4.00	168	.02	.01	.01	126.
1.01	3.10	19	.00	0.00	.00	3.	1.02	4.10	169	.02	.01	.01	129.
1.01	3.20	20	.00	0.00	.00	3.	1.02	4.20	170	.02	.01	.01	131.
1.01	3.30	21	.00	0.00	.00	2.	1.02	4.30	171	.02	.01	.01	135.
1.01	3.40	22	.00	0.00	.00	2.	1.02	4.40	172	.02	.01	.01	138.
1.01	3.50	23	.00	0.00	.00	2.	1.02	4.50	173	.02	.01	.01	142.
1.01	4.00	24	.00	0.00	.00	2.	1.02	5.00	174	.02	.01	.01	145.
1.01	4.10	25	.00	0.00	.00	2.	1.02	5.10	175	.02	.01	.01	149.
1.01	4.20	26	.00	0.00	.00	2.	1.02	5.20	176	.02	.01	.01	153.
1.01	4.30	27	.00	0.00	.00	2.	1.02	5.30	177	.02	.01	.01	157.
1.01	4.40	28	.00	0.00	.00	1.	1.02	5.40	178	.02	.01	.01	160.
1.01	4.50	29	.00	0.00	.00	1.	1.02	5.50	179	.02	.01	.01	164.
1.01	5.00	30	.00	0.00	.00	1.	1.02	6.00	180	.02	.01	.01	168.
1.01	5.10	31	.00	0.00	.00	1.	1.02	6.10	181	.06	.05	.01	171.
1.01	5.20	32	.00	0.00	.00	1.	1.02	6.20	182	.06	.05	.01	175.
1.01	5.30	33	.00	0.00	.00	1.	1.02	6.30	183	.06	.05	.01	180.
1.01	5.40	34	.00	0.00	.00	1.	1.02	6.40	184	.06	.05	.01	185.
1.01	5.50	35	.00	0.00	.00	1.	1.02	6.50	185	.06	.05	.01	191.
1.01	6.00	36	.00	0.00	.00	1.	1.02	7.00	186	.06	.05	.01	197.
1.01	6.10	37	.00	0.00	.00	1.	1.02	7.10	187	.06	.05	.01	204.
1.01	6.20	38	.00	0.00	.00	1.	1.02	7.20	188	.06	.05	.01	212.
1.01	6.30	39	.00	0.00	.00	1.	1.02	7.30	189	.06	.05	.01	221.
1.01	6.40	40	.00	0.00	.00	1.	1.02	7.40	190	.06	.05	.01	231.
1.01	6.50	41	.00	0.00	.00	1.	1.02	7.50	191	.06	.05	.01	242.
1.01	7.00	42	.00	0.00	.00	1.	1.02	8.00	192	.06	.05	.01	255.
1.01	7.10	43	.00	0.00	.00	1.	1.02	8.10	193	.06	.05	.01	269.
1.01	7.20	44	.00	0.00	.00	0.	1.02	8.20	194	.06	.05	.01	285.
1.01	7.30	45	.00	0.00	.00	0.	1.02	8.30	195	.06	.05	.01	303.

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1.01	7.40	46	.00	0.00	.00	0.	1.02	8.40	196	.06	.05	.01	323.
1.01	7.50	47	.00	0.00	.00	0.	1.02	8.50	197	.06	.05	.01	345.
1.01	8.00	48	.00	0.00	.00	0.	1.02	9.00	198	.06	.05	.01	369.
1.01	8.10	49	.00	0.00	.00	0.	1.02	9.10	199	.06	.05	.01	394.
1.01	8.20	50	.00	0.00	.00	0.	1.02	9.20	200	.06	.05	.01	420.
1.01	8.30	51	.00	0.00	.00	0.	1.02	9.30	201	.06	.05	.01	448.
1.01	8.40	52	.00	0.00	.00	0.	1.02	9.40	202	.06	.05	.01	477.
1.01	8.50	53	.00	0.00	.00	0.	1.02	9.50	203	.06	.05	.01	506.
1.01	9.00	54	.00	0.00	.00	0.	1.02	10.00	204	.06	.05	.01	536.
1.01	9.10	55	.00	0.00	.00	0.	1.02	10.10	205	.06	.05	.01	566.
1.01	9.20	56	.00	0.00	.00	0.	1.02	10.20	206	.06	.05	.01	597.
1.01	9.30	57	.00	0.00	.00	0.	1.02	10.30	207	.06	.05	.01	628.
1.01	9.40	58	.00	0.00	.00	0.	1.02	10.40	208	.06	.05	.01	658.
1.01	9.50	59	.00	0.00	.00	0.	1.02	10.50	209	.06	.05	.01	688.
1.01	10.00	60	.00	0.00	.00	0.	1.02	11.00	210	.06	.05	.01	719.
1.01	10.10	61	.00	0.00	.00	0.	1.02	11.10	211	.06	.05	.01	748.
1.01	10.20	62	.00	0.00	.00	0.	1.02	11.20	212	.06	.05	.01	777.
1.01	10.30	63	.00	0.00	.00	0.	1.02	11.30	213	.06	.05	.01	805.
1.01	10.40	64	.00	0.00	.00	0.	1.02	11.40	214	.06	.05	.01	833.
1.01	10.50	65	.00	0.00	.00	0.	1.02	11.50	215	.06	.05	.01	859.
1.01	11.00	66	.00	0.00	.00	0.	1.02	12.00	216	.06	.05	.01	885.
1.01	11.10	67	.00	0.00	.00	0.	1.02	12.10	217	.36	.35	.01	913.
1.01	11.20	68	.00	0.00	.00	0.	1.02	12.20	218	.36	.35	.01	941.
1.01	11.30	69	.00	0.00	.00	0.	1.02	12.30	219	.36	.35	.01	972.
1.01	11.40	70	.00	0.00	.00	0.	1.02	12.40	220	.36	.35	.01	1004.
1.01	11.50	71	.00	0.00	.00	0.	1.02	12.50	221	.36	.35	.01	1047.
1.01	12.00	72	.00	0.00	.00	0.	1.02	13.00	222	.36	.35	.01	1092.
1.01	12.10	73	.03	0.00	.03	0.	1.02	13.10	223	.43	.43	.01	1143.
1.01	12.20	74	.03	0.00	.03	0.	1.02	13.20	224	.43	.43	.01	1201.
1.01	12.30	75	.03	0.00	.03	0.	1.02	13.30	225	.43	.43	.01	1267.
1.01	12.40	76	.03	0.00	.03	0.	1.02	13.40	226	.43	.43	.01	1343.
1.01	12.50	77	.03	0.00	.03	0.	1.02	13.50	227	.43	.43	.01	1428.
1.01	13.00	78	.03	0.00	.03	0.	1.02	14.00	228	.43	.43	.01	1527.
1.01	13.10	79	.03	0.00	.03	0.	1.02	14.10	229	.54	.53	.01	1640.
1.01	13.20	80	.03	0.00	.03	0.	1.02	14.20	230	.54	.53	.01	1768.
1.01	13.30	81	.03	0.00	.03	0.	1.02	14.30	231	.54	.53	.01	1914.
1.01	13.40	82	.03	0.00	.03	0.	1.02	14.40	232	.54	.53	.01	2079.
1.01	13.50	83	.03	0.00	.03	0.	1.02	14.50	233	.54	.53	.01	2261.
1.01	14.00	84	.03	0.00	.03	0.	1.02	15.00	234	.54	.53	.01	2460.
1.01	14.10	85	.04	0.00	.04	0.	1.02	15.10	235	.49	.49	.01	2676.
1.01	14.20	86	.04	0.00	.04	0.	1.02	15.20	236	.82	.82	.01	2910.
1.01	14.30	87	.04	0.00	.04	0.	1.02	15.30	237	1.48	1.48	.01	3166.
1.01	14.40	88	.04	0.00	.04	0.	1.02	15.40	238	3.71	3.70	.01	3463.
1.01	14.50	89	.04	0.00	.04	0.	1.02	15.50	239	1.07	1.06	.01	3779.
1.01	15.00	90	.04	0.00	.04	0.	1.02	16.00	240	.66	.65	.01	4123.
1.01	15.10	91	.04	0.00	.04	0.	1.02	16.10	241	.51	.50	.01	4505.
1.01	15.20	92	.06	0.00	.06	0.	1.02	16.20	242	.51	.50	.01	4902.
1.01	15.30	93	.11	.03	.09	0.	1.02	16.30	243	.51	.50	.01	5317.
1.01	15.40	94	.28	.27	.01	3.	1.02	16.40	244	.51	.50	.01	5751.
1.01	15.50	95	.08	.07	.01	5.	1.02	16.50	245	.51	.50	.01	6196.
1.01	16.00	96	.05	.04	.01	10.	1.02	17.00	246	.51	.50	.01	6665.
1.01	16.10	97	.04	.03	.01	16.	1.02	17.10	247	.40	.39	.01	7146.
1.01	16.20	98	.04	.03	.01	24.	1.02	17.20	248	.40	.39	.01	7636.
1.01	16.30	99	.04	.03	.01	33.	1.02	17.30	249	.40	.39	.01	8155.
1.01	16.40	100	.04	.03	.01	44.	1.02	17.40	250	.40	.39	.01	8678.
1.01	16.50	101	.04	.03	.01	55.	1.02	17.50	251	.40	.39	.01	9206.
1.01	17.00	102	.04	.03	.01	69.	1.02	18.00	252	.40	.39	.01	9745.
1.01	17.10	103	.03	.02	.01	85.	1.02	18.10	253	.03	.02	.01	10270.
1.01	17.20	104	.03	.02	.01	102.	1.02	18.20	254	.03	.02	.01	10785.
1.01	17.30	105	.03	.02	.01	122.	1.02	18.30	255	.03	.02	.01	11226.

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1.01	17.40	106	.03	.02	.01	145.	1.02	18.40	256	.03	.02	.01	11653.
1.01	17.50	107	.03	.02	.01	169.	1.02	18.50	257	.03	.02	.01	12025.
1.01	18.00	108	.03	.02	.01	196.	1.02	19.00	258	.03	.02	.01	12353.
1.01	18.10	109	.00	0.00	.00	224.	1.02	19.10	259	.03	.02	.01	12634.
1.01	18.20	110	.00	0.00	.00	252.	1.02	19.20	260	.03	.02	.01	12855.
1.01	18.30	111	.00	0.00	.00	280.	1.02	19.30	261	.03	.02	.01	13030.
1.01	18.40	112	.00	0.00	.00	308.	1.02	19.40	262	.03	.02	.01	13155.
1.01	18.50	113	.00	0.00	.00	334.	1.02	19.50	263	.03	.02	.01	13217.
1.01	19.00	114	.00	0.00	.00	358.	1.02	20.00	264	.03	.02	.01	13240.
1.01	19.10	115	.00	0.00	.00	382.	1.02	20.10	265	.03	.02	.01	13222.
1.01	19.20	116	.00	0.00	.00	403.	1.02	20.20	266	.03	.02	.01	13161.
1.01	19.30	117	.00	0.00	.00	422.	1.02	20.30	267	.03	.02	.01	13058.
1.01	19.40	118	.00	0.00	.00	440.	1.02	20.40	268	.03	.02	.01	12890.
1.01	19.50	119	.00	0.00	.00	453.	1.02	20.50	269	.03	.02	.01	12678.
1.01	20.00	120	.00	0.00	.00	466.	1.02	21.00	270	.03	.02	.01	12435.
1.01	20.10	121	.00	0.00	.00	476.	1.02	21.10	271	.03	.02	.01	12154.
1.01	20.20	122	.00	0.00	.00	484.	1.02	21.20	272	.03	.02	.01	11850.
1.01	20.30	123	.00	0.00	.00	490.	1.02	21.30	273	.03	.02	.01	11540.
1.01	20.40	124	.00	0.00	.00	492.	1.02	21.40	274	.03	.02	.01	11196.
1.01	20.50	125	.00	0.00	.00	492.	1.02	21.50	275	.03	.02	.01	10836.
1.01	21.00	126	.00	0.00	.00	489.	1.02	22.00	276	.03	.02	.01	10455.
1.01	21.10	127	.00	0.00	.00	485.	1.02	22.10	277	.03	.02	.01	10056.
1.01	21.20	128	.00	0.00	.00	479.	1.02	22.20	278	.03	.02	.01	9647.
1.01	21.30	129	.00	0.00	.00	471.	1.02	22.30	279	.03	.02	.01	9220.
1.01	21.40	130	.00	0.00	.00	462.	1.02	22.40	280	.03	.02	.01	8788.
1.01	21.50	131	.00	0.00	.00	451.	1.02	22.50	281	.03	.02	.01	8358.
1.01	22.00	132	.00	0.00	.00	439.	1.02	23.00	282	.03	.02	.01	7944.
1.01	22.10	133	.00	0.00	.00	425.	1.02	23.10	283	.03	.02	.01	7561.
1.01	22.20	134	.00	0.00	.00	411.	1.02	23.20	284	.03	.02	.01	7196.
1.01	22.30	135	.00	0.00	.00	394.	1.02	23.30	285	.03	.02	.01	6797.
1.01	22.40	136	.00	0.00	.00	376.	1.02	23.40	286	.03	.02	.01	6450.
1.01	22.50	137	.00	0.00	.00	357.	1.02	23.50	287	.03	.02	.01	6117.
1.01	23.00	138	.00	0.00	.00	340.	1.03	0.00	288	.03	.02	.01	5797.
1.01	23.10	139	.00	0.00	.00	322.	1.03	.10	289	0.00	0.00	0.00	5489.
1.01	23.20	140	.00	0.00	.00	304.	1.03	.20	290	0.00	0.00	0.00	5197.
1.01	23.30	141	.00	0.00	.00	288.	1.03	.30	291	0.00	0.00	0.00	4918.
1.01	23.40	142	.00	0.00	.00	272.	1.03	.40	292	0.00	0.00	0.00	4654.
1.01	23.50	143	.00	0.00	.00	257.	1.03	.50	293	0.00	0.00	0.00	4411.
1.02	0.00	144	.00	0.00	.00	243.	1.03	1.00	294	0.00	0.00	0.00	4181.
1.02	.10	145	.02	.01	.01	229.	1.03	1.10	295	0.00	0.00	0.00	3964.
1.02	.20	146	.02	.01	.01	215.	1.03	1.20	296	0.00	0.00	0.00	3758.
1.02	.30	147	.02	.01	.01	203.	1.03	1.30	297	0.00	0.00	0.00	3563.
1.02	.40	148	.02	.01	.01	191.	1.03	1.40	298	0.00	0.00	0.00	3381.
1.02	.50	149	.02	.01	.01	180.	1.03	1.50	299	0.00	0.00	0.00	3210.
1.02	1.00	150	.02	.01	.01	171.	1.03	2.00	300	0.00	0.00	0.00	3047.
									SUM	27.24	24.87	2.40	601993.
										(693.)	(632.)	(61.)	(17046.54)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	13240.	11019.	4050.	2002.	600472.
CMS	375.	312.	115.	57.	17003.
INCHES		15.07	22.16	22.82	22.82
MM		382.89	562.94	579.57	579.57
AC-FT		5464.	8034.	8271.	8271.
THOUS CU M		6740.	9909.	10202.	10202.

Sh. 9

HYDROGRAPH AT STAINFLOW FOR PLAN 1, RTIO 1

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	265.	220.	81.	40.	12009.
CMS	7.	6.	2.	1.	340.
INCHES		.30	.44	.46	.46
MM		7.66	11.26	11.59	11.59
AC-FT		109.	161.	165.	165.
THOUS CU M		135.	198.	204.	204.

HYDROGRAPH AT STAINFLOW FOR PLAN 1, RTIO 2

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	397.	331.	122.	60.	18014.
CMS	11.	9.	3.	2.	510.
INCHES		.45	.66	.68	.68
MM		11.49	16.89	17.39	17.39
AC-FT		164.	241.	248.	248.
THOUS CU M		202.	297.	306.	306.

HYDROGRAPH AT STAINFLOW FOR PLAN 1, RTIO 3

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	530.	441.	162.	80.	24019.
CMS	15.	12.	5.	2.	680.
INCHES		.60	.89	.91	.91
MM		15.32	22.52	23.18	23.18
AC-FT		219.	321.	331.	331.
THOUS CU M		270.	396.	408.	408.

HYDROGRAPH AT STAINFLOW FOR PLAN 1, RTIO 4

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	662.	551.	203.	100.	30024.
CMS	19.	16.	6.	3.	850.
INCHES		.75	1.11	1.14	1.14
MM		19.14	28.15	28.98	28.98
AC-FT		273.	402.	414.	414.
THOUS CU M		337.	495.	510.	510.

