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NEW JERSEY DEPT OF ENVIRONMENTAL PROTECTION TRENTON

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NATIONAL DAM SAFETY PROGRAM, CAMP BEISLER DAM (NJ-00141), RARIT--ETC(U)

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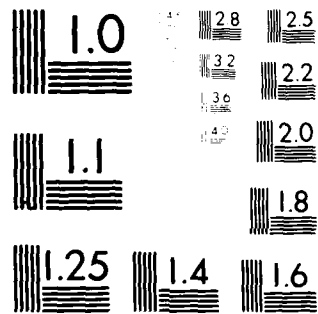
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(NJ-00141), RARITAN RIVER BASIN,
SPRUCE RUN, HUNTERDON COUNTY,
NEW JERSEY, 1

Inspection Report

CAMP BEISLER DAM

NJ 00141

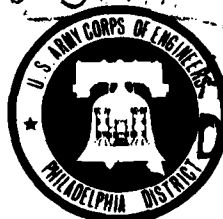
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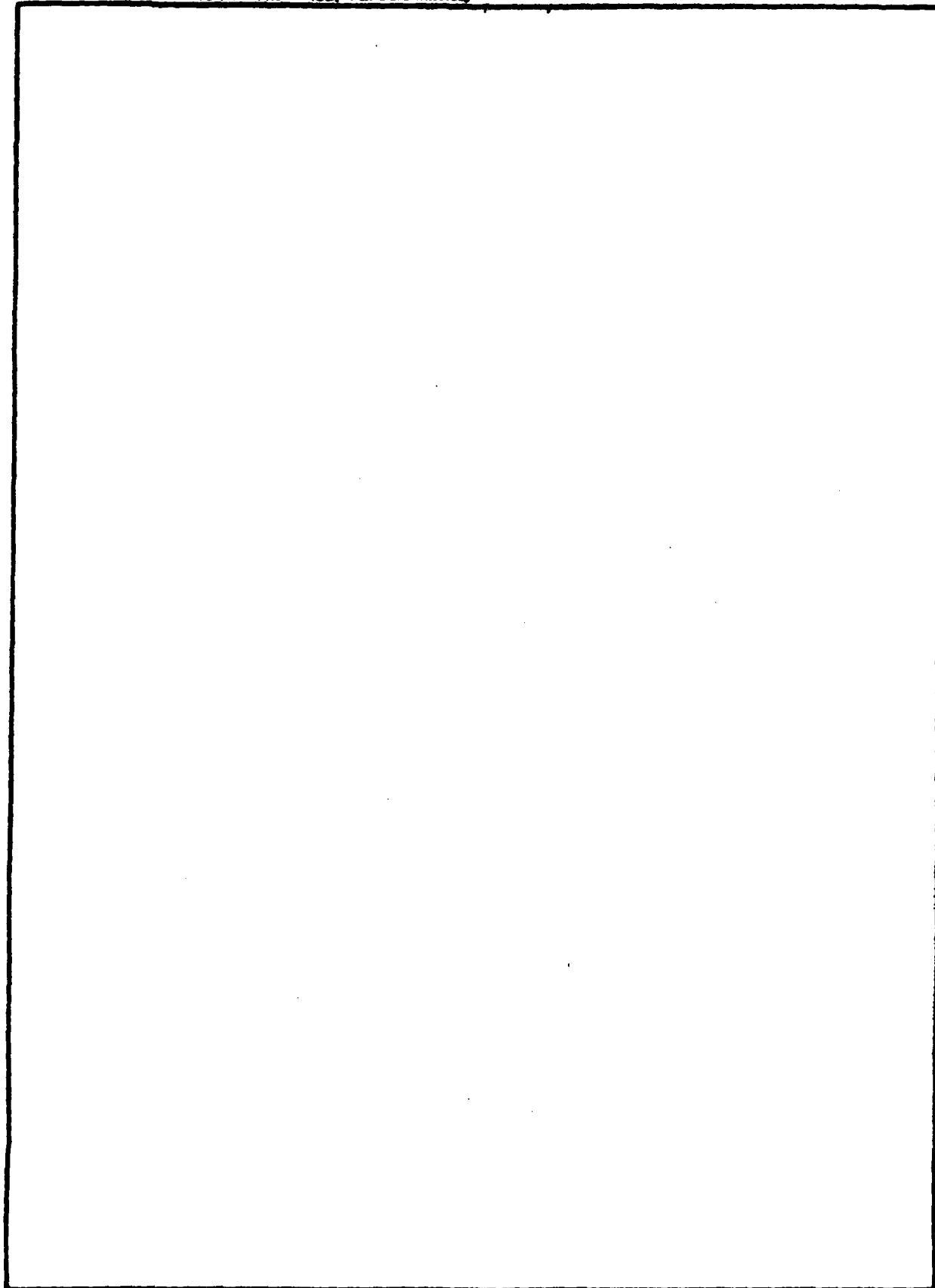
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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER DAEN/NAP-53842/NJ00141-81/05	2. GOVT ACCESSION NO. AD-A099669	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Inspection Report National Dam Safety Program Camp Beisler Dam, NJ00141 Hunterdon County, N.J.		5. TYPE OF REPORT & PERIOD COVERED FINAL
7. AUTHOR(s) Talerico, John P., P.E.		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS Harris-ECI Associates 453 Amboy Ave. Woodbridge, N.J. 07095		8. CONTRACT OR GRANT NUMBER(s) DACW61-79-C-0011
11. CONTROLLING OFFICE NAME AND ADDRESS NJ Department of Environmental Protection Division of Water Resources P.O. Box CN029 Trenton, NJ 08625		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) U.S. Army Engineer District, Philadelphia Custom House, 2d & Chestnut Streets Philadelphia, PA 19106		12. REPORT DATE May, 1981
		13. NUMBER OF PAGES 40
		15. SECURITY CLASS. (of this report) Unclassified
		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) C		
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 Embankments Visual Inspection Structural Analysis National Dam Safety Program Outlet works Camp Beisler Dam, N.J.		
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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PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-N

28 MAY 1961

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

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Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Camp Beisler Dam in Hunterdon County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Camp Beisler Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in good overall condition. The dam's spillway is considered inadequate because a flow equivalent to 62 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). To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures and studies within twelve months from the date of approval of this report. Within three months of the consultant's findings remedial measures to ensure spillway adequacy should be initiated.

b. The following remedial actions should be initiated within twelve months from the date of approval of this report:

(1) Determine if the observed flow near the left end of the dam is seepage from the dam and if so, it should be monitored monthly to determine its volume and whether it presents a problem to the safety of the dam.