HYDROGRAPH AT STAINFLOW FOR PLAN 1, RTIO 5

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1324.	1102.	405.	200.	60047.
CMS	37.	31.	11.	6.	1700.
INCHES		1.51	2.22	2.28	2.28
MM		38.29	56.29	57.96	57.96
AC-FT		546.	803.	827.	827.
THOUS CU M		674.	991.	1020.	1020.

Sh. 10

HYDROGRAPH AT STAINFLOW FOR PLAN 1, RTIO 6

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1986.	1653.	608.	300.	90071.
CMS	56.	47.	17.	9.	2551.
INCHES		2.26	3.32	3.42	3.42
MM		57.43	84.44	86.94	86.94
AC-FT		820.	1205.	1241.	1241.
THOUS CU M		1011.	1486.	1530.	1530.

HYDROGRAPH AT STAINFLOW FOR PLAN 1, RTIO 7

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3310.	2755.	1013.	500.	150118.
CMS	94.	78.	29.	14.	4251.
INCHES		3.77	5.54	5.70	5.70
MM		95.72	140.74	144.89	144.89
AC-FT		1366.	2008.	2068.	2068.
THOUS CU M		1685.	2477.	2551.	2551.

HYDROGRAPH AT STAINFLOW FOR PLAN 1, RTIO 8

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6620.	5510.	2025.	1001.	300236.
CMS	187.	156.	57.	28.	8502.
INCHES		7.54	11.08	11.41	11.41
MM		191.44	281.47	289.79	289.79
AC-FT		2732.	4017.	4135.	4135.
THOUS CU M		3370.	4955.	5101.	5101.

HYDROGRAPH AT STAINFLOW FOR PLAN 1, RTIO 9

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	13240.	11019.	4050.	2002.	600472.
CMS	375.	312.	115.	57.	17003.
INCHES		15.07	22.16	22.82	22.82
MM		382.89	562.94	579.57	579.57
AC-FT		5464.	8034.	8271.	8271.
THOUS CU M		6740.	9909.	10202.	10202.

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HYDROGRAPH ROUTING

OUTFLOW FROM LAKE COMO DAM

	ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
	OUTFLO	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

Sh. 11

	NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
	1	0	0	0.000	0.000	0.000	-15.	-1

STAGE	14.60	15.10	15.60	16.60	17.60	18.10	18.60	19.60	20.60	21.60
	22.60									
FLOW	0.00	40.00	99.00	160.00	184.00	726.00	1683.00	4248.00	7574.00	11509.00
	15971.00									

SURFACE AREA=	0.	46.	71.	124.
CAPACITY=	0.	138.	312.	794.
ELEVATION=	6.	15.	18.	23.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
14.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
17.6	0.0	0.0	0.

STATION OUTFLO, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	1.	1.
1.	1.	1.	1.	1.	1.	2.	2.	2.	2.
2.	2.	3.	3.	3.	3.	3.	3.	4.	4.
4.	4.	4.	4.	4.	4.	5.	4.	4.	5.
5.	5.	5.	5.	5.	5.	5.	5.	5.	5.
5.	4.	4.	4.	4.	4.	4.	4.	4.	4.
4.	4.	4.	4.	4.	4.	4.	4.	4.	4.
4.	4.	4.	4.	4.	4.	4.	4.	4.	4.
4.	4.	4.	4.	4.	4.	4.	4.	4.	4.
4.	4.	4.	4.	4.	4.	4.	4.	4.	4.
4.	4.	5.	5.	5.	5.	5.	5.	6.	6.
6.	6.	6.	7.	7.	7.	7.	8.	8.	8.
8.	9.	9.	9.	10.	10.	11.	11.	11.	12.
13.	13.	14.	15.	15.	16.	17.	19.	20.	21.
23.	24.	26.	28.	30.	32.	34.	37.	39.	43.
48.	52.	57.	62.	66.	72.	77.	82.	87.	92.
97.	100.	103.	105.	108.	110.	112.	115.	117.	119.
121.	122.	124.	125.	127.	128.	129.	130.	131.	132.
132.	133.	133.	133.	133.	133.	133.	133.	133.	132.
132.	131.	131.	130.	129.	129.	128.	127.	126.	125.

Sh. 12

STORAGE

138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	139.	139.	139.	139.	139.	139.	139.	139.	139.
139.	139.	140.	140.	140.	140.	140.	140.	140.	140.
140.	140.	140.	140.	140.	140.	141.	141.	141.	141.
141.	141.	141.	141.	141.	141.	141.	141.	141.	141.
141.	141.	141.	141.	141.	141.	140.	140.	140.	140.
140.	140.	140.	140.	140.	140.	140.	140.	140.	140.
140.	140.	140.	140.	140.	140.	140.	140.	140.	140.
140.	140.	140.	140.	140.	140.	140.	140.	140.	140.
140.	140.	140.	140.	140.	140.	140.	140.	140.	140.
141.	141.	141.	141.	141.	141.	141.	141.	141.	141.
141.	142.	142.	142.	142.	142.	142.	142.	143.	143.
143.	143.	143.	143.	144.	144.	144.	144.	145.	145.
145.	146.	146.	147.	147.	148.	148.	149.	150.	150.
151.	152.	153.	154.	156.	157.	158.	160.	162.	163.
165.	167.	169.	171.	173.	176.	178.	180.	182.	185.
187.	189.	191.	193.	196.	198.	200.	202.	204.	206.
207.	209.	210.	212.	213.	214.	215.	216.	217.	218.
218.	219.	219.	219.	219.	219.	219.	219.	219.	218.
218.	217.	217.	216.	216.	215.	214.	213.	213.	212.

STAGE

14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
14.7	14.7	14.7	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.7	14.7	14.7
14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.9
14.9	14.9	14.9	14.9	15.0	15.0	15.0	15.1	15.1	15.1
15.2	15.2	15.2	15.3	15.3	15.4	15.4	15.5	15.5	15.5
15.6	15.6	15.7	15.7	15.7	15.8	15.8	15.9	15.9	15.9
16.0	16.0	16.0	16.0	16.1	16.1	16.1	16.1	16.1	16.1

Sh. 13

16.1	16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.1
16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.0	16.0

PEAK OUTFLOW IS 133. AT TIME 47.50 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	133.	127.	45.	22.	6635.
CMS	4.	4.	1.	1.	188.
INCHES		.17	.25	.25	.25
MM		4.40	6.25	6.40	6.40
AC-FT		63.	89.	91.	91.
THOUS CU M		77.	110.	113.	113.

STATION OUTFLO, PLAN 1, RATIO 2

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	1.	1.	1.	1.
1.	1.	1.	2.	2.	2.	2.	3.	3.	3.
3.	4.	4.	4.	4.	5.	5.	5.	5.	6.
6.	6.	6.	6.	6.	6.	7.	7.	7.	7.
7.	7.	7.	7.	7.	7.	7.	7.	7.	7.
7.	7.	7.	7.	7.	6.	6.	6.	6.	6.
6.	6.	6.	6.	6.	6.	6.	6.	6.	6.
6.	6.	6.	6.	6.	6.	5.	5.	5.	5.
5.	5.	5.	5.	5.	5.	5.	5.	5.	6.
6.	6.	6.	6.	6.	6.	6.	6.	6.	6.
7.	7.	7.	7.	7.	8.	8.	8.	9.	9.
9.	9.	10.	10.	10.	11.	11.	11.	12.	12.
13.	13.	14.	14.	15.	15.	16.	16.	17.	18.
19.	20.	21.	22.	23.	24.	26.	28.	29.	31.
34.	36.	39.	42.	46.	51.	56.	61.	66.	72.
78.	84.	91.	98.	102.	106.	109.	113.	117.	121.
125.	129.	133.	136.	140.	144.	147.	150.	154.	157.
159.	161.	162.	163.	164.	164.	165.	166.	166.	167.
167.	168.	168.	168.	169.	169.	169.	169.	169.	169.
169.	169.	168.	168.	168.	168.	167.	167.	167.	166.

STORAGE

138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.

Sh. 14

138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	139.
139.	139.	139.	139.	139.	139.	139.	140.	140.	140.
140.	140.	140.	140.	141.	141.	141.	141.	141.	141.
141.	141.	141.	142.	142.	142.	142.	142.	142.	142.
142.	142.	142.	142.	142.	142.	142.	142.	142.	142.
142.	142.	142.	142.	142.	142.	142.	142.	142.	142.
142.	142.	142.	141.	141.	141.	141.	141.	141.	141.
141.	141.	141.	141.	141.	141.	141.	141.	141.	141.
141.	141.	141.	141.	141.	141.	141.	141.	141.	141.
141.	141.	141.	141.	141.	141.	141.	142.	142.	142.
142.	142.	142.	142.	142.	142.	143.	143.	143.	143.
143.	143.	144.	144.	144.	144.	144.	145.	145.	145.
145.	146.	146.	146.	147.	147.	147.	148.	148.	148.
149.	150.	150.	151.	152.	152.	153.	154.	155.	157.
158.	159.	161.	163.	165.	167.	169.	171.	173.	176.
178.	181.	184.	187.	190.	194.	197.	200.	204.	208.
211.	215.	219.	222.	226.	229.	233.	236.	239.	242.
245.	248.	250.	253.	255.	257.	259.	261.	263.	264.
265.	266.	267.	268.	268.	269.	269.	269.	269.	269.
269.	269.	268.	268.	267.	266.	265.	265.	264.	263.

STAGE

14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.7	14.7	14.7	14.7	14.7	14.7	14.7
14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.8
14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8
14.8	14.8	14.9	14.9	14.9	14.9	14.9	14.9	15.0	15.0
15.0	15.0	15.1	15.1	15.2	15.2	15.2	15.3	15.3	15.4
15.4	15.5	15.5	15.6	15.6	15.7	15.8	15.8	15.9	16.0
16.0	16.1	16.1	16.2	16.3	16.3	16.4	16.4	16.5	16.5
16.6	16.6	16.7	16.7	16.8	16.8	16.8	16.8	16.9	16.9
16.9	16.9	16.9	16.9	17.0	17.0	17.0	17.0	17.0	17.0
17.0	17.0	17.0	16.9	16.9	16.9	16.9	16.9	16.9	16.9

PEAK OUTFLOW IS 169. AT TIME 48.17 HOURS

Sh. 15

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME

CFS	169.	163.	60.	30.	8922.
CMS	5.	5.	2.	1.	253.
INCHES		.22	.33	.34	.34
MM		5.67	8.38	8.61	8.61
AC-FT		81.	120.	123.	123.
THOUS CU M		100.	147.	152.	152.

STATION OUTFLO, PLAN 1, RATIO 3

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.	1.	1.	1.	1.
1.	2.	2.	2.	3.	3.	3.	3.	4.	4.
5.	5.	5.	6.	6.	6.	6.	7.	7.	7.
8.	8.	8.	8.	8.	9.	9.	9.	9.	9.
9.	9.	9.	9.	9.	9.	9.	9.	9.	9.
9.	9.	9.	9.	9.	9.	9.	8.	8.	8.
8.	8.	8.	8.	8.	8.	8.	8.	8.	8.
8.	7.	7.	7.	7.	7.	7.	7.	7.	7.
7.	7.	7.	7.	7.	7.	7.	7.	7.	7.
7.	7.	8.	8.	8.	8.	8.	8.	8.	8.
9.	9.	9.	9.	10.	10.	10.	11.	11.	11.
12.	12.	13.	13.	14.	14.	15.	15.	16.	16.
17.	17.	18.	19.	19.	20.	21.	22.	23.	24.
25.	26.	27.	29.	31.	32.	34.	35.	39.	42.
46.	51.	56.	61.	66.	72.	78.	85.	92.	99.
103.	107.	112.	116.	121.	126.	131.	136.	141.	146.
151.	156.	161.	163.	164.	166.	168.	170.	172.	173.
175.	176.	178.	179.	180.	181.	182.	183.	199.	230.
251.	265.	273.	277.	278.	275.	271.	265.	257.	249.
240.	231.	222.	212.	203.	194.	185.	184.	184.	183.

STORAGE

138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	139.	139.	139.
139.	139.	139.	139.	139.	140.	140.	140.	140.	140.
141.	141.	141.	141.	141.	142.	142.	142.	142.	142.
142.	143.	143.	143.	143.	143.	143.	143.	143.	143.

Sh. 16

143.	143.	143.	143.	143.	143.	143.	143.	143.	143.
143.	143.	143.	143.	143.	143.	143.	143.	143.	143.
143.	143.	143.	143.	143.	143.	143.	142.	142.	142.
142.	142.	142.	142.	142.	142.	142.	142.	142.	142.
142.	142.	142.	142.	142.	142.	142.	142.	142.	142.
142.	142.	142.	142.	142.	143.	143.	143.	143.	143.
143.	143.	143.	143.	144.	144.	144.	144.	144.	145.
145.	145.	145.	146.	146.	146.	147.	147.	147.	147.
149.	148.	149.	149.	149.	150.	150.	151.	151.	152.
153.	153.	154.	155.	156.	157.	158.	160.	161.	163.
165.	167.	169.	171.	173.	176.	179.	182.	185.	188.
191.	195.	199.	203.	208.	212.	217.	222.	227.	232.
237.	242.	247.	252.	257.	262.	267.	272.	277.	281.
286.	290.	294.	298.	301.	305.	308.	311.	313.	315.
317.	317.	318.	318.	318.	318.	318.	317.	317.	315.
316.	315.	315.	314.	313.	313.	312.	312.	311.	310.

STAGE

14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.7
14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
14.7	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8
14.8	14.8	14.8	14.8	14.8	14.9	14.9	14.9	14.9	14.9
14.9	14.9	14.9	15.0	15.0	15.0	15.0	15.1	15.1	15.1
15.2	15.2	15.2	15.3	15.3	15.4	15.4	15.5	15.5	15.6
15.7	15.7	15.8	15.9	16.0	16.0	16.1	16.2	16.3	16.4
16.5	16.5	16.6	16.7	16.8	16.9	16.9	17.0	17.1	17.2
17.2	17.3	17.3	17.4	17.4	17.5	17.5	17.6	17.6	17.6
17.7	17.7	17.7	17.7	17.7	17.7	17.7	17.7	17.7	17.7
17.7	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6

PEAK OUTFLOW IS 278. AT TIME 47.50 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	278.	210.	78.	38.	11490.
CMS	8.	6.	2.	1.	325.
INCHES		.29	.42	.44	.44
MM		7.30	10.78	11.09	11.09
AC-FT		104.	154.	158.	158.
THOUS CU M		129.	190.	195.	195.

Sh. 17

STATION OUTFLO, PLAN 1, RATIO 4

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	1.	1.	1.	1.	1.	2.
2.	2.	2.	3.	3.	4.	4.	4.	5.	5.
6.	5.	6.	7.	7.	8.	8.	8.	9.	9.
9.	10.	10.	10.	11.	11.	11.	11.	11.	11.
11.	11.	11.	11.	11.	11.	11.	11.	11.	11.
11.	11.	11.	11.	11.	11.	11.	11.	10.	10.
10.	10.	10.	10.	10.	10.	10.	10.	10.	9.
9.	9.	9.	9.	9.	9.	9.	9.	9.	9.
9.	9.	9.	9.	9.	9.	9.	9.	9.	9.
9.	9.	9.	10.	10.	10.	10.	10.	10.	11.
11.	11.	11.	12.	12.	13.	13.	13.	14.	14.
15.	15.	16.	16.	17.	18.	18.	19.	20.	20.
21.	22.	22.	23.	24.	25.	26.	27.	28.	30.
31.	32.	34.	36.	38.	40.	44.	48.	52.	57.
61.	67.	73.	79.	86.	93.	100.	104.	108.	113.
118.	123.	129.	134.	140.	146.	152.	159.	162.	164.
167.	169.	172.	174.	177.	179.	181.	183.	244.	316.
372.	414.	445.	468.	483.	492.	496.	495.	491.	483.
473.	461.	448.	433.	418.	402.	386.	370.	353.	337.
322.	306.	292.	277.	264.	250.	238.	226.	214.	203.

STORAGE

138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	139.	139.	139.	139.
139.	139.	139.	140.	140.	140.	140.	141.	141.	141.
141.	142.	142.	142.	142.	142.	143.	143.	143.	143.
144.	144.	144.	144.	144.	144.	144.	144.	144.	145.
145.	145.	145.	145.	145.	145.	145.	145.	145.	145.
145.	144.	144.	144.	144.	144.	144.	144.	144.	144.
144.	144.	144.	144.	144.	144.	144.	144.	144.	144.
143.	143.	143.	143.	143.	143.	143.	143.	143.	143.
143.	143.	143.	143.	143.	143.	143.	143.	143.	143.
143.	143.	143.	144.	144.	144.	144.	144.	144.	144.
144.	144.	145.	145.	145.	145.	146.	146.	146.	146.

Sh. 18

147.	147.	147.	148.	148.	148.	149.	149.	149.	150.
150.	151.	151.	152.	152.	153.	153.	154.	155.	156.
156.	157.	158.	159.	161.	162.	164.	165.	167.	169.
171.	173.	176.	179.	182.	185.	188.	192.	196.	200.
205.	210.	215.	220.	226.	232.	238.	244.	251.	257.
264.	270.	277.	284.	291.	297.	304.	310.	316.	321.
325.	327.	330.	331.	332.	333.	333.	333.	333.	332.
331.	331.	330.	329.	328.	327.	326.	324.	323.	322.
321.	320.	319.	318.	317.	317.	316.	315.	314.	313.

STAGE

14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.7	14.7	14.7
14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
14.7	14.7	14.7	14.7	14.8	14.8	14.8	14.8	14.8	14.8
14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.9
14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	15.0	15.0
15.0	15.0	15.0	15.0	15.1	15.1	15.1	15.2	15.2	15.2
15.3	15.3	15.4	15.4	15.5	15.5	15.6	15.7	15.8	15.8
15.9	16.0	16.1	16.2	16.3	16.4	16.5	16.6	16.7	16.8
16.9	17.0	17.1	17.2	17.3	17.4	17.5	17.6	17.7	17.7
17.8	17.8	17.8	17.9	17.9	17.9	17.9	17.9	17.9	17.9
17.9	17.9	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.7
17.7	17.7	17.7	17.7	17.7	17.7	17.6	17.6	17.6	17.6

PEAK OUTFLOW IS 496. AT TIME 46.17 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	496.	349.	117.	58.	17272.
CMS	14.	10.	3.	2.	489.
INCHES		.48	.64	.66	.66
MM		12.14	16.28	16.67	16.67
AC-FT		173.	232.	238.	238.
THOUS CU M		214.	287.	293.	293.

STATION OUTFLO, PLAN 1, RATIO 5

Sh. 19

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	1.	1.	1.	1.	1.	2.	2.	3.	3.
4.	4.	5.	6.	6.	7.	8.	9.	10.	10.
11.	12.	13.	14.	15.	15.	16.	17.	18.	18.
19.	19.	20.	20.	21.	21.	22.	22.	22.	22.
23.	23.	23.	23.	23.	23.	23.	23.	23.	22.
22.	22.	22.	22.	22.	21.	21.	21.	21.	21.
20.	20.	20.	20.	20.	20.	19.	19.	19.	19.
19.	19.	19.	18.	18.	18.	18.	18.	18.	18.
18.	18.	18.	18.	18.	18.	18.	18.	18.	18.
19.	19.	19.	19.	19.	20.	20.	20.	21.	21.
22.	22.	23.	23.	24.	25.	26.	27.	27.	28.
29.	30.	32.	33.	34.	35.	36.	37.	39.	40.
42.	44.	46.	48.	51.	53.	56.	59.	62.	65.
69.	73.	77.	82.	88.	93.	99.	103.	107.	111.
116.	121.	127.	133.	140.	147.	154.	161.	164.	168.
171.	175.	179.	183.	323.	476.	605.	716.	868.	987.
1076.	1143.	1194.	1231.	1257.	1275.	1285.	1289.	1286.	1277.
1264.	1246.	1224.	1199.	1171.	1140.	1107.	1072.	1035.	996.
955.	915.	874.	833.	793.	755.	721.	699.	675.	650.
624.	598.	572.	546.	521.	497.	473.	450.	428.	407.

STORAGE

138.	138.	138.	138.	138.	138.	138.	138.	138.	136.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	139.	139.	139.	139.	139.	140.	140.
140.	140.	141.	141.	142.	142.	143.	143.	144.	144.
145.	145.	146.	146.	146.	147.	147.	148.	148.	149.
149.	149.	150.	150.	150.	150.	151.	151.	151.	151.
151.	151.	151.	151.	151.	151.	151.	151.	151.	151.
151.	151.	151.	151.	151.	151.	151.	150.	150.	150.
150.	150.	150.	150.	150.	149.	149.	149.	149.	149.
149.	149.	149.	149.	149.	149.	149.	149.	149.	149.
149.	149.	149.	149.	149.	149.	149.	149.	149.	149.
149.	149.	149.	149.	149.	149.	150.	150.	150.	150.
151.	151.	151.	152.	152.	153.	153.	154.	154.	155.
155.	156.	157.	157.	158.	159.	160.	160.	161.	162.
163.	164.	165.	166.	167.	168.	169.	170.	171.	173.
174.	176.	178.	180.	183.	185.	188.	191.	195.	199.
203.	208.	213.	219.	225.	232.	240.	248.	256.	266.
276.	286.	298.	310.	321.	332.	340.	348.	354.	359.
363.	366.	368.	369.	370.	371.	371.	371.	371.	371.
370.	370.	369.	368.	367.	365.	364.	363.	361.	360.

Sh. 20

358.	355.	355.	353.	351.	350.	348.	347.	345.	344.
342.	340.	338.	336.	335.	333.	331.	330.	328.	327.

STAGE

14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7
14.7	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8
14.8	14.8	14.8	14.9	14.9	14.9	14.9	14.9	14.9	14.9
14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9
14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9
14.9	14.9	14.9	14.8	14.8	14.8	14.8	14.8	14.8	14.8
14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8
14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.8
14.8	14.8	14.8	14.8	14.8	14.8	14.8	14.9	14.9	14.9
14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	15.0
15.0	15.0	15.0	15.0	15.0	15.0	15.1	15.1	15.1	15.1
15.1	15.1	15.2	15.2	15.2	15.2	15.2	15.3	15.3	15.3
15.3	15.4	15.4	15.5	15.5	15.6	15.6	15.7	15.7	15.8
15.9	16.0	16.1	16.2	16.3	16.4	16.5	16.6	16.8	16.9
17.1	17.2	17.4	17.6	17.7	17.9	18.0	18.1	18.2	18.2
18.3	18.3	18.3	18.4	18.4	18.4	18.4	18.4	18.4	18.4
18.4	18.4	18.4	18.3	18.3	18.3	18.3	18.3	18.3	18.2
18.2	18.2	18.2	18.2	18.1	18.1	18.1	18.1	18.1	18.0
18.0	18.0	18.0	17.9	17.9	17.9	17.9	17.8	17.8	17.8

PEAK OUTFLOW IS 1289. AT TIME 44.67 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1289.	1000.	316.	154.	46339.
CMS	36.	28.	9.	4.	1312.
INCHES		1.37	1.73	1.76	1.76
MM		34.76	43.95	44.73	44.73
AC-FT		496.	627.	638.	638.
THOUS CU M		612.	774.	787.	787.

STATION OUTFLO, PLAN 1, RATIO 5

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Sh. 21

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.	1.	1.	1.	2.	2.	3.	3.	4.	5.
5.	6.	7.	8.	9.	11.	12.	13.	14.	15.
17.	18.	19.	20.	22.	23.	24.	25.	26.	27.
24.	29.	30.	30.	31.	32.	32.	33.	33.	33.
34.	34.	34.	34.	34.	34.	34.	34.	34.	34.
33.	33.	33.	33.	32.	32.	32.	32.	31.	31.
31.	30.	30.	30.	30.	29.	29.	29.	29.	28.
28.	28.	28.	28.	28.	27.	27.	27.	27.	27.
27.	27.	27.	27.	27.	27.	27.	27.	27.	28.
28.	28.	28.	29.	29.	29.	30.	30.	31.	32.
32.	33.	34.	35.	36.	37.	38.	40.	41.	43.
46.	48.	50.	52.	55.	57.	59.	62.	64.	67.
70.	73.	75.	78.	82.	85.	89.	93.	97.	100.
103.	106.	109.	113.	117.	122.	127.	132.	138.	144.
151.	159.	163.	166.	170.	174.	178.	182.	307.	485.
642.	818.	1019.	1181.	1316.	1430.	1528.	1612.	1687.	1767.
1830.	1878.	1913.	1939.	1955.	1963.	1964.	1958.	1944.	1922.
1895.	1861.	1823.	1781.	1735.	1685.	1644.	1597.	1545.	1491.
1433.	1373.	1313.	1253.	1194.	1136.	1080.	1026.	974.	924.
875.	829.	785.	744.	713.	690.	665.	639.	613.	587.

STORAGE

138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	139.	139.	139.	139.	140.	140.	140.	141.
141.	142.	142.	143.	143.	144.	145.	146.	146.	147.
148.	149.	149.	150.	151.	151.	152.	153.	153.	154.
155.	155.	156.	156.	156.	157.	157.	157.	158.	158.
158.	158.	158.	158.	158.	158.	158.	158.	158.	158.
158.	158.	158.	157.	157.	157.	157.	157.	157.	156.
156.	156.	156.	156.	155.	155.	155.	155.	155.	155.
155.	155.	154.	154.	154.	154.	154.	154.	154.	154.
154.	154.	154.	154.	154.	154.	154.	154.	154.	154.
154.	155.	155.	155.	155.	155.	156.	156.	156.	157.
157.	158.	158.	159.	159.	160.	161.	162.	163.	163.
164.	165.	166.	167.	168.	169.	170.	171.	172.	174.
175.	176.	177.	179.	180.	182.	183.	185.	187.	189.
192.	194.	197.	201.	204.	208.	213.	218.	224.	230.
237.	244.	253.	262.	272.	283.	295.	307.	320.	332.
343.	352.	360.	367.	373.	377.	381.	385.	388.	390.
392.	394.	395.	396.	396.	397.	397.	396.	396.	395.
394.	393.	392.	391.	389.	388.	386.	384.	382.	380.
377.	375.	372.	370.	368.	365.	363.	361.	359.	357.
355.	353.	351.	350.	348.	346.	345.	343.	341.	339.

Sh. 22

STAGE

14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6

14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.7
14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.8	14.8	14.8
14.8	14.8	14.8	14.9	14.9	14.9	14.9	14.9	14.9	14.9
14.9	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
15.0	15.0	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9
14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9
14.9	14.9	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
15.0	15.0	15.0	15.0	15.1	15.1	15.1	15.1	15.1	15.1
15.1	15.2	15.2	15.2	15.2	15.2	15.3	15.3	15.3	15.3
15.4	15.4	15.4	15.4	15.5	15.5	15.5	15.5	15.6	15.6
15.7	15.7	15.8	15.8	15.9	16.0	16.1	16.1	16.2	16.3
16.5	16.6	16.7	16.9	17.0	17.2	17.3	17.5	17.7	17.9
18.0	18.1	18.3	18.3	18.4	18.5	18.5	18.6	18.6	18.6
18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7	18.7
18.7	18.7	18.7	18.6	18.6	18.6	18.6	18.6	18.5	18.5
18.5	18.4	18.4	18.4	18.3	18.3	18.3	18.3	18.2	18.2
18.2	19.2	18.1	18.1	18.1	18.1	18.0	18.0	18.0	18.0

PEAK OUTFLOW IS 1964. AT TIME 44.50 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1964.	1601.	516.	252.	75467.
CMS	56.	45.	15.	7.	2137.
INCHES		2.19	2.82	2.87	2.87
MM		55.64	71.69	72.84	72.84
AC-FT		794.	1023.	1039.	1039.
THOUS CU M		979.	1262.	1282.	1282.

STATION OUTFLO, PLAN 1, RATIO 7

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	1.	1.
1.	1.	2.	2.	3.	4.	4.	5.	7.	8.
9.	11.	12.	14.	16.	18.	20.	21.	24.	26.
28.	30.	32.	34.	36.	38.	39.	42.	44.	47.
49.	51.	52.	54.	56.	57.	58.	59.	60.	60.

Sh. 23

61.	61.	61.	61.	61.	61.	61.	60.	60.	59.
59.	58.	57.	57.	56.	55.	55.	54.	53.	52.
52.	51.	50.	50.	49.	48.	48.	47.	47.	46.
46.	46.	45.	45.	45.	44.	44.	44.	44.	44.
44.	44.	44.	44.	44.	44.	44.	45.	45.	45.
46.	46.	47.	49.	48.	49.	50.	52.	53.	55.
56.	58.	60.	62.	65.	67.	70.	73.	76.	79.
82.	85.	88.	92.	96.	99.	101.	103.	105.	107.
110.	112.	114.	117.	120.	123.	126.	130.	133.	138.
142.	147.	152.	158.	162.	165.	168.	171.	175.	179.
183.	328.	504.	664.	870.	1086.	1271.	1437.	1589.	1749.
1923.	2081.	2230.	2370.	2502.	2626.	2741.	2846.	2942.	3025.
3097.	3157.	3204.	3239.	3262.	3274.	3275.	3265.	3241.	3207.
3162.	3108.	3046.	2976.	2900.	2819.	2731.	2638.	2541.	2440.
2337.	2232.	2128.	2025.	1925.	1829.	1737.	1656.	1587.	1516.
1445.	1375.	1306.	1240.	1176.	1115.	1057.	1003.	951.	901.

STORAGE

138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
139.	139.	139.	139.	140.	140.	141.	141.	142.	142.
143.	144.	145.	146.	147.	148.	149.	151.	152.	153.
154.	156.	157.	158.	159.	160.	162.	163.	164.	165.
166.	166.	167.	168.	169.	169.	170.	170.	170.	171.
171.	171.	171.	171.	171.	171.	171.	171.	170.	170.
170.	170.	169.	169.	169.	169.	168.	168.	168.	167.
167.	167.	166.	166.	166.	166.	165.	165.	165.	165.
164.	164.	164.	164.	164.	164.	164.	164.	164.	164.
164.	164.	164.	164.	164.	164.	164.	164.	164.	164.
164.	165.	165.	165.	165.	166.	166.	167.	167.	168.
169.	170.	171.	171.	173.	174.	175.	176.	177.	179.
180.	182.	183.	185.	186.	188.	190.	191.	193.	195.
197.	199.	202.	204.	207.	209.	213.	216.	219.	223.
228.	233.	238.	244.	251.	258.	266.	275.	285.	297.
309.	322.	334.	345.	355.	363.	371.	378.	384.	390.
395.	400.	405.	410.	414.	418.	422.	425.	428.	431.
434.	436.	437.	438.	439.	440.	440.	439.	438.	437.
436.	434.	432.	430.	427.	424.	421.	418.	415.	412.
409.	405.	402.	399.	395.	392.	390.	387.	384.	381.
378.	375.	372.	369.	367.	364.	362.	360.	358.	356.

STAGE

14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6

Sh. 24

14.6	14.6	14.6	14.6	14.6	14.6	14.7	14.7	14.7	14.7
14.7	14.7	14.8	14.8	14.8	14.8	14.8	14.9	14.9	14.9
14.9	15.0	15.0	15.0	15.0	15.1	15.1	15.1	15.1	15.2
15.2	15.2	15.2	15.2	15.2	15.2	15.3	15.3	15.3	15.3
15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3
15.3	15.3	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2
15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2
15.2	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1
15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1
15.1	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2
15.2	15.3	15.3	15.3	15.3	15.3	15.4	15.4	15.4	15.4
15.5	15.5	15.5	15.5	15.6	15.6	15.6	15.7	15.7	15.7
15.8	15.8	15.9	15.9	15.9	16.0	16.0	16.1	16.2	16.2
16.3	16.4	16.5	16.6	16.7	16.8	16.9	17.1	17.2	17.4
17.6	17.7	17.9	18.0	18.2	18.3	18.4	18.5	18.6	18.6
18.7	18.8	18.8	18.9	18.9	19.0	19.0	19.1	19.1	19.1
19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2	19.2
19.2	19.2	19.1	19.1	19.1	19.0	19.0	19.0	18.9	18.9
18.9	18.8	18.8	18.7	18.7	18.7	18.6	18.6	18.5	18.5
18.5	18.4	18.4	18.4	18.3	18.3	18.3	18.2	18.2	18.2

PEAK OUTFLOW IS 3275. AT TIME 44.50 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3275.	2731.	918.	448.	134301.
CMS	93.	77.	26.	13.	3803.
INCHES		3.74	5.02	5.10	5.10
MM		94.88	127.62	129.63	129.63
AC-FT		1354.	1821.	1850.	1850.
THOUS CU M		1670.	2246.	2282.	2282.