(2) Construct a concrete headwall and apron at the outlet end of the discharge pipe. Also, attempt to locate the toe drain outlets and if found provide for their discharge through the headwall.

(3) All brush should be removed from the upstream slope to avoid any problems that may develop from roots. The slope should then be reseeded to develop a growth of grass for surface erosion protection.

NAPEN-N

Honorable Brendan T. Byrne

(4) Determine if the low-level outlet gate is operable, and if not, institute remedial action to make it operable.

c. The owner should develop an emergency action plan (if one is not already available) outlining actions to be taken by the operator to minimize downstream effects of an emergency and establish a flood warning system for the downstream communities within three months from the date of approval of this report.

d. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam, within one year from the date of approval of this report.

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

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

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,


KENNETH R. MOSER
Major, Corps of Engineers
Acting District Engineer

1 Incl
As stated

Copies furnished:

Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CNO29
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Regulation
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CAMP BEISLER DAM (NJ00141)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 12 January and 3 February 1981 by Harris - ECI Associates, under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Camp Beisler Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in good overall condition. The dam's spillway is considered inadequate because a flow equivalent to 62 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). To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures and studies within twelve months from the date of approval of this report. Within three months of the consultant's findings remedial measures to ensure spillway adequacy should be initiated.

b. The following remedial actions should be initiated within twelve months from the date of approval of this report:

(1) Determine if the observed flow near the left end of the dam is seepage from the dam and if so, it should be monitored monthly to determine its volume and whether it presents a problem to the safety of the dam.

(2) Construct a concrete headwall and apron at the outlet end of the discharge pipe. Also, attempt to locate the toe drain outlets and if found provide for their discharge through the headwall.

(3) All brush should be removed from the upstream slope to avoid any problems that may develop from roots. The slope should then be reseeded to develop a growth of grass for surface erosion protection.

(4) Determine if the low-level outlet gate is operable, and if not, institute remedial action to make it operable.

c. The owner should develop an emergency action plan (if one is not already available) outlining actions to be taken by the operator to minimize downstream effects of an emergency and establish a flood warning system for the downstream communities within three months from the date of approval of this report.

d. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam, within one year from the date of approval of this report.

APPROVED:



KENNETH R. MOSER

Major, Corps of Engineers
Acting District Engineer

DATE:

27 May 1981

RARITAN RIVER BASIN
SPRUCE RUN, HUNTERDON COUNTY
NEW JERSEY

CAMP BEISLER DAM

NJ00141

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA 19106

MAY, 1981

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

Name: Camp Beisler Dam, I.D. NJ 00141
State Located: New Jersey
County Located: Hunterdon County
Stream: Spruce Run
River Basin: Raritan River
Date of Inspection: January 12, and February 3, 1981

Assessment of General Conditions

Camp Beisler Dam is an earthfill dam with a concrete drop inlet, the main spillway, located in the center of the dam. In addition there is an auxiliary spillway at the right end of the dam. The overall condition of the dam is good. There are no signs of distress or instability in the embankment. Possible seepage was observed approximately 100 feet from the left end of the dam. The low-level outlet was not opened and is not used. The hazard potential is recommended to be downgraded from "high" to "significant".

Camp Beisler Dam is considered inadequate in view of its lack of spillway capacity to pass the SDF (1/2 PMF) without overtopping the dam. The spillway is capable of passing a flood equal to 30.5 percent of the PMF (61 percent of the 1/2 PMF), and is assessed as "inadequate".

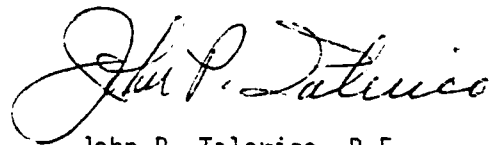
At present, the engineering data available is not sufficient to make a definitive statement on the stability of the dam, but based on the findings of the visual inspection, the preliminary assessment of static stability is that it is satisfactory. The following actions are recommended along with a timetable for their completion. All recommended actions should be conducted under the supervision of an Engineer who is experienced in the design, construction and inspection of dams.

1. Carry out a more precise hydrologic and hydraulic analysis of the dam within twelve months, to determine the need and type of mitigating measures necessary. Based on the results of these studies, remedial measures should be instituted. This should include the installation of a tailwater gage.
2. Determine if the observed flow is seepage from the dam and if so, it should be monitored monthly to determine its volume and whether it presents a problem to the safety of the dam.

3. Construct a concrete headwall and apron at the outlet end of the discharge pipe. Also, attempt to locate the toe drain outlets, and if found provide for their discharge through the headwall. This work should be started within twelve months.
4. All brush should be removed from the upstream slope to avoid problems that may develop from roots. The slope should then be seeded to develop a growth of grass for surface erosion protection. This program should be started within twelve months.
5. Determine if low-level outlet gate is operable, and if not institute remedial action to make it operable within twelve months.
6. The owner should develop an emergency action plan (if one is not already available) outlining actions to be taken by the operator to minimize downstream effects of an emergency and establish a flood warning system for the downstream communities within three months.

Furthermore, while of a less urgent nature, the following additional action is recommended and should be carried out within twelve months.

The owner should develop within one (1) year after formal approval of the report, written operating procedures and a periodic maintenance plan to insure the safety of the dam.



John P. Talerico, P.E.
HARRIS - ECI ASSOCIATES



Photo taken January 12, 1981

CAMP BEISLER DAM

View from top of auxiliary spillway, toward left end of dam. Area of grass at center right of photo is location of low-level outlet channel.