STATION OUTFLO, PLAN 1, RATIO 8

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	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.	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.	1.	1.	1.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	1.	1.	1.	2.
2.	3.	4.	5.	6.	7.	9.	11.	13.	15.
18.	21.	24.	27.	31.	35.	38.	43.	49.	55.
60.	66.	71.	77.	82.	87.	91.	96.	100.	102.
104.	105.	107.	109.	110.	111.	112.	113.	114.	115.
115.	114.	116.	116.	116.	116.	116.	115.	115.	115.
114.	114.	113.	113.	112.	111.	110.	110.	109.	108.
108.	107.	106.	105.	105.	104.	103.	103.	102.	101.
101.	100.	100.	100.	99.	99.	98.	97.	97.	96.
96.	96.	96.	96.	95.	96.	96.	96.	96.	97.
97.	98.	99.	100.	100.	101.	102.	103.	105.	106.
108.	110.	112.	114.	116.	119.	122.	125.	128.	131.

Sh. 25

134.	138.	141.	145.	149.	153.	157.	160.	162.	164.
166.	168.	170.	172.	174.	176.	179.	181.	190.	315.
428.	533.	634.	736.	898.	1044.	1182.	1319.	1460.	1606.
1783.	1986.	2187.	2390.	2598.	2811.	3031.	3258.	3491.	3731.
3976.	4227.	4534.	4823.	5090.	5337.	5564.	5770.	5954.	6115.
6251.	6364.	6451.	6513.	6552.	6568.	6563.	6534.	6480.	6404.
6307.	6191.	6061.	5916.	5759.	5590.	5410.	5220.	5022.	4816.
4605.	4393.	4196.	4025.	3847.	3669.	3492.	3319.	3151.	2988.
2831.	2681.	2537.	2402.	2274.	2153.	2039.	1931.	1830.	1735.

STORAGE

138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	139.	139.	139.	139.	139.	139.	139.	139.
139.	139.	139.	139.	139.	139.	139.	139.	139.	139.
139.	139.	139.	139.	139.	139.	139.	139.	139.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	139.	139.
139.	140.	140.	141.	141.	142.	143.	144.	146.	147.
149.	150.	152.	154.	156.	159.	161.	163.	166.	168.
171.	173.	175.	178.	180.	182.	184.	186.	188.	190.
192.	194.	195.	196.	198.	199.	200.	201.	201.	202.
202.	203.	203.	203.	203.	203.	203.	203.	202.	202.
201.	201.	200.	200.	199.	199.	198.	197.	197.	196.
195.	195.	194.	193.	193.	192.	192.	191.	191.	190.
190.	189.	189.	188.	188.	188.	187.	187.	187.	187.
187.	186.	186.	186.	186.	186.	186.	186.	187.	187.
187.	187.	188.	188.	189.	190.	191.	192.	193.	194.
196.	197.	199.	201.	204.	206.	208.	211.	214.	217.
220.	224.	227.	231.	235.	239.	243.	247.	251.	256.
261.	266.	271.	277.	283.	289.	296.	304.	313.	321.
328.	335.	342.	349.	356.	362.	367.	373.	378.	385.
391.	397.	404.	410.	417.	424.	431.	439.	447.	455.
464.	472.	481.	489.	496.	503.	510.	516.	521.	525.
530.	533.	535.	537.	538.	539.	539.	538.	536.	534.
531.	528.	524.	520.	515.	511.	505.	500.	495.	489.
483.	477.	471.	465.	459.	453.	447.	441.	435.	430.
425.	420.	415.	411.	407.	403.	399.	396.	392.	389.

STAGE

14.6	14.6	14.6	14.5	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.7	14.7	14.7	14.7	14.7	14.8	14.8
14.8	14.9	14.9	14.9	15.0	15.0	15.1	15.1	15.2	15.2
15.3	15.3	15.4	15.4	15.5	15.5	15.5	15.6	15.6	15.6
15.7	15.7	15.7	15.8	15.8	15.8	15.8	15.8	15.8	15.9
15.9	15.9	15.9	15.9	15.9	15.9	15.9	15.9	15.9	15.9
15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8
15.7	15.7	15.7	15.7	15.7	15.7	15.7	15.7	15.7	15.6

Sh. 26

15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6
15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6
15.6	15.6	15.6	15.6	15.6	15.6	15.7	15.7	15.7	15.7
15.7	15.8	15.8	15.8	15.9	15.9	16.0	16.0	16.1	16.1
16.2	16.2	16.3	16.4	16.4	16.5	16.6	16.6	16.7	16.8
16.8	16.9	17.0	17.1	17.2	17.3	17.4	17.5	17.6	17.7
17.8	17.9	18.0	18.1	18.2	18.3	18.3	18.4	18.5	18.6
18.6	18.7	18.8	18.9	19.0	19.0	19.1	19.2	19.3	19.4
19.5	19.6	19.7	19.8	19.9	19.9	20.0	20.1	20.1	20.2
20.2	20.2	20.3	20.3	20.3	20.3	20.3	20.3	20.3	20.2
20.2	20.2	20.1	20.1	20.1	20.0	19.9	19.9	19.8	19.8
19.7	19.6	19.6	19.5	19.4	19.4	19.3	19.2	19.2	19.1
19.0	19.0	18.9	18.9	18.8	18.8	18.7	18.7	18.7	18.6

PEAK OUTFLOW IS 6568. AT TIME 44.33 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6568.	5476.	1929.	940.	281965.
CMS	186.	155.	55.	27.	7984.
INCHES		7.49	10.56	10.71	10.71
MM		190.27	268.11	272.15	272.15
AC-FT		2715.	3826.	3884.	3884.
THOUS CU M		3349.	4719.	4791.	4791.

STATION OUTFLO, PLAN 1, RATIO 9

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.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	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.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	2.	2.	3.
4.	6.	7.	9.	12.	14.	18.	21.	26.	30.
35.	42.	51.	60.	69.	79.	89.	99.	105.	110.
115.	121.	126.	131.	137.	142.	146.	151.	155.	160.
161.	163.	164.	166.	167.	168.	169.	170.	171.	171.
172.	172.	173.	173.	174.	174.	174.	174.	174.	174.
174.	174.	174.	174.	174.	173.	173.	173.	173.	172.
172.	172.	172.	171.	171.	171.	171.	170.	170.	170.
170.	170.	169.	169.	169.	169.	169.	169.	169.	169.
169.	169.	169.	169.	169.	169.	169.	170.	170.	170.
170.	171.	171.	172.	172.	173.	174.	175.	176.	177.
178.	179.	181.	183.	196.	269.	333.	390.	442.	490.
534.	575.	614.	651.	685.	718.	767.	814.	856.	895.
934.	973.	1015.	1061.	1111.	1147.	1229.	1300.	1381.	1473.
1577.	1698.	1867.	2042.	2228.	2426.	2639.	2872.	3129.	3407.
3711.	4040.	4424.	4866.	5304.	5744.	6192.	6649.	7118.	7605.
8106.	8710.	9242.	9760.	10256.	10726.	11164.	11570.	11966.	12298.
12570.	12790.	12956.	13070.	13137.	13160.	13139.	13070.	12950.	12785.
12580.	12339.	12068.	11770.	11453.	11139.	10791.	10419.	10025.	9613.

Sh. 27

9190.	8743.	8341.	7926.	7533.	7195.	6853.	6514.	6181.	5858.
5547.	5249.	4967.	4701.	4450.	4220.	4036.	3850.	3665.	3485.
				STORAGE					
138.	138.	138.	138.	139.	139.	139.	139.	139.	139.
139.	139.	139.	139.	139.	139.	139.	139.	139.	139.
139.	139.	139.	139.	139.	139.	139.	139.	139.	139.
139.	139.	139.	139.	139.	139.	139.	139.	139.	139.
139.	139.	139.	139.	139.	139.	139.	139.	139.	139.
139.	139.	139.	139.	139.	139.	139.	139.	139.	139.
139.	139.	139.	139.	139.	139.	139.	139.	139.	139.
139.	139.	139.	139.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	138.	138.	138.	138.
138.	138.	138.	138.	138.	138.	139.	139.	139.	140.
140.	141.	142.	143.	145.	146.	148.	151.	153.	156.
159.	163.	166.	170.	175.	179.	183.	188.	193.	198.
203.	208.	213.	218.	222.	227.	232.	237.	241.	245.
249.	253.	257.	260.	264.	267.	269.	272.	274.	276.
277.	279.	280.	281.	282.	283.	283.	284.	284.	284.
284.	283.	283.	283.	282.	282.	281.	280.	280.	279.
278.	277.	277.	276.	275.	275.	274.	273.	273.	272.
272.	271.	271.	270.	270.	270.	270.	270.	269.	269.
269.	269.	270.	270.	270.	270.	271.	271.	272.	273.
274.	275.	276.	277.	279.	281.	283.	286.	288.	292.
295.	299.	303.	308.	313.	318.	322.	326.	329.	333.
336.	338.	341.	344.	346.	348.	350.	352.	354.	356.
357.	359.	360.	362.	364.	366.	369.	372.	375.	379.
383.	388.	394.	399.	405.	412.	418.	426.	435.	444.
455.	466.	478.	490.	502.	515.	528.	541.	555.	570.
584.	599.	613.	627.	640.	653.	666.	677.	687.	695.
702.	708.	712.	715.	717.	716.	717.	715.	712.	704.
703.	697.	690.	682.	674.	665.	655.	645.	634.	623.
611.	600.	589.	578.	568.	557.	547.	537.	528.	518.
509.	501.	493.	486.	479.	472.	466.	459.	453.	447.
				STAGE					
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
14.7	14.7	14.7	14.7	14.7	14.8	14.8	14.9	14.9	15.0
15.0	15.1	15.2	15.3	15.3	15.4	15.5	15.6	15.7	15.8
15.9	16.0	16.0	16.1	16.2	16.3	16.4	16.5	16.5	16.6
16.7	16.7	16.8	16.8	16.9	16.9	17.0	17.0	17.0	17.1
17.1	17.1	17.1	17.2	17.2	17.2	17.2	17.2	17.2	17.2
17.2	17.2	17.2	17.2	17.2	17.2	17.1	17.1	17.1	17.1
17.1	17.1	17.1	17.1	17.1	17.1	17.0	17.0	17.0	17.0
17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0
17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0
17.0	17.1	17.1	17.1	17.1	17.1	17.2	17.2	17.3	17.3
17.4	17.4	17.5	17.5	17.6	17.7	17.7	17.8	17.8	17.9
17.9	18.0	18.0	18.0	18.1	18.1	18.1	18.1	18.2	18.2
18.2	18.2	18.3	18.3	18.3	18.3	18.4	18.4	18.4	18.5
18.5	18.6	18.7	18.7	18.8	18.9	19.0	19.1	19.2	19.3

Sh. 28

19.4	19.5	19.7	19.8	19.9	20.0	20.2	20.3	20.5	20.6
20.5	20.9	21.0	21.2	21.3	21.4	21.5	21.6	21.7	21.8
21.8	21.9	21.9	21.9	22.0	22.0	22.0	21.9	21.9	21.9
21.8	21.8	21.7	21.7	21.6	21.5	21.4	21.3	21.2	21.1
21.0	20.9	20.8	20.7	20.6	20.5	20.4	20.3	20.2	20.1
20.0	19.9	19.8	19.7	19.7	19.6	19.5	19.4	19.4	19.3

PEAK OUTFLOW IS 13160. AT TIME 44.33 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	13160.	10968.	3957.	1927.	577971.
CMS	373.	311.	112.	55.	16366.
INCHES		15.00	21.71	21.96	21.96
MM		381.09	551.33	557.85	557.85
AC-FT		5439.	7868.	7961.	7961.
THOUS CU M		6708.	9705.	9820.	9820.

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 .02	RATIO 2 .03	RATIO 3 .04	RATIO 4 .05	RATIO 5 .10	RATIO 6 .15	RATIO 7 .25	RATIO 8 .50	RATIO 9 1.00
HYDROGRAPH AT	INFLOW	6.80	1	265.	397.	530.	662.	1324.	1986.	3310.	6620.	13240.
		(17.61)		(7.50)	(11.25)	(15.00)	(18.75)	(37.49)	(56.24)	(93.73)	(187.46)	(374.92)
ROUTED TO	OUTFLO	6.80	1	133.	169.	278.	496.	1289.	1964.	3275.	6568.	13160.
		(17.61)		(3.77)	(4.78)	(7.86)	(14.03)	(36.49)	(55.63)	(92.74)	(185.99)	(372.64)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	14.60	14.60	17.60
STORAGE	138.	138.	312.
OUTFLOW	0.	0.	184.

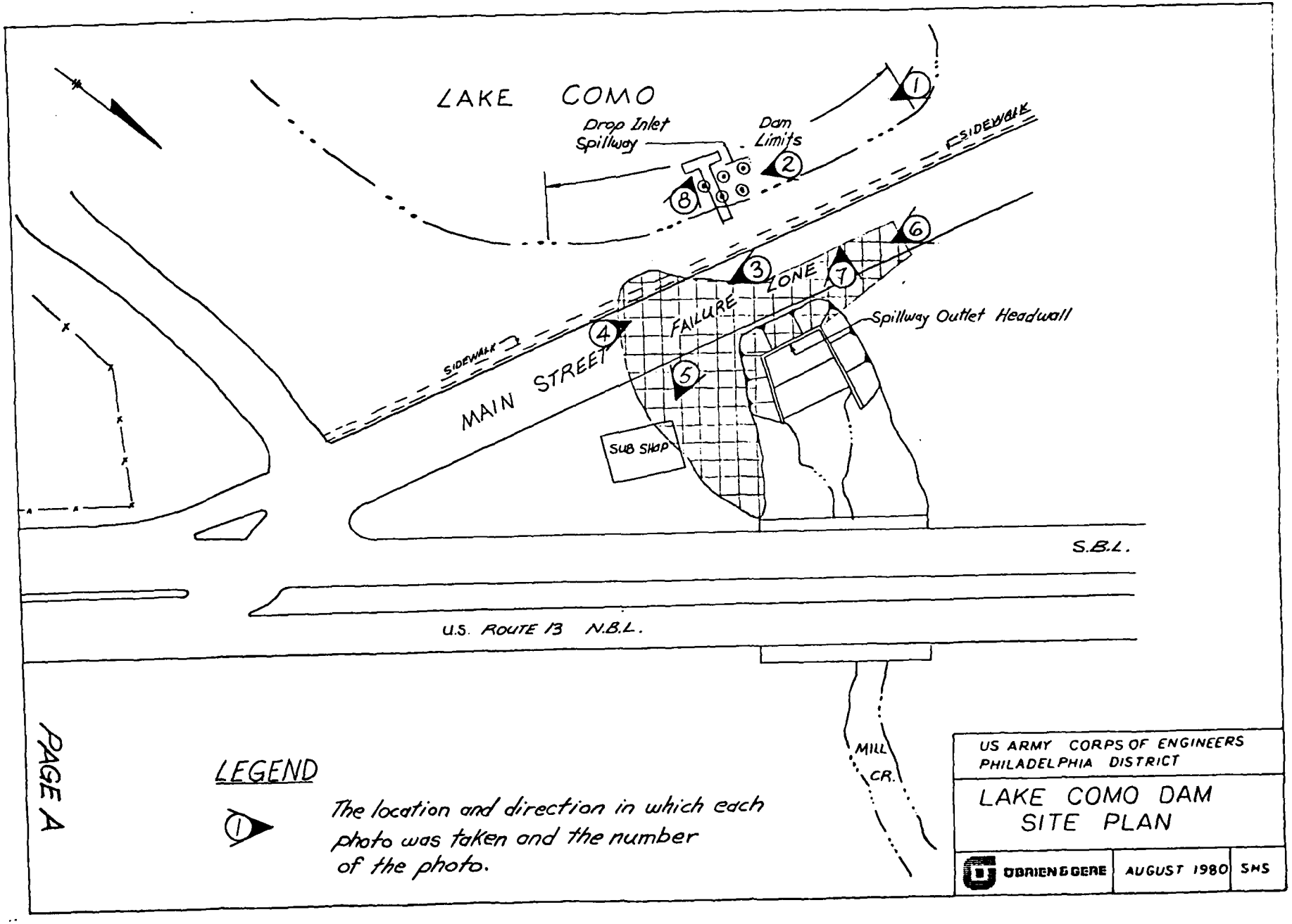
RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.02	16.16	0.00	219.	133.	0.00	47.50	0.00
.03	16.47	0.00	264.	169.	0.00	48.17	0.00
.04	17.09	.09	318.	278.	3.17	47.50	0.00
.05	17.89	.29	333.	496.	5.33	46.17	0.00
.10	18.39	.79	371.	1289.	7.67	44.67	0.00
.15	18.71	1.11	397.	1964.	8.67	44.50	0.00
.25	19.22	1.62	440.	3275.	9.83	44.50	0.00
.50	20.30	2.70	539.	6568.	12.00	44.33	0.00
1.00	21.97	4.37	718.	13160.	16.00	44.33	0.00

Sh. 29

APPENDIX

D

Photographs



PAGE A

LEGEND

(1) The location and direction in which each photo was taken and the number of the photo.

US ARMY CORPS OF ENGINEERS
PHILADELPHIA DISTRICT

LAKE COMO DAM
SITE PLAN

O'BRIEN & GERE | AUGUST 1980 | SMS

APPENDIX D

SELECTED PHOTOGRAPHS OF THE SITE

1. UPSTREAM OVERVIEW LOOKING TOWARDS RIGHT ABUTMENT.
(8/12/80)

2. VIEW OF MULTIPLE DROP INLET SPILLWAY, ACCESS BRIDGE AND OPERATORS FOR LOW-LEVEL OUTLET.
(8/12/80)

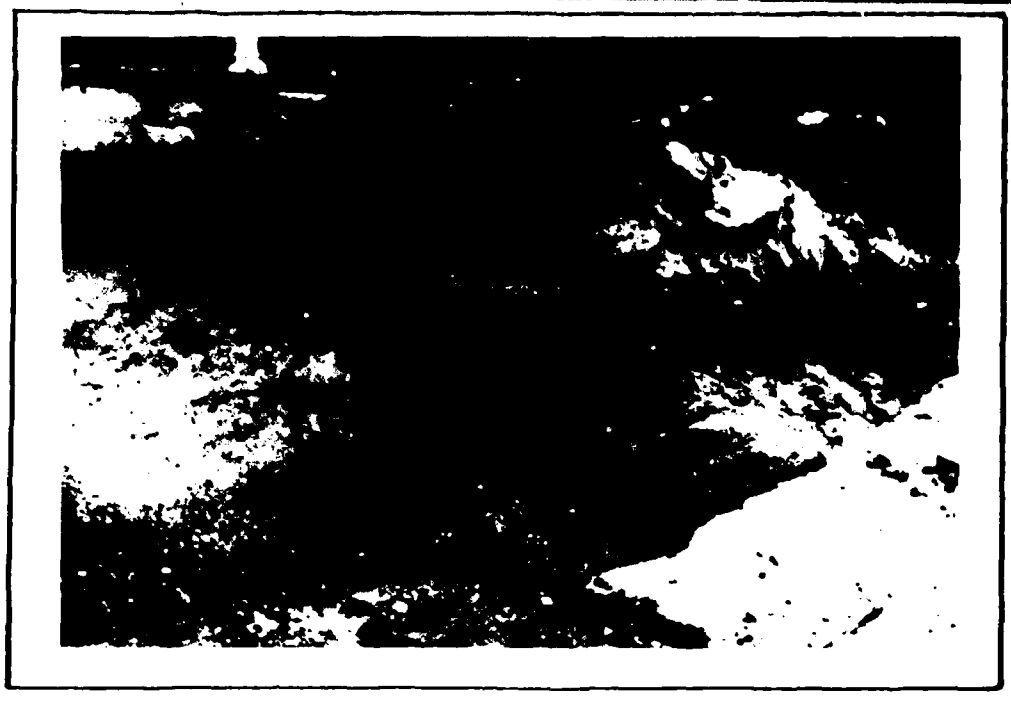
3. VIEW SHOWING THE ZONE OF FAILURE AT THE RIGHT ABUTMENT WHICH WAS PREVENTED FROM BREACHING BY SANDBAGGING.

(8/12/80)

4. VIEW SHOWING FAILURE ZONE LOOKING TOWARDS LEFT ABUTMENT. NOTE THE RUPTURED 6" WATER AND 4" GAS LINES.
(8/12/80)

5. VIEW EXHIBITING UNDERMINING OF RESTAURANT DOWNSTREAM OF THE RIGHT ABUTMENT. AUTO IN LEFT BACKGROUND IS TRAVELING UPON U.S. ROUTE 13.
(8/12/80)

6. VIEW OF FAILURE ZONE LOOKING TOWARDS RIGHT ABUTMENT. AREA OF OVERTOPPING EXTENDED ABOUT 500 FEET TO CEMETARY IN BACKGOUND.
(8/12/80)



7. VIEW EXHIBITING CONTACT BETWEEN EMBANKMENT FILL ON LEFT AND NATURAL ABUTMENT MATERIAL ON RIGHT.
(8/12/80)

8. OPERATOR FOR LOW-LEVEL OUTLET.
(8/12/80)

APPENDIX

E

Drawings

O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
LAKE COMO DAM				

APPENDIX E

TABLE OF CONTENTS

DRAWINGS

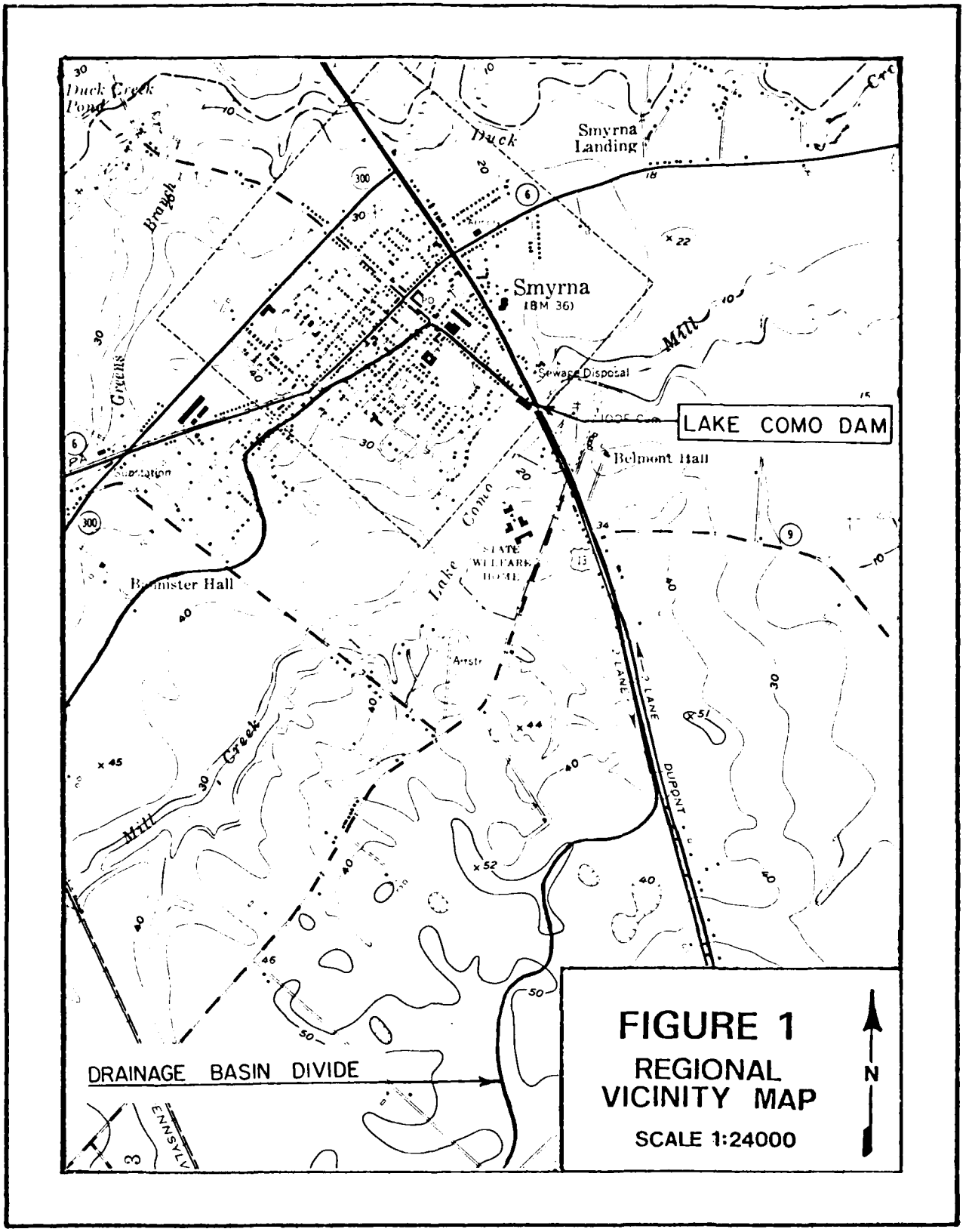
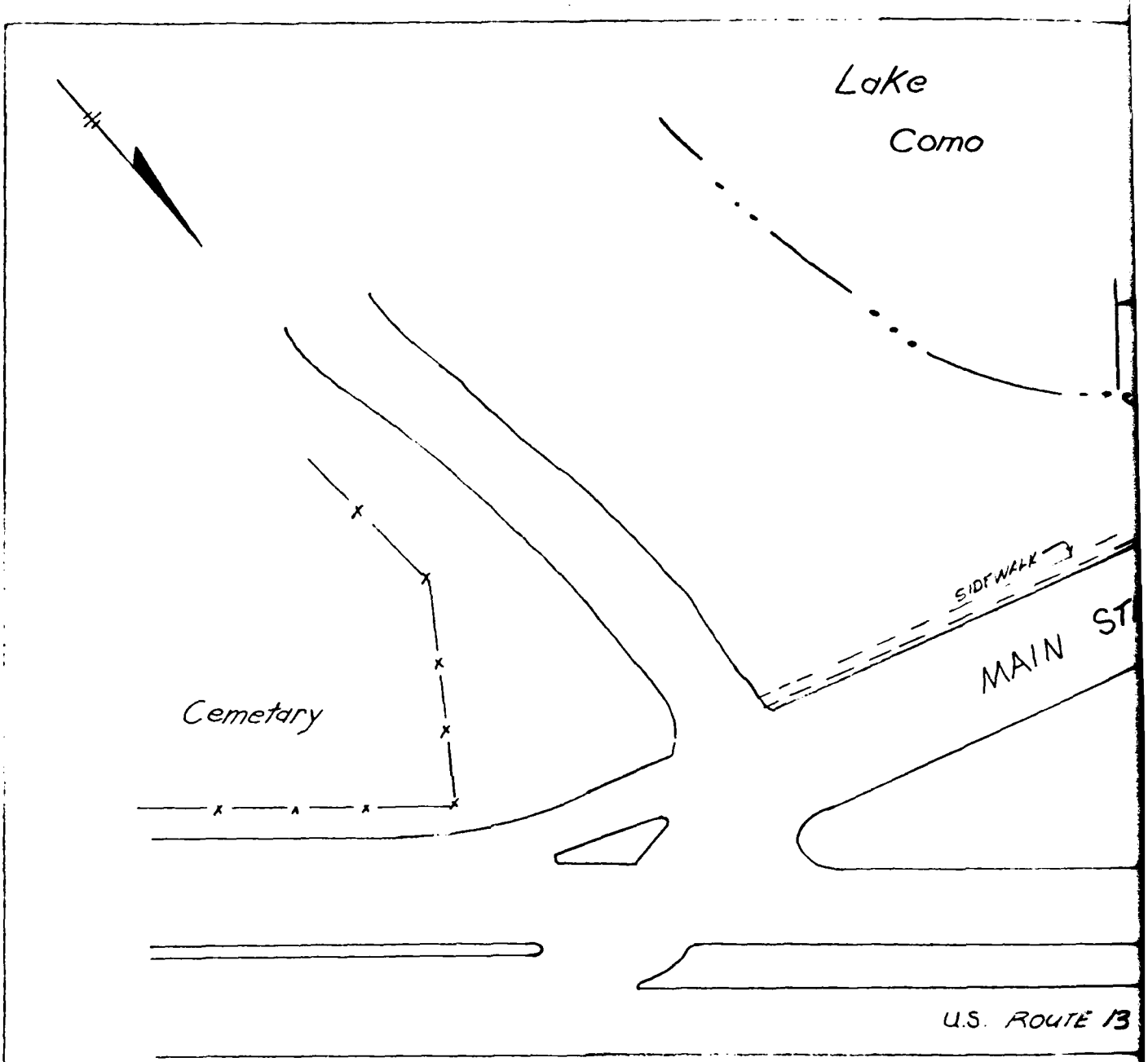
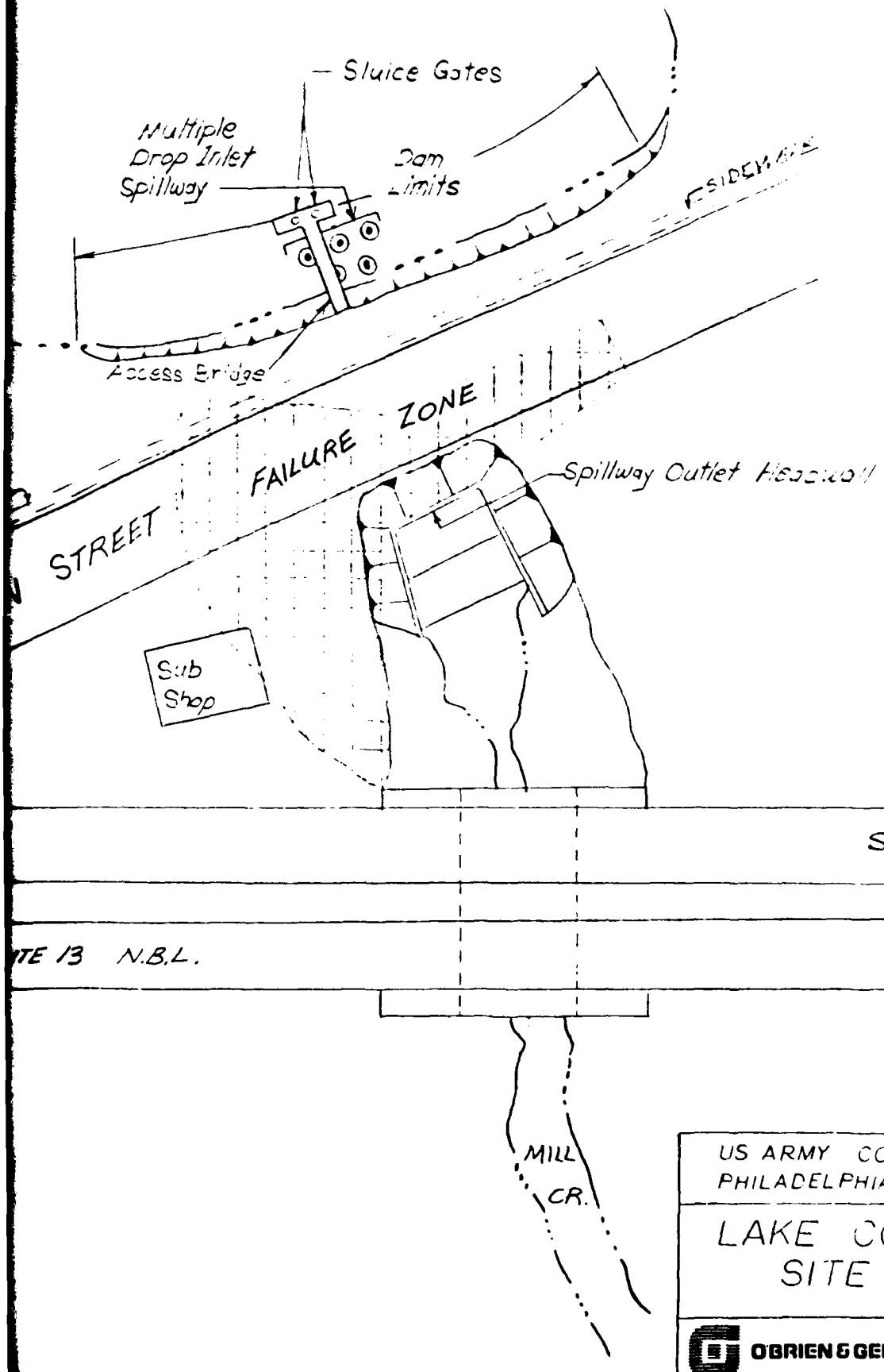