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 the 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 intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

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

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ASSESSMENT OF GENERAL CONDITIONS

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

CAMP BEISLER DAM, I.D. NJ 00141

SECTION 1

1. PROJECT INFORMATION

1.1 General

a. Authority

The National Dam Inspection Act (Public Law 92-367, 1972) provides for the National Inventory and Inspection Program by the U.S. Army Corps of Engineers. This inspection was made in accordance with this authority under Contract C-FPM No. 35 with the State of New Jersey who, in turn, is contracted to the Philadelphia District of the Corps of Engineers, and was carried out by the engineering firm of Harris-ECI Associates of Woodbridge, New Jersey.

b. Purpose of Inspection

The visual inspection of Camp Beisler Dam was made on January 12 and February 3, 1981. The purpose of the inspection was to make a general assessment as to the structural integrity and operational adequacy of the dam embankment and its appurtenant structures.

c. Scope of Report

The report summarizes available pertinent data relating to the project; presents a summary of visual observations made during the field inspection; presents an evaluation of hydrologic and hydraulic conditions at the site; presents an evaluation as to the structural adequacy of the various project features; and assesses the general condition of the dam with respect to safety.

1.2 Description of Project

a. Description of Dam and Appurtenances

Camp Beisler Dam is an earthfill dam approximately 630 feet long and 17.1 feet high. There are two spillways, one is a 8 foot x 6 foot concrete drop inlet with a 14 foot x 12 foot concrete anti-vortex cover and the other is a 70 foot wide earth channel auxiliary spillway with a concrete control sill. The drop inlet is located 400 feet from the right end of the dam and its crest is 5.1 feet below the top of the embankment. The concrete anti-vortex cover is 12-inches thick and is supported on four 12-inch diameter concrete columns 2.5 feet high. In the front wall of the spillway are two 6-inch steel cold water outlet pipes. The pipes, with inverts 1.75 feet below the spillway crest and tops one inch below the crest extend one foot inside the inlet. Attached to lake side of the front wall is a 36-inch diameter half round corrugated metal pipe for cold water control. The auxiliary spillway located at the right end of the dam, has a crest elevation 2.8 feet below the top of the dam. The flow from the drop inlet discharges into the downstream channel through a 60-inch corrugated metal pipe which also serves as the low-level outlet. The auxiliary spillway discharges onto the existing ground beyond the toe of the slope and flows into the downstream channel.

The embankment had a design top width of 15 feet with a 2.5H:1V slope on both faces. During construction, the excess excavated material was spoiled on the downstream slope of the dam along both sides of the discharge channel. This resulted in the dam having an irregular crest width, varying up to 100 feet wide left and 140 feet wide right of the spillway. According to the plans, gravel toe drains were supposed to have been constructed for distance 200 feet left and 120 feet right of the outlet pipe.

The low-level outlet consists of a 60-inch corrugated metal pipe that carries the discharge from the main spillway. The low-level flow into the pipe is controlled by a 16-inch rising stem sluice gate attached to the upstream face of the inlet. The gate is raised manually by turning a hand-wheel attached to the top of the frame. The pipe, which discharges directly into the downstream channel, has two anti-seep collars extending two feet beyond the outside of the pipe.

The downstream channel starts at the outlet and meanders down past the embankment toe on the left into a wooded area and then crosses under Sharrer Road approximately 800 feet from the dam. On the left before Sharrer Road is a development of more than a dozen homes. The houses appear to be above the flood plain.

A generalized description of soil conditions is contained in Report No. 6, Hunterdon County, Engineering Soil Survey of New Jersey, by Rutgers University. The report, dated 1952, describes the dam area as gneissic bedrock with overlaying silts, silty clays and silty sands of variable depths. The U.S.G.S. Geologic Overlay Sheet 22 classifies the rock as undifferentiated pre-cambian. The downstream channel is described as recent alluvium of variable depth.

b. Location

Camp Beisler Dam is located in Camp Beisler on Spruce Run, in the Township of Lebanon, Hunterdon County, New Jersey. The camp is accessible from Route 57 at Penwell by way of Penwell Road to Turkey Top Road to Sharrer Road to Pleasant Grove Road.

c. Size Classification

According to the "Recommended Guidelines for Safety Inspection of Dams" by the U.S. Department of the Army, Office of the Chief Engineers, the dam is classified in the dam size category as being "small", since its storage volume of 61 acre-feet is less than 1,000 acre-feet. The dam is also classified as "small" because its height of 17.1 feet is less than 40 feet. The overall size classification of Camp Beisler Dam is "small".

d. Hazard Classification

A hazard potential classification of "significant" has been assigned to Camp Beisler Dam on the basis that even though the homes downstream are above the flood reach, they are close enough to the stream that children play within the flood reach on both sides of the stream. Therefore the possibility exists of the loss of a few lives in the event of dam failure.

e. Ownership

Camp Beisler Dam is owned by:

New Jersey Synod Lutheran
Church of America
1930 State Highway No.33
Hamilton Square, NJ 08690

Attention: Mr. Mark Burkhardt
Camp Director
(201) 832-7264

f. Purpose

Camp Beisler Dam is presently used for recreational purposes only.

g. Design and Construction History

Camp Beisler Dam was designed by the U.S. Soil Conservation Service. The permit to construct the dam was issued on August 26, 1968 with the dam being completed in February 1971.

h. Normal Operating Procedures

The discharge from the lake is unregulated and allowed to naturally balance the inflow into the lake. According to the owner the low-level outlet is not used.

1.3 Pertinent Data

a. Drainage Area 1.21 sq. mi.

b. Discharge at Dam Site

Ungated spillway capacity at elevation of top of dam: 1,416 cfs (884.1 NGVD)

Total spillway capacity at maximum pool elevation (SDF): 2,675 (884.45 NGVD)

c. Elevation (Feet above NGVD)

Top of dam: 884.1

Maximum pool design surcharge (SDF): 884.45

Recreation pool: 879.2

Spillway crest: Main: 879.0

Auxiliary: 881.3

Streambed at centerline of dam: 867 (estimated)

Maximum tailwater: 870 (estimated)

d. Reservoir

Length of maximum pool: 2,500 ft. (estimated)

Length of recreation pool: 900 ft. (estimated)

e. Storage (acre-feet)

Spillway Crest: 20 (879.0 NGVD)

Top of dam: 61

Maximum pool (SDF): 65

f. Reservoir Surface (acres)

Top of dam: 15.2 (estimated)

Maximum pool (SDF): 15.5 (estimated)

Recreation pool: 6.0 (estimated)

Spillway crest: 5.0 (879.0 NGVD)

g. Dam

Type: Earthfill with concrete drop inlet.