FIGURE 1

REGIONAL VICINITY MAP

SCALE 1:24000


Lake
Como
SIDEWALK
MAIN ST
Cemetary
U.S. ROUTE 13

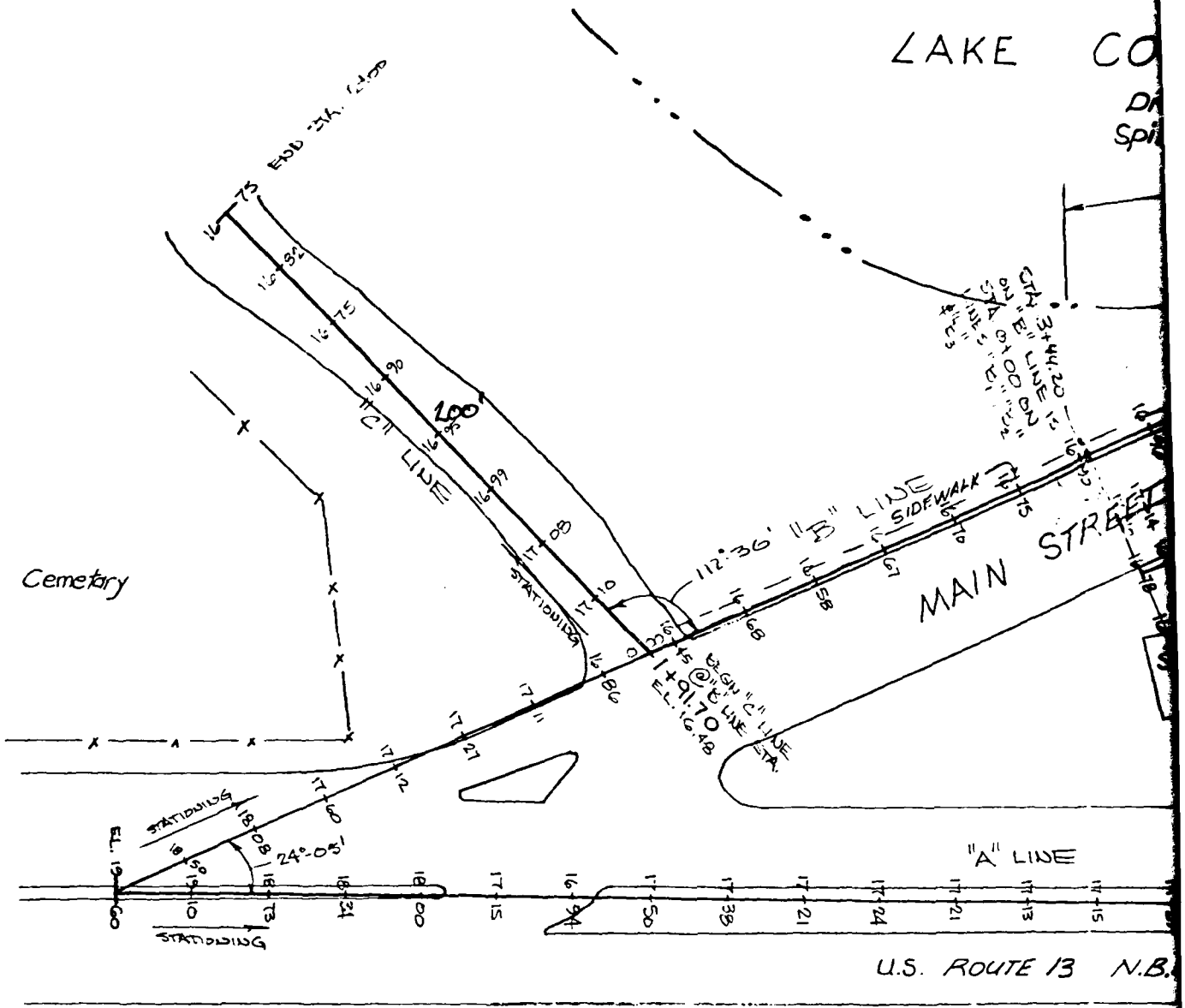


SHEET 2

US ARMY CORPS OF ENGINEERS
PHILADELPHIA DISTRICT

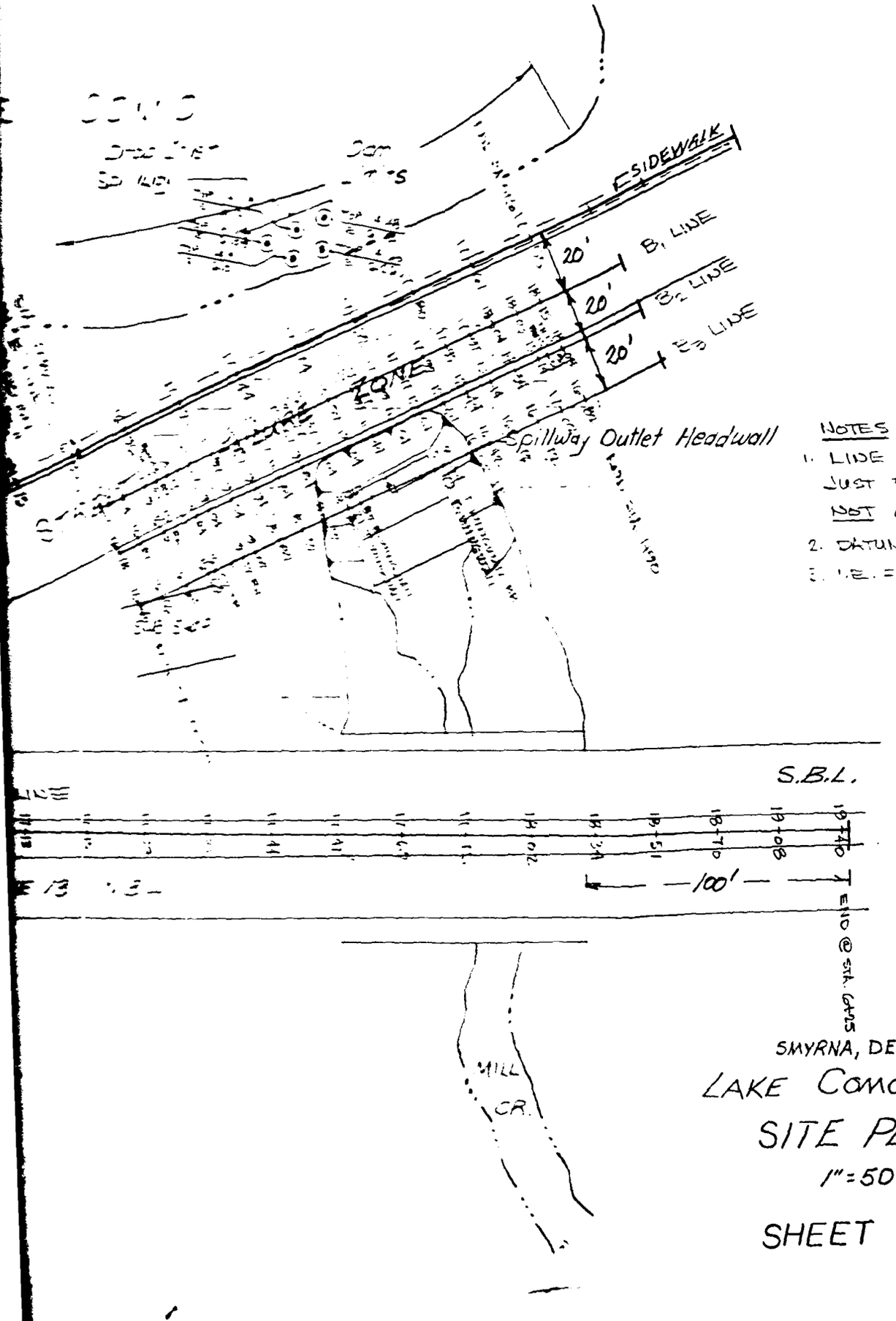
LAKE COMO DAM
SITE PLAN

O'BRIEN & GERE | AUGUST 1980 | SHS



Topographic Survey Lines
Elevations @ 25' Intervals

Topographic Survey Lines
Elevs. @ 10' Intervals and at
limits of failure zone



NOTES

1. LINE "B" WAS ESTABLISHED JUST BEHIND SIDEWALK, NOT ON SIDEWALK
2. DATUM = USC&GS
3. I.E. = INVERT ELEVATION

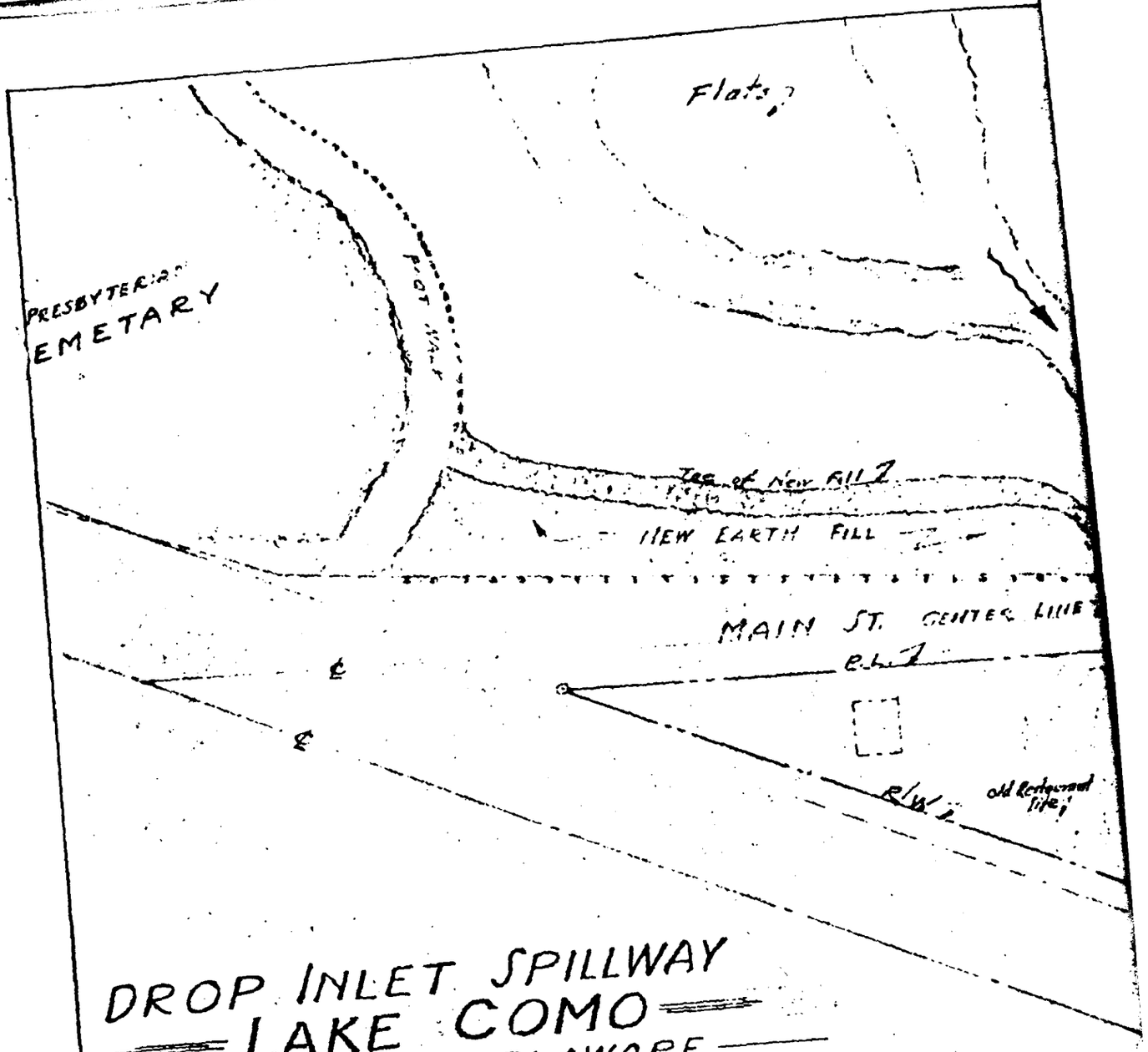
SMYRNA, DE

LAKE COMO DAM

SITE PLAN

1" = 50'

SHEET 3



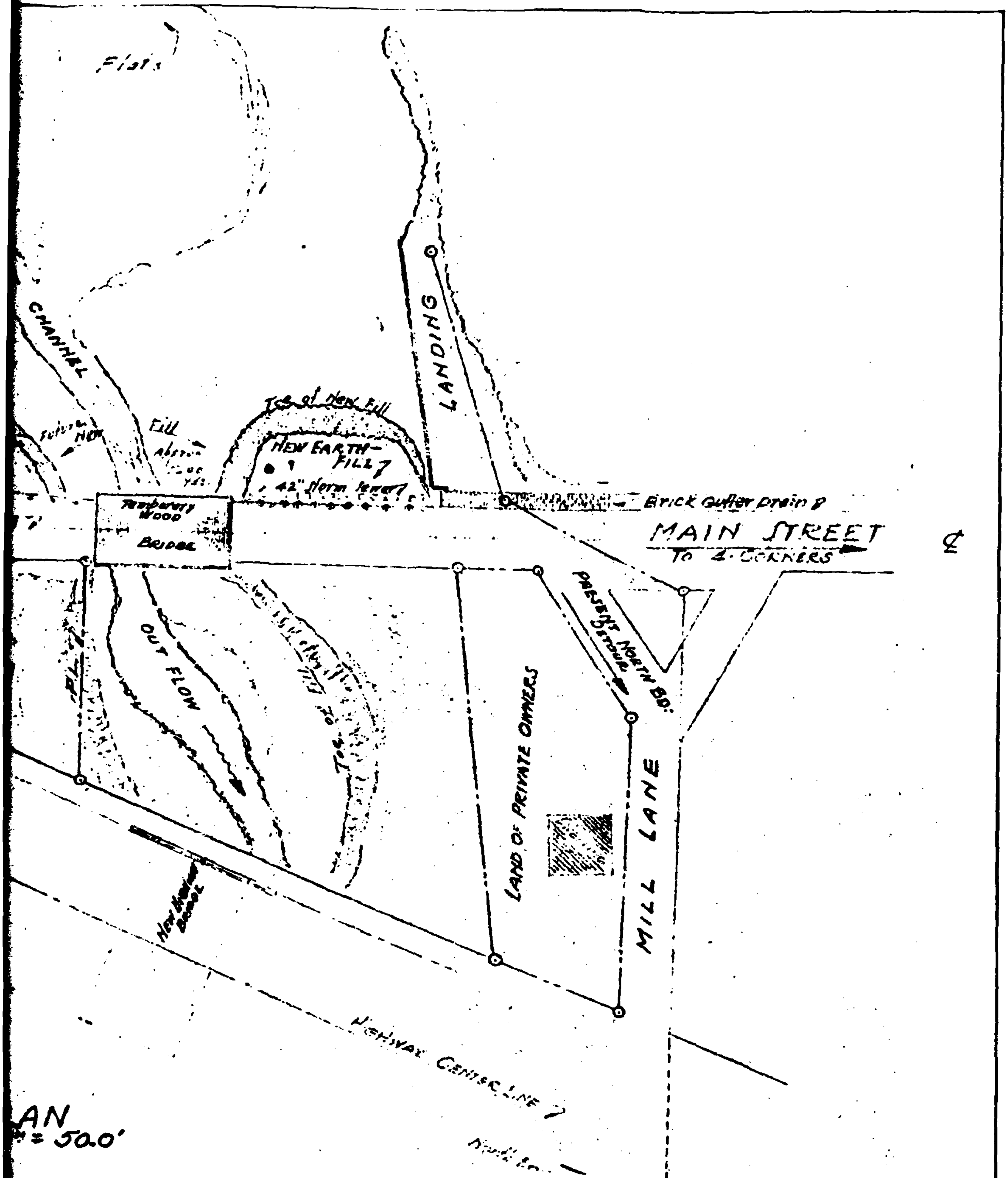
DROP INLET SPILLWAY
LAKE COMO
SMYRNA, DELAWARE.

PROJECT - TOWN COMMISSIONERS
PLAYGROUND - RECREATION COMM'T.