Length: 630 ft. (effective)

Height: 17.1 ft.

Top width: Varies from 15 ft. - 140 ft.

Side slopes - Upstream: 2.5H:1V
- Downstream: 2.5H:1V

Zoning: Unknown

Impervious core: None

Control Sill: 70 ft. concrete sill at auxiliary spillway.

Grout curtain: None.

h. Diversion and Regulating Tunnel

i. Spillway

Type: Main: Concrete Drop Inlet
Auxiliary: Earth channel

Length of weir: Main: 28 ft.
Auxiliary: 70 ft.

Crest elevation: Main: 879.0 (NGVD)
Auxiliary: 881.3 (NGVD)

Gates: None

U/S Channel: Camp Beisler Lake

D/S Channel: Main: Natural Channel
Auxiliary: Existing ground

j. Regulating Outlets

Low level outlet: 60-inch C.M.P.

Controls: Manually controlled 16-inch sluice gate.

Emergency gate: None

Outlet: 867.0 NGVD

SECTION 2

2. ENGINEERING DATA

2.1 Design

Drawings and specifications for the construction of the Camp Beisler Dam are available in the files of NJ Department of Environmental Protection (NJ-DEP) in Trenton and also at the offices of the U.S. Department of Agriculture - Soil Conservation Service (SCS) in Somerset N.J. The structural design data of the spillway as well as the hydrology and hydraulic data for a 25-year and 50-year design storm is also available at the above locations. One drawing shows the location of and data obtained from test pits taken along the dam. Soil test results, design computations and other geotechnical data needed to assess the stability properly are not available.

2.2 Construction

Data is not available concerning the as-built construction of the dam. No data exists of construction methods, borrow sources or other data pertinent to the construction of the dam.

2.3 Operation

Formal operation records are not kept for the dam and reservoir. The lake is allowed to operate naturally without regulation.

2.4 Evaluation

a. Availability

The availability of engineering data is good. The construction plans and specifications for the dam are available from the NJ-DEP and the SCS.

b. Adequacy

The engineering data available from the plans and from the field was adequate to perform hydrologic and hydraulic computations. The data was insufficient to perform stability analysis, but a preliminary evaluation could be made based on visual observations.

c. Validity

The information contained in the drawings and checked by limited field measurements appears to be valid, except as noted herein. The crest width of the dam is not 15 feet as shown on the original plans, but varies up to 100 feet wide left and 140 feet wide right of the spillway. The gravel toe drain outlets shown at the low-level outlet discharge could not be found.

SECTION 3

3. VISUAL INSPECTION

3.1 Findings

a. General

The visual inspection of Camp Beisler Dam revealed the dam and spillways to be in good condition. At the time of the inspection the lake level was just below the crest of the main spillway with the water discharging through the cold water pipes.

b. Dam

The earth embankment appears sound. No surface cracking on the embankment or at the toe was noticed. No sloughing or erosion of the embankment was observed. The vertical alignment of the crest is good. The horizontal alignment of the crest along the upstream slope is good, but the downstream crest alignment is irregular since that section was a spoil disposal area during construction. One area of possible seepage was observed at the downstream toe approximately 100 feet from the left end of the dam. Since this section is in the disposal area and about 200 feet from the upstream face the source of the water may not be seepage from the dam. There is a heavy growth of brush along the entire upstream face of the embankment. No evidence of burrowing by animals was observed. The gravel toe drain outlet pipes, shown on the plans to be on each side of the low-level outlet pipe, could not be located.

c. Appurtenant Structures

1. Spillways

The main spillway is a drop inlet structure with two cold water outlet pipes and a sluice gate and is in good condition. Only minor spalling in the concrete was observed. The auxiliary spillway, which is grass covered is in good condition. There is one crack in the crest of the concrete control sill located approximately 25 feet from the left end. Horizontal and vertical alignment of the auxiliary spillway appeared good.

2. Bridge and Piers

Concrete columns, part of the main spillway, support the concrete anti-vortex cover. The cover and columns are in good condition.

3. Outlet Works

The low-level outlet works is also the main spillway. It consists of a drop inlet with a 16-inch rising stem sluice gate, operated by a handwheel attached to the top of the frame, at the upstream face of the drop inlet and a 60-inch corrugated metal pipe that carries the flow from the drop inlet directly downstream into Spruce Run. The outlet is in excellent condition. There is no headwall at the end of the 60-inch C.M.P. Most of the slope riprap at the pipe outlet is missing.

d. Reservoir Area

The reservoir's side slopes are moderately steep and wooded. There is a swimming beach along the right shore looking upstream. There is no indication of slope instability.

e. Downstream Channel

The downstream channel is in good condition. The channel which starts at the outlet meanders down past the spoil area on the left into a wooded area approximately 150-feet from the crest. The bottom of the channel is rocky with no debris. The side slopes of the channel through the spoil area are moderately steep with a heavy growth of brush, once into the wooded area the side slopes become flat. There is some erosion along the right bank within the spoil disposal area. A development of more than a dozen homes exists approximately 500 feet downstream above the flood reach on the left side of the stream.

SECTION 4

4. OPERATIONAL PROCEDURES

4.1 Procedures

Camp Beisler Dam is used to impound water for recreational activities. The level of the lake is maintained through the unregulated flow over the spillway.

4.2 Maintenance of the Dam

There is no regular inspection and maintenance program for the dam and appurtenant structures. The NJ Synod Lutheran Church is responsible for the maintenance of the dam.

4.3 Maintenance of Operating Facilities

The low-level outlet operating facilities consist of the one manually operated 16-inch sluice gate. Operation of the gate was not demonstrated as the handwheel was not available.

4.4 Evaluation

The present operational and maintenance procedures are fair with the dam and spillway being maintained in a serviceable condition.

SECTION 5

5. HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design

The drainage area above Camp Beisler Dam is approximately 1.2 square miles. A drainage map of the water shed of the dam site is presented on Plate 1, Appendix D.

The topography within the basin is generally moderately sloped. Elevations range from approximately 1,040 feet above NGVD at the west end of the watershed to about 870 feet at the dam site. Land use patterns within the watershed are mostly woodland.