SHEET NO. (1)

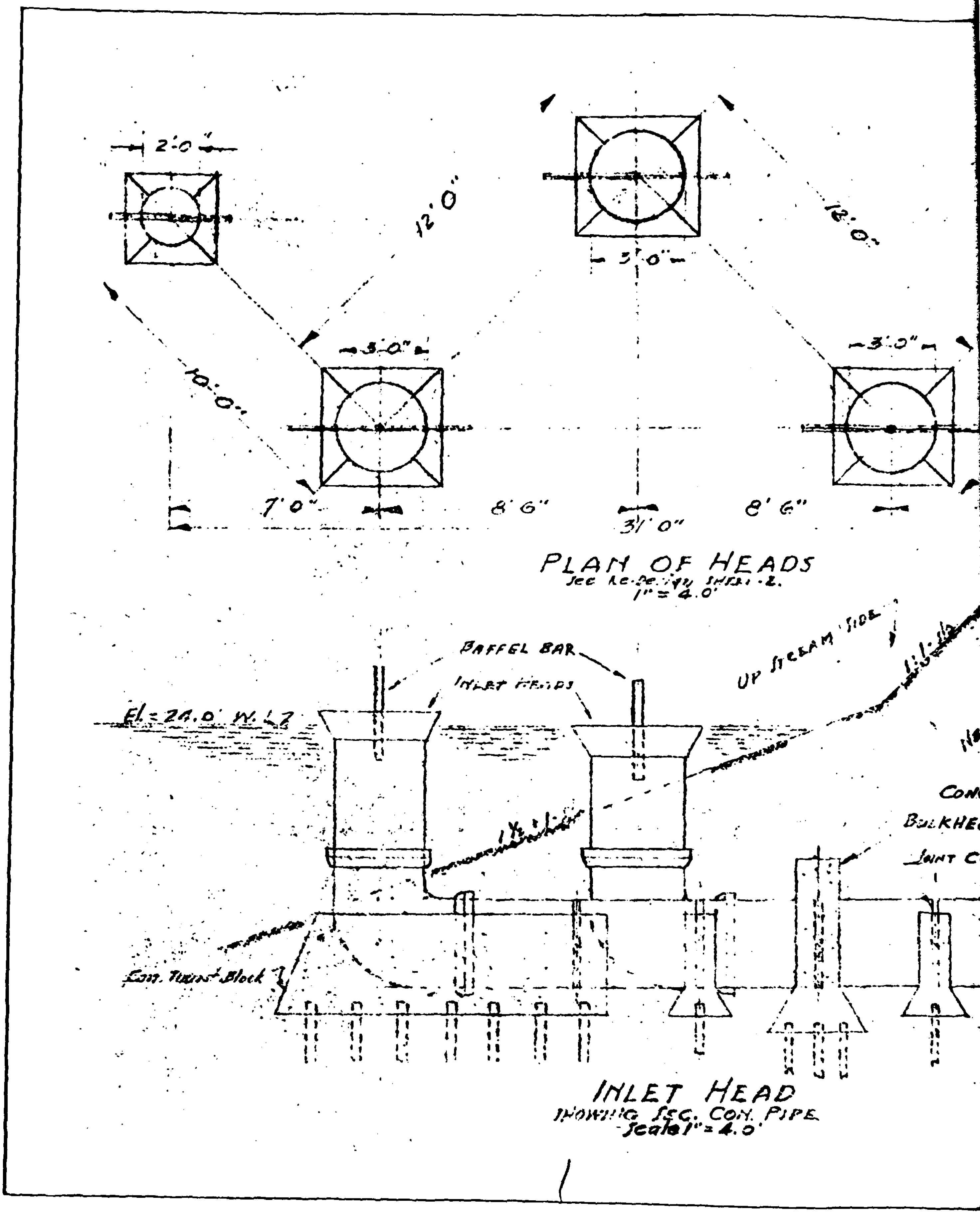
J. E. HADDAWAY ENGINEER
WYOMING, DELAWARE.
FROM DESIGNS OF PROF. L. H. KESSLER
UNIVERSITY OF WISC.
MARCH - 1941.

PL
Scale 1"

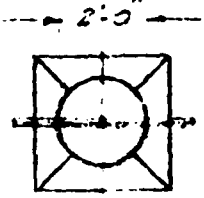

Flats
CHANNEL
Fill
Toe of New Fill
NEW EARTH-FILL
42" Storm Sewer
LANDING
Temporary Wood Bridge
Brick Gutter Drain
MAIN STREET
To 4-CORNERS
℄
PRESENT NORTH BD. DETOUR
OUT FLOW
FILL
LAND OF PRIVATE OWNERS
MILL LANE
HIGHWAY CENTER LINE
AN
= 50.0'

SHEET 4

1

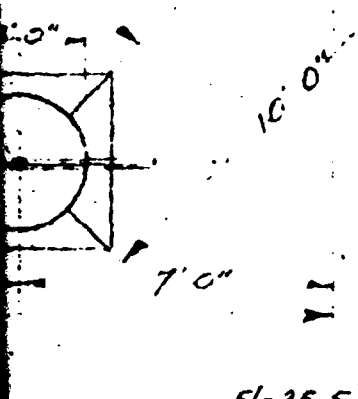


2'-0"
12'0"
12'0"
3'0"
3'0"
3'0"
10'0"
7'0"
8'6"
31'0"
8'6"
PLAN OF HEADS
1" = 4.0'
BAFFEL BAR
INLET HEADS
UP STREAM SIDE
El = 24.0' W.L.
CON
BULKHE
JOINT C
INLET HEAD
Scale 1" = 4.0'

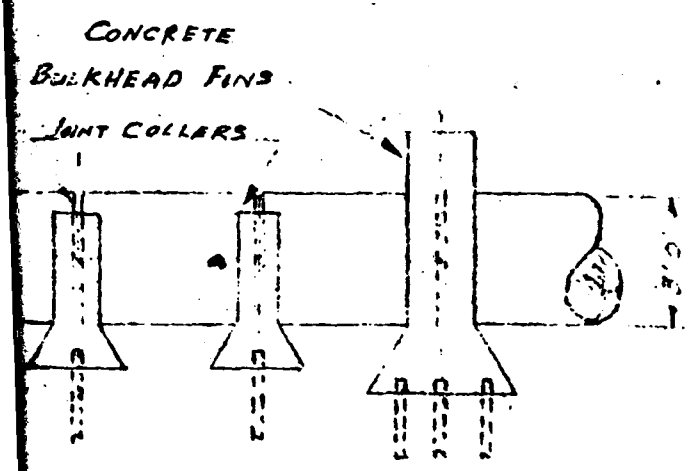


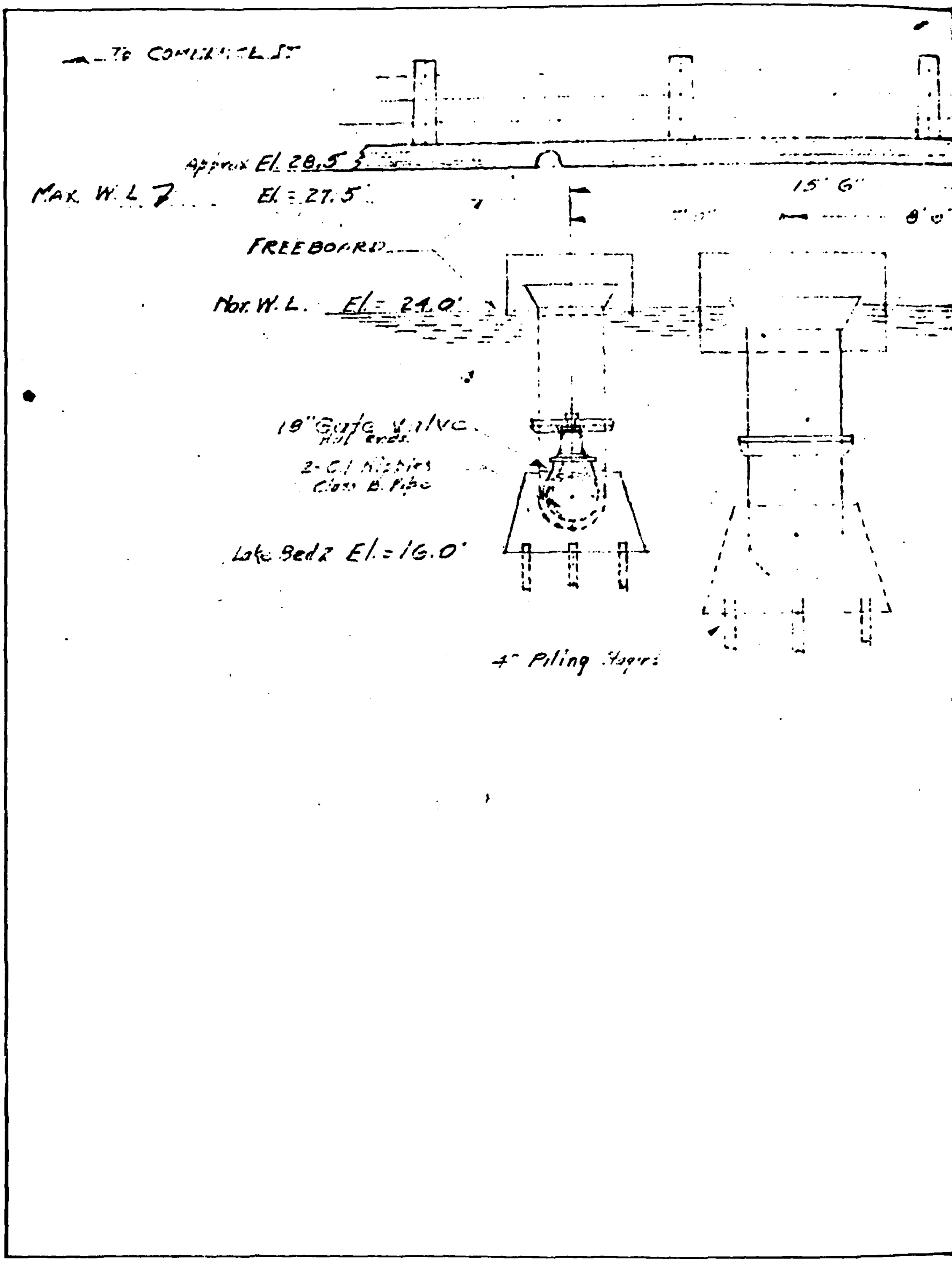
DROP INLET SPILLWAY
LAKE COMO
SMYRNA, DELAWARE.
PROJECT - TOWN COMMISSIONERS
PLAYGROUND - RECREATION COMM'T.

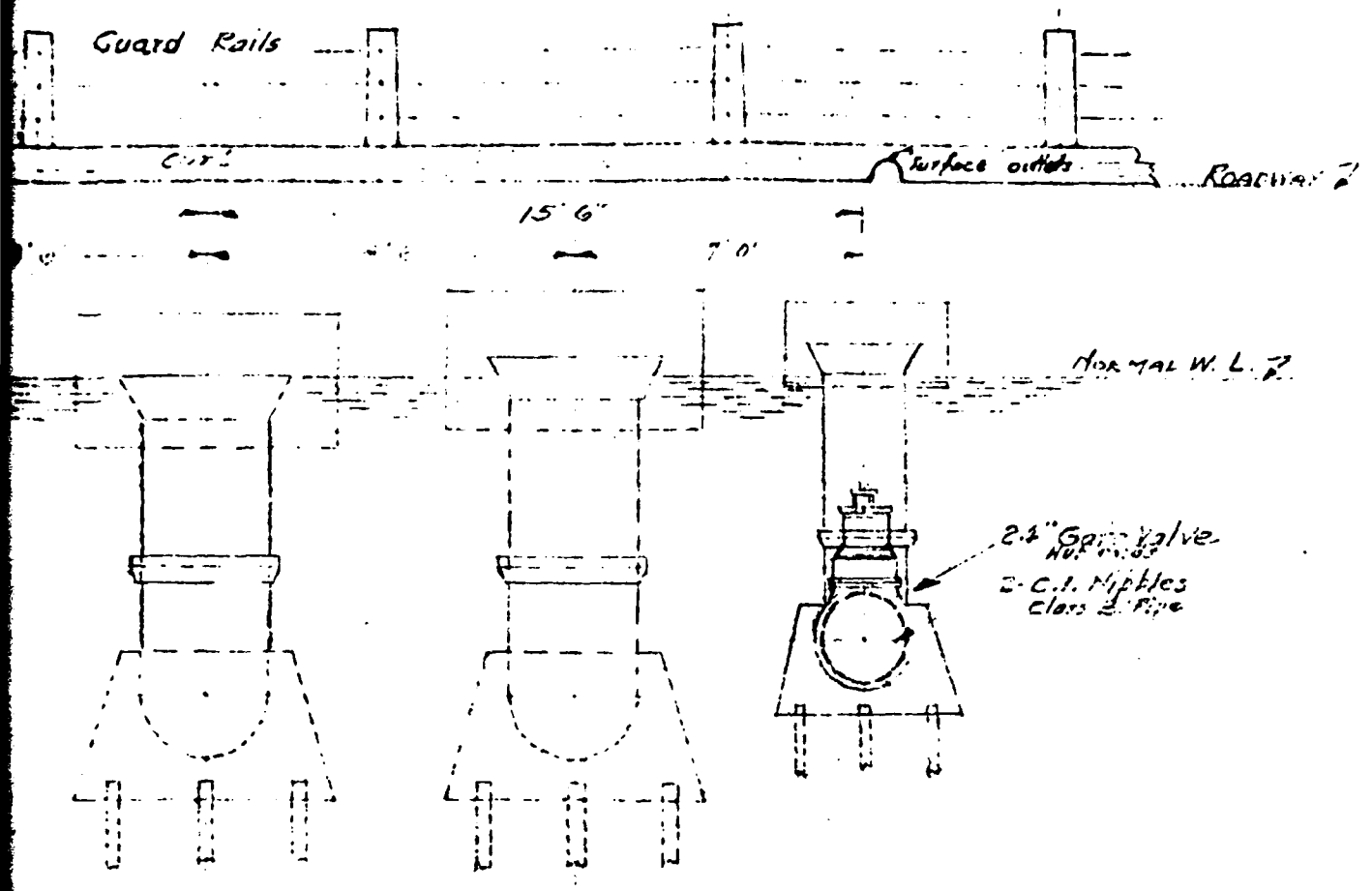
SHEET NO. (1)



J. E. HADDAWAY ENGINEER
WYOMING, DELAWARE
FROM DESIGNS OF PROF. L. H. KESSLER
UNIVERSITY OF WISC.
MARCH - 1941.




Approx El. 28.5
Max. W. L.
El. = 27.5
15' 6"
8' 0"
FREEBOARD
Nor. W. L. El. = 24.0'
2-C.I. Nipples
Class B. Pipe
Lake Bed El. = 16.0'
4" Piling



DROP INLETS
FINISHED ELEVATION
SCALE 1" = 4.0'
UP-STREAM SIDE.

DROP INLET SPILLWAY
LAKE COMO
SMYRNA, DELAWARE.
PROJECT - TOWN COMMISSIONERS
PLAYGROUND - RECREATION COMM'T.

SHEET NO. (1)

J. E. HADDAWAY ENGINEER
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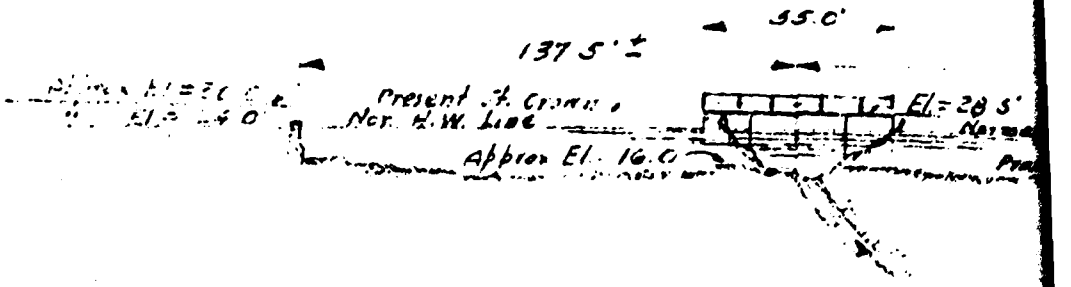
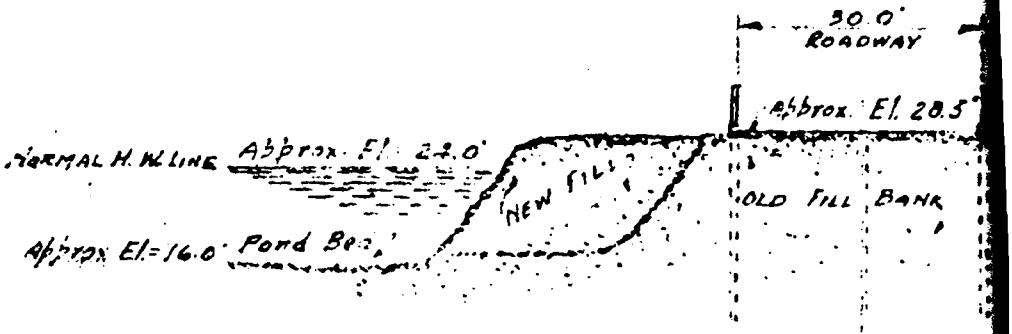
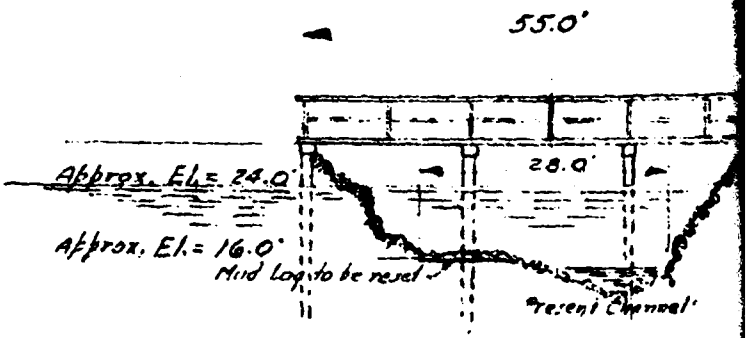
MARCH - 1941.