The evaluation of the hydraulic and hydrologic features of the dam was based on criteria set forth in the Corps guidelines and additional guidance provided by the Philadelphia District, Corps of Engineers. The SDF for the Dam falls in a range of 1/2 PMF to PMF. In this case, the low end of the range, 1/2 PMF, is chosen since the factors used to select size and hazard classification are on the low-side of their respective ranges.

The Probable Maximum Flood (PMF) was calculated from the probable maximum precipitation using Hydrometeorological Report No. 33 with standard reduction factors. Due to the small drainage area, the SCS triangular hydrograph transformed to a curvilinear hydrograph was adopted for developing the unit hydrograph, with the aid of the HEC-1-DB Flood Hydrograph Computer Program.

Initial and constant infiltration loss rates were applied to the Probable Maximum Precipitation to obtain rainfall excesses. The rainfall excesses were applied to the unit hydrograph to obtain the PMF and various ratios of PMF utilizing program HEC-1-DB.

The SDF peak outflow calculated for the dam is 2,675 cfs. This value is derived from the half PMF, and results in overtopping of the dam, assuming that the lake was originally at the spillway crest elevation.

The stage-outflow relation for the spillway was determined from the geometry of the spillway and dam utilizing HEC-1 Dam Safety Version Program

The reservoir stage-storage capacity relationship was computed directly by the conic method, utilizing the HEC-1-DB program. The reservoir surface areas at various elevations were measured by planimeter from a U.S.G.S. Quadrangle topographic map. Reservoir storage capacity included surcharge levels exceeding the top of the dam, and the spillway rating curve was based

on the assumption that the dam remains intact during routing. The spillway rating curve is presented in the Hydrologic Computation, Appendix D.

A breach analysis indicates that the stage of the stream where it crosses Sharrer Road is 0.6 feet higher, due to dam failure from overtopping at 0.4 PMF than it would without failure at 0.4 PMF. This is not likely to jeopardize the road downstream significantly more than without failure. The discharge facility is thus rated "inadequate".

Drawdown calculations indicate that to empty the lake to an elevation of 867 NGVD through the one low-level outlet would take 11 hours, assuming a 2 cfs/square mile inflow. This is considered to be a reasonable drawdown period, and provision of additional outlets should not be considered.

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b. Experience Data

No records of reservoir stage or spillway discharge are maintained for this site.

c. Visual Observation

The downstream channel is in good condition. It meanders from the outlet down past the spoil disposal area on the left into a wooded area. The bottom of the channel is rocky and clear of debris. The sides through the disposal area are relatively steep and then flatten out once into the wooded section.

A housing development is located left of the channel, above the flood reach, approximately 500 feet downstream from the dam.

The side slopes of the reservoir are moderately steep and do not exhibit signs of instability. A swimming beach is along the right shoreline. The drainage area is wooded and undeveloped.

d. Overtopping Potential

A storm of magnitude equivalent to the SDF would cause overtopping of the dam to a height of 0.35 feet. Computations indicate that the dam can pass approximately 30.5 percent of the PMF without overtopping the dam crest. Since the 1/2 PMF is the Spillway Design Flood (SDF) for this dam, according to the Recommended Guidelines for Safety Inspection of Dams by the Corps of Engineers, the spillway capacity of the dam is assessed as "inadequate".

SECTION 6

6. STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

There are no signs of distress in the embankment of the Camp Beisler Dam. Flowing water was observed along the downstream toe of slope approximately 100 feet from the left end of the dam. In as much as this section is part of the spoil disposal area, it is possible the flow could be from another source other than seepage from the dam. The heavy growth of brush growing along the upstream slope could pose a threat to stability. The spillways are in good condition.

b. Design and Construction Data

No design computations relating to stability were uncovered during the report preparation phase. No embankment or foundation soil parameters are available for carrying out a conventional stability analysis of the embankment.

c. Operating Records

No operating records are available relating to the stability of the dam.

d. Post-Construction Changes

There are no known post-construction changes since the dam was built in 1971.

e. Static Stability

A static stability analysis was not performed for Camp Beisler Dam because the lack of data on which to base assumptions of material properties within embankment zones might produce misleading results, but based on the findings of the visual inspection, the preliminary assessment of static stability is that it is satisfactory.

f. Seismic Stability

The dam is located in Seismic Zone 1, as defined in Recommended Guidelines for Safety Inspection of Dams, prepared by the Corps of Engineers. In general, projects located in Seismic Zones 0, 1 and 2 may be assumed to present no hazard from earthquake, provided the static stability conditions are satisfactory and conventional safety margins exist, and based on the findings of the visual inspection, the preliminary assessment of the static and seismic stabilities is that they are satisfactory.

SECTION 7

7. ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment

a. Safety

The dam has been inspected visually and a review has been made of the available engineering data. This assessment is subject to the limitations inherent in the visual inspection procedures stipulated by the Corps of Engineers for a Phase 1 report.

Camp Beisler Dam is inadequate because the dam does not have the spillway capacity to pass the SDF, one half of the PMF, without overtopping. Overtopping of the dam carries with it the danger of a likely progressive failure of the dam. The present spillway capacity of the dam is approximately 30.5 percent of the PMF.

No definitive statement pertaining to the safety of the embankment can be made without acquisition of embankment material engineering properties, but based on the findings of the visual inspection, preliminary assessment of the static stability is that it is satisfactory.

b. Adequacy of Information

The information uncovered was adequate to perform hydrologic and hydraulic computations. The data was insufficient to perform even an approximate computation of the stability of the dam. A preliminary assessment of the dam could be made by visual observation only.

c. Urgency

The remedial measures and recommended actions along with a timetable for their completion are detailed below. All recommended action should be conducted under the supervision of an Engineer who is experienced in the design, construction and inspection of dams.

7.2 Remedial Measures

a. Alternatives for Increasing Spillway Capacity

Alternatives for increasing spillway capacity are as follows:

1. Increase the embankment height of the dam thus permitting a higher discharge to pass over the spillway and reducing the possibility of overtopping.

2. Lower the spillway crest elevation.
3. Increase the effective spillway crest length.
4. A combination of any of the above alternatives.

b. Recommendations

1. Carry out a more precise hydrologic and hydraulic analysis of the dam within twelve months, to determine the need and type of mitigating measures necessary. If required, conduct a study of the means of increasing spillway discharge capacity and develop alternative schemes for construction. This should include the installation of headwater and tailwater gages. The ability of the dam to withstand overtopping should also be studied.
2. Determine if observed flow is seepage from the dam and if so, it should be monitored monthly to determine its volume and whether it presents a problem to the safety of the dam.
3. Construct a concrete headwall and apron at the outlet end of the discharge pipe. Also, attempt to locate the toe drain outlets and if found provide for their discharge through the headwall. This work should be started within twelve months.
4. All brush should be removed from the upstream slope to avoid any problems that may develop from roots. The slope should then be reseeded to develop a growth of grass for surface erosion protection. This should be done within twelve months.
5. Determine if low-level outlet gate is operable, and if not institute remedial action to make it operable within twelve months.

The following additional action is recommended:

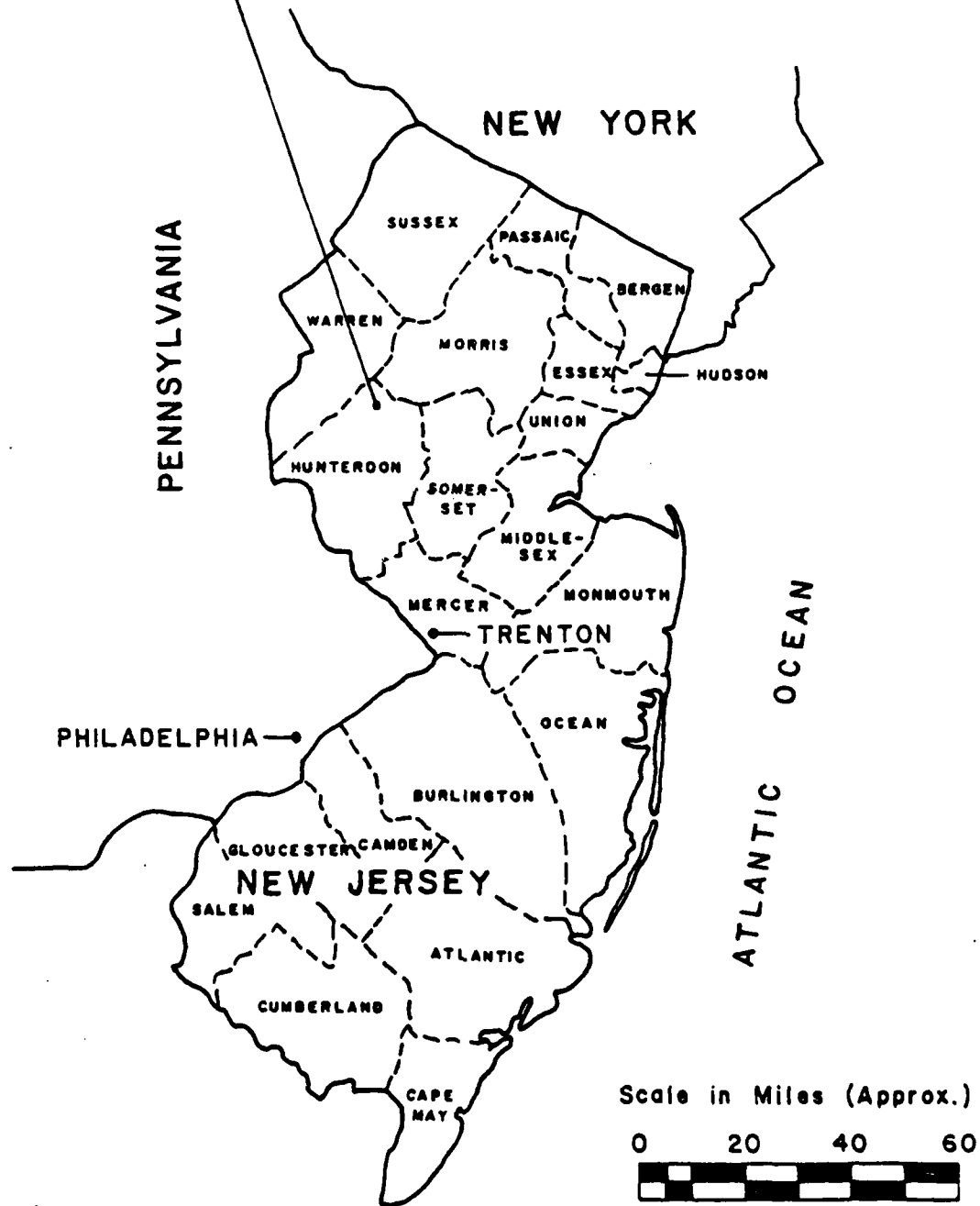
The owner should develop an emergency action plan (if one is not already available) outlining actions to be taken by the operator to minimize downstream effects of an emergency and establish a flood warning system for the downstream communities within three months.