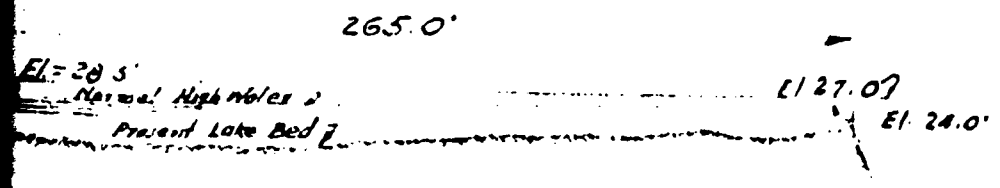
PRESENT ELEV. - U
Scale 1" = 50.



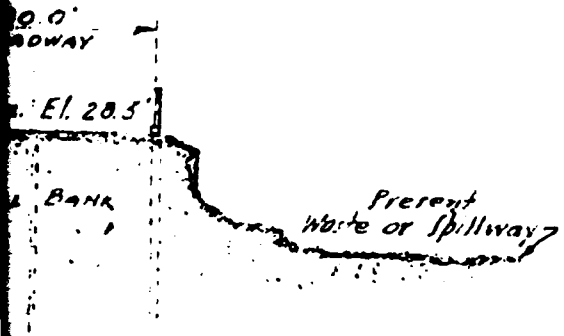
PRESENT TYPIC
CROSS SEC
Scale 1" = 20'



TEMPORARY WOOD
BRIDGE
Showing Flood Gate Wash
UP-STREAM ELEVATI
Scale 1" = 20.0'

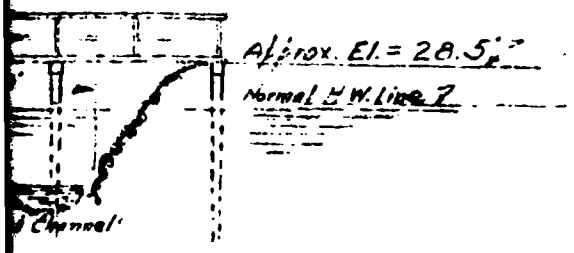


ELEV. - UP STREAM
1" = 50.0'



NT TYPICAL
S SECTION
le 1" = 20'

DROP INLET SPILLWAY
LAKE COMO
SMYRNA, DELAWARE.
PROJECT - TOWN COMMISSIONERS
PLAYGROUND - RECREATION COMM'T.



WOOD
GE
ate Wash out
ELEVATION
0.0'

SHEET NO. (1)

J. E. HADDAWAY ENGINEER
WYOMING, DELAWARE.
FROM DESIGNS OF PROF. L. H. KESSLER
UNIVERSITY OF WISC.
MARCH - 1941.

MAILGRAM SERVICE CENTER
MIDDLETOWN, VA. 22645

Mailgram

4-045806S232002 08/19/80 ICS IPMMTZZ CSP PHAB
1 2155974756 MGM TDMT PHILADELPHIA PA 08-19 0355P EST

ARMY CORP OF ENGINEERS J MEEHAN RMD ATTN B
HEVERIN
CUSTOM HOUSE 2 AND CHESTNUT ST
PHILADELPHIA PA 19106

THIS MAILGRAM IS A CONFIRMATION COPY OF THE FOLLOWING MESSAGE:

2155974756 TDMT PHILADELPHIA PA 468 08-19 0355P EST
PMS R D BERICK JR DIRECTOR DIV HIGHWAYS RPT DLY MGM, DLR
DEPT OF TRANSPORTATION OFFICE OF ADMINISTRATION
DOVER DE 99901
SUBJECT LAKE COMO SMYRNA DELAWARE

AT THE REQUEST OF MR KIRSHNA PATEL OF THE DIVISION OF SOIL AND WATER CONSERVATION DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL REPRESENTATIVES OF THIS OFFICE CONDUCTED A PHASE I INSPECTION OF LAKE COMO DAM IN SMYRNA ON 12 AUGUST 1980 THIS INSPECTION WAS REQUESTED BECAUSE OF THE DAMS CONDITION AS A RESULT OF THE OVERTOPPING WHICH OCCURRED ON 29 JULY 1980 IN RESPONSE TO MR PATEL'S REQUEST WE ARE HEREBY TRANSMITTING PRELIMINARY ENTRANT RECOMMENDATIONS FOR IMMEDIATE REMEDIAL ACTIONS THAT SHOULD BE UNDERTAKEN AT LAKE COMO DAM UNTIL PERMANENT REPAIRS ARE COMPLETED A FOREMAN PHASE 1 INSPECTION REPORT WILL BE ISSUED AT APPROXIMATELY TWO (2) MONTHS

A. AT THE CONCLUSION OF THE VISUAL INSPECTION OF THE DAM WE RECOMMEND THE LAKE BE LOWERED TWO (2) FEET UNTIL REPAIRS ARE COMPLETED WE ARE NOW RECOMMENDING THAT IT BE LOWERED AN ADDITIONAL FOOT TO A TOTAL OF THREE (3) FEET BELOW THE CREST OF THE SPILLWAY PIPE RISERS UNTIL REPAIRS ARE MADE IN ORDER TO INCREASE THE LAKES IMPOUNDING CAPACITY

B. CONTINUOUS MONITORING OF THE LAKE LEVEL SHOULD BE CONDUCTED DURING PERIODS OF HEAVY PERCIPITATION SO THAT INCREASED IN THE LAKE LEVEL CAN MINIMIZED

C. THE DAMS OWNERS SHOULD DEVELOP AN EMERGENCY ACTION PLAN OUTLINING ACTIONS TO BE TAKEN BY THE OPERATOR TO MINIMIZE DOWNSTREAM EFFECTS OF AN EMERGENCY AT THE DAM AND A DOWNSTREAM WARNING SYSTEM FOR THE LAKE COMO SUBSHOP THE ROUTE 13 HIGHWAY THE SEWAGE PUMPING STATION AND LOCAL EMERGENCY OFFICIALS

D. THE EMBANKMENT SHOULD BE INSPECTED PERIODICALLY BY AN EXPERIENCED ENGINEER FOR SIGNS OF SEEPAGE OR ADDITIONAL SLOUGHING UNTIL PERMANENT REPAIRS ARE MADE

SHEET 8

Mailgram

E. USING CORPS OF ENGINEERS SCREANING CRITERIOR THE SPILLWAY IS CONSIDERED INADEQUATE AS A FLOW EQUIVALENT TO 5 PERCENT OF THE ONE HALF PMF OR NINE (9) PERCENT OF THE 100 YEAR FLOOD WOULD CAUSE A DAM TO BE OVERTOPPED THEREFORE THE OWNER SHOULD ENGAGE A QUALIFIED PROFESSIONAL CONSULTANT USING MORE PERCISE METHODS PROCEDURES AND STUDIES TO DETERMINE THE ACTUAL CAPACITY OF THE SPILLWAY AND ANY MITIGATING MEASURES NECESSARY

F. BORINGS SHOULD BE TAKING THROUGH THE EMBANKMENT AND FOUNDATION TO DETERMINE SOIL TYPES IN-PLACE DENSITIES AND OTHER SOIL PROPERTIES

G. A DETAILED TOPOGRAPHIC SURVEY OF THE EMBANKMENT FROM THE UPSTREAM SLOPE TO THE ROUTE 13 BRIDGE SHOULD BE MADE

H. GAS LINES AND WATER LINES SHOULD BE REMOVED FROM THE EMBANKMENT AND RELOCATED

I. THE OWNERS SHOULD ENGAGE A QUALIFIED PROFESSIONAL CONSULTANT EXPERIENCED IN THE DESIGN AND CONSTRUCTION OF DAMS TO DESIGN AN ADEQUATE EMBANKMENT SECTION FOR THE DAM

2. REPRESENTATIVES OF THIS OFFICE ARE AVAILABLE TO DISCUSS POSSIBLE SPILLWAY AND EMBANKMENT REMEDIAL MEASURES AND COST ESTIMATES WITH THE DIVISION OF SOIL AND WATER CONSERVATION DIVISION OF HIGHWAYS AND THE CITY OF SMYRNA UNDER OUR TECHNICAL ASSISTANCE CAPABILITIES AT THEIR CONVENIENCE YOUR COOPERATION IN THIS MATTER IS APPRECIATED

JOEL T CALLAHAN LT COL CORP OF ENGINEERS ACTING DISTRICT ENGINEERS
CUSTOM HOUSE 2 AND CHESTNUT ST
PHILADELPHIA PA 19106

15:56 EST

MGMCOMP

5241 (R1 78)

SHEET 9

AD-A096 058 O'BRIEN AND GERE ENGINEERS INC PHILADELPHIA PA F/G 13/13
NATIONAL DAM SAFETY PROGRAM. LAKE COMO DAM (DE 00028), DELAWARE--ETC(U)
NOV 80 J J WILLIAMS DACW61-80-D-0013
UNCLASSIFIED DAEN/NAP-53842/DE00028-80/ NL

State of Delaware
DELAWARE GEOLOGICAL SURVEY
UNIVERSITY OF DELAWARE
Newark, Delaware
19711

ROBERT R. JORDAN, STATE GEOLOGIST
101 PENNY HALL
PHONE: 302-738-2833, 2834

August 15, 1980

Mr. J. J. Schuh, Chief of Design
Division of Highways
Department of Transportation
Administration Center
Dover, DE 19901

Dear Jack:

This will confirm our telephone conversation of this morning in which I passed along to you the flow information for Mill Creek for the storm of July 29. The data were provided by the U. S. Geological Survey as part of the stream gaging program in Delaware. The peak flow below the dam at Lake Como was calculated at 2,520 cfs. USGS staff believe this flow may be near, or perhaps exceed, the flow for the statistical 100-year flood. The flow at the first bridge north of Lake Como was estimated at 1,250 cfs. The difference in flow indicates the large amount of rain that fell within the drainage area of the lake proper, exclusive of the inflow from Mill Creek. This agrees with the precipitation maps recently worked up by John Talley of this office.

These figures are provisional subject to complete review by the USGS. However, the staff of the Dover USGS office feels fairly confident of their accuracy.

We are glad to have been of service and know that you will appreciate the rapid response of our federal cooperators in supplying the data you needed.

Sincerely,

Kenneth D. Woodruff
Associate Director

KDW:dcw

cc: Art Hodges, USGS

10

APPENDIX

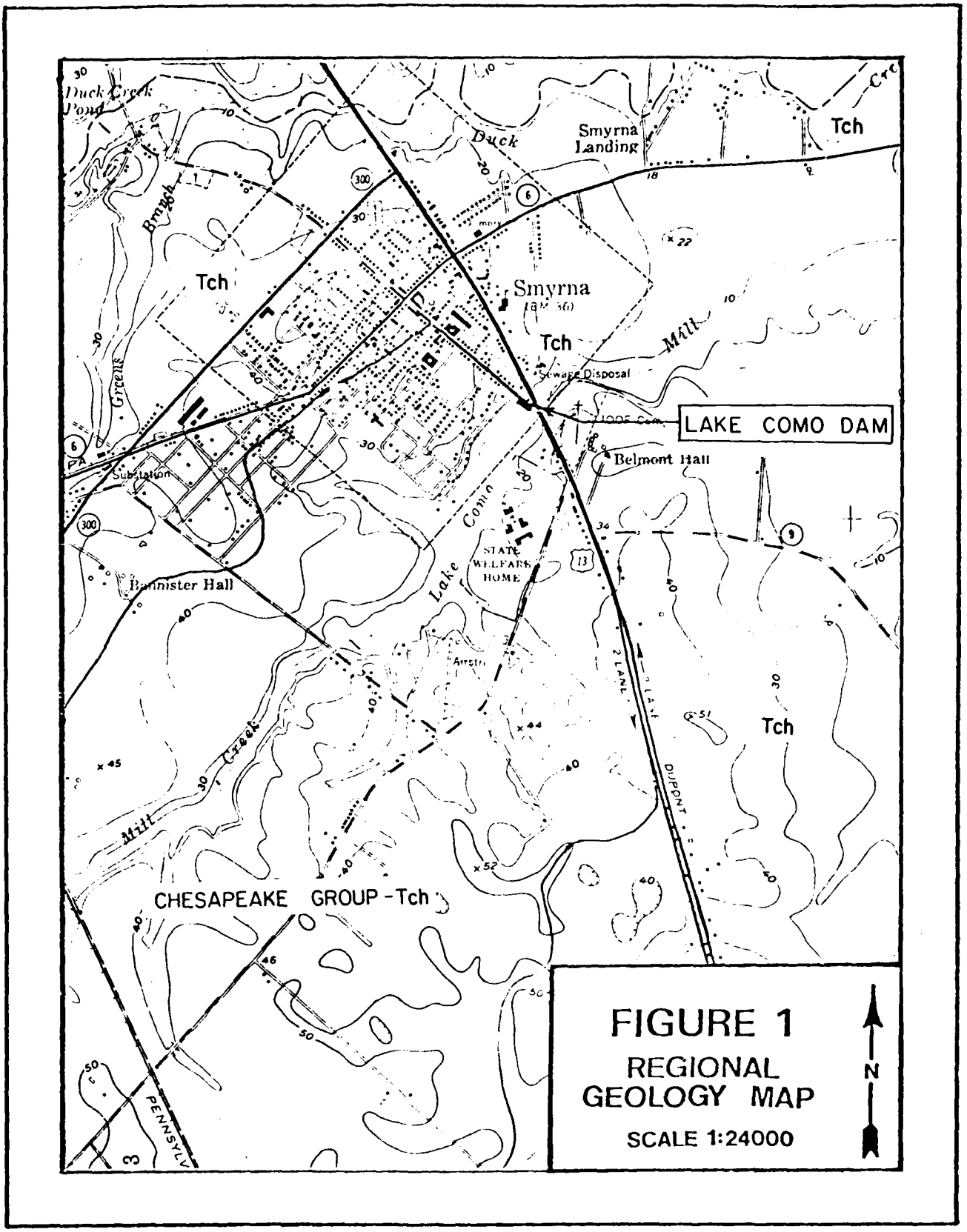
F

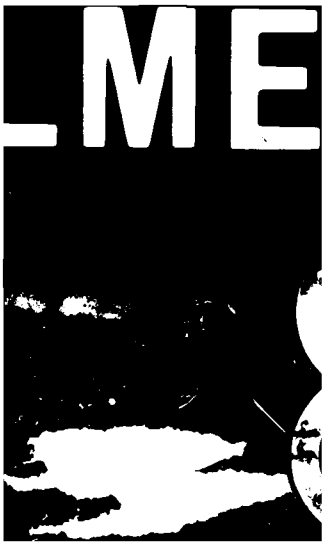
SITE GEOLOGY

SITE GEOLOGY

LAKE COMO DAM

Lake Como Dam is located in the Coastal Plain physiographic province. The Miocene sediments at the site are primarily bluish gray silts with quartz sand and shell beds. The Chesapeake Group sands and silts were deposited during marine submergence of the Delaware Peninsula and attain depths of over 1,000 feet.


Duck Creek Pond
Smyrna Landing
Tch
Smyrna
Tch
Sewage Disposal
LAKE COMO DAM
Belmont Hall
Substation
Lake Como
STATE WELFARE HOME
Bannister Hall
Tch
Mill Creek
CHESAPEAKE GROUP - Tch
PENNSYLV
DUPONT
FIGURE 1
REGIONAL GEOLOGY MAP
SCALE 1:24000
N


LME