c. O & M Procedures

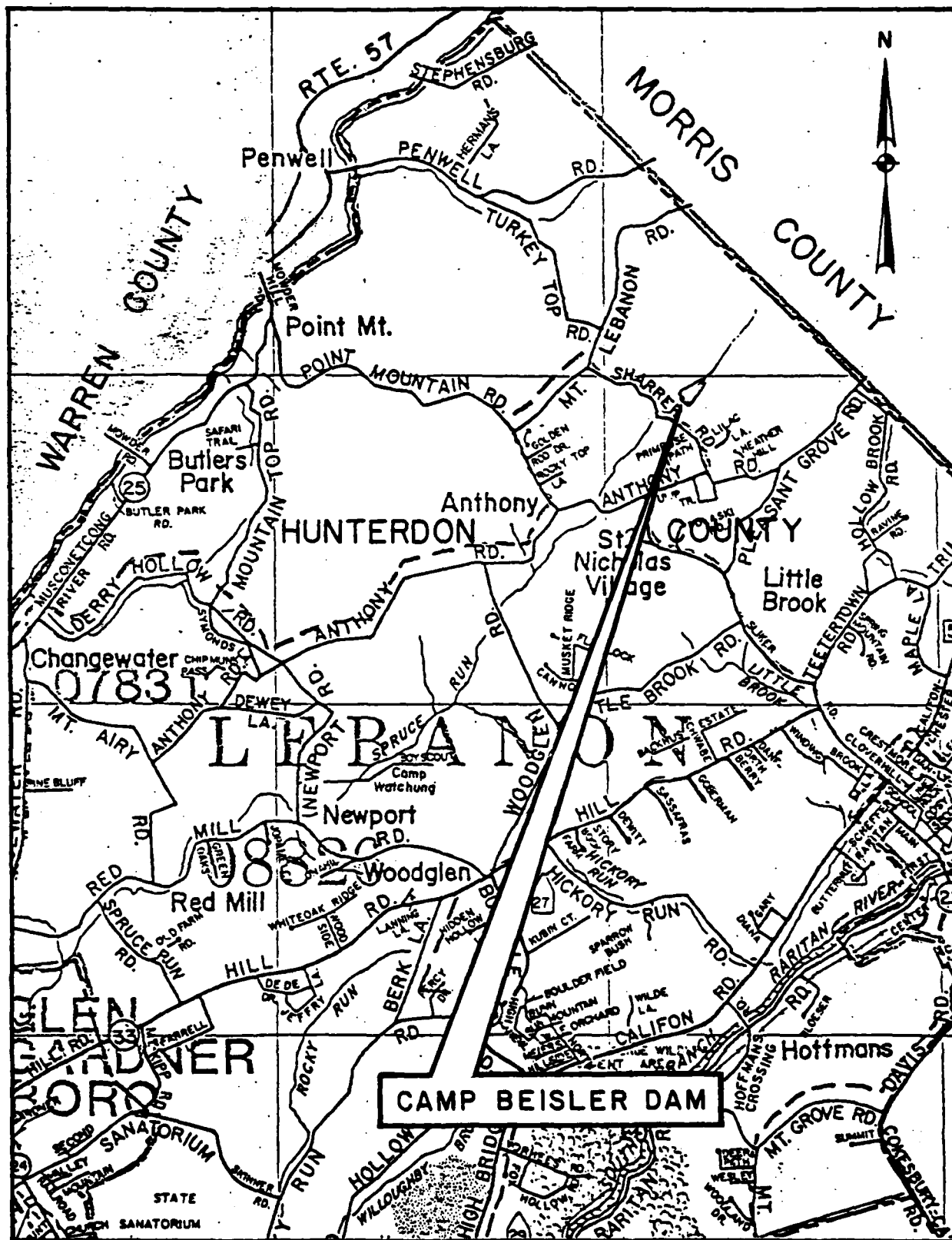
The owner should develop, within one (1) year after formal approval of the report, written operating procedures and a periodic maintenance plan to insure the safety of the dam.

P L A T E S

CAMP BEISLER DAM
LEBANON TOWNSHIP
HUNTERDON COUNTY, N. J.



KEY MAP

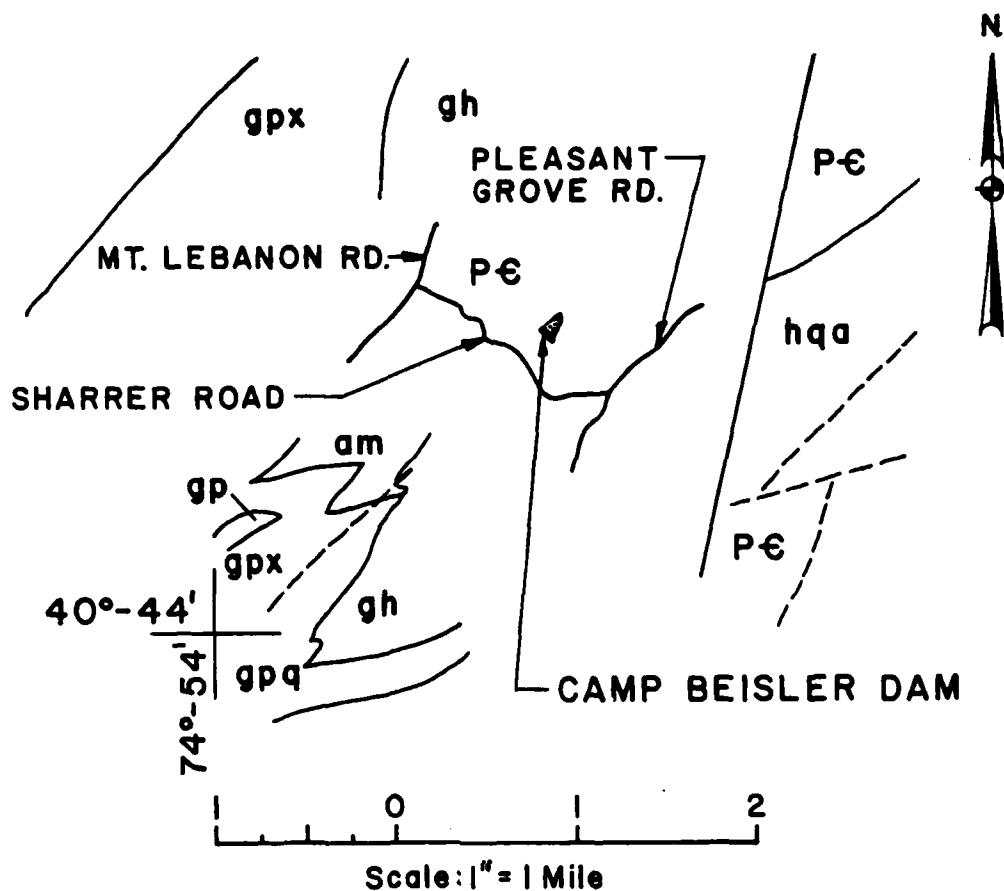


Scale in Miles (Approx.)



VICINITY MAP

PLATE 2



LEGEND

PRE-CAMBRIAN

- P-Є Undifferentiated Pre-Cambrian
- am Amphibolite
- gh Hornblende Granite
- gp Pyroxene Granite
- gpq Plagioclase-Quartz Granite
- gpx Pyroxene Gneiss
- hqa Hypersthene-Quartz-Andesine Gneiss

FAULT

(Dashed Where Inferred)

GEOLOGIC MAP CAMP BEISLER DAM

3

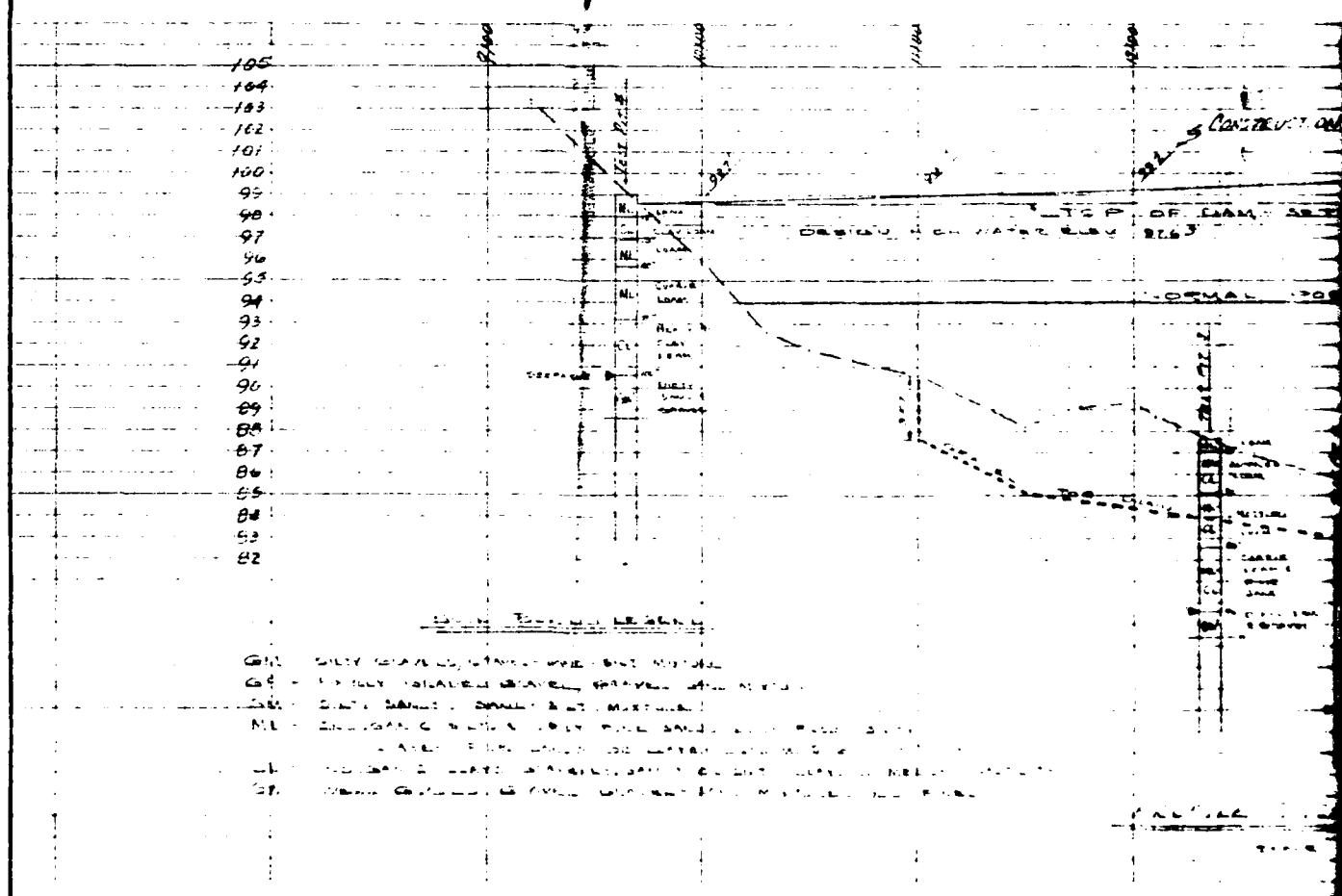
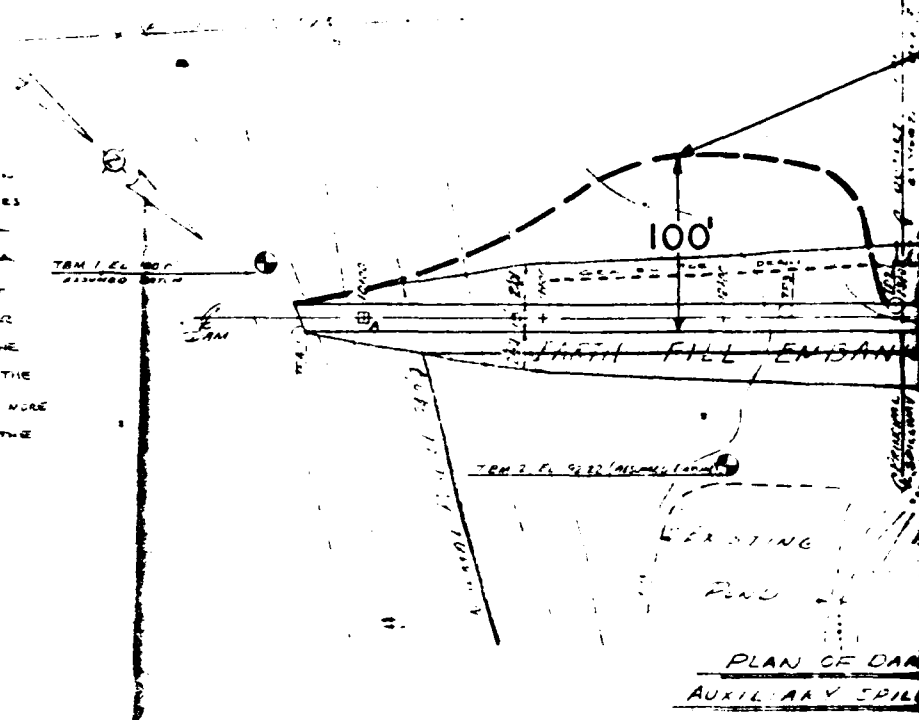


THE DEPT. OF DEFENSE
CASH MANAGEMENT AND FINANCE

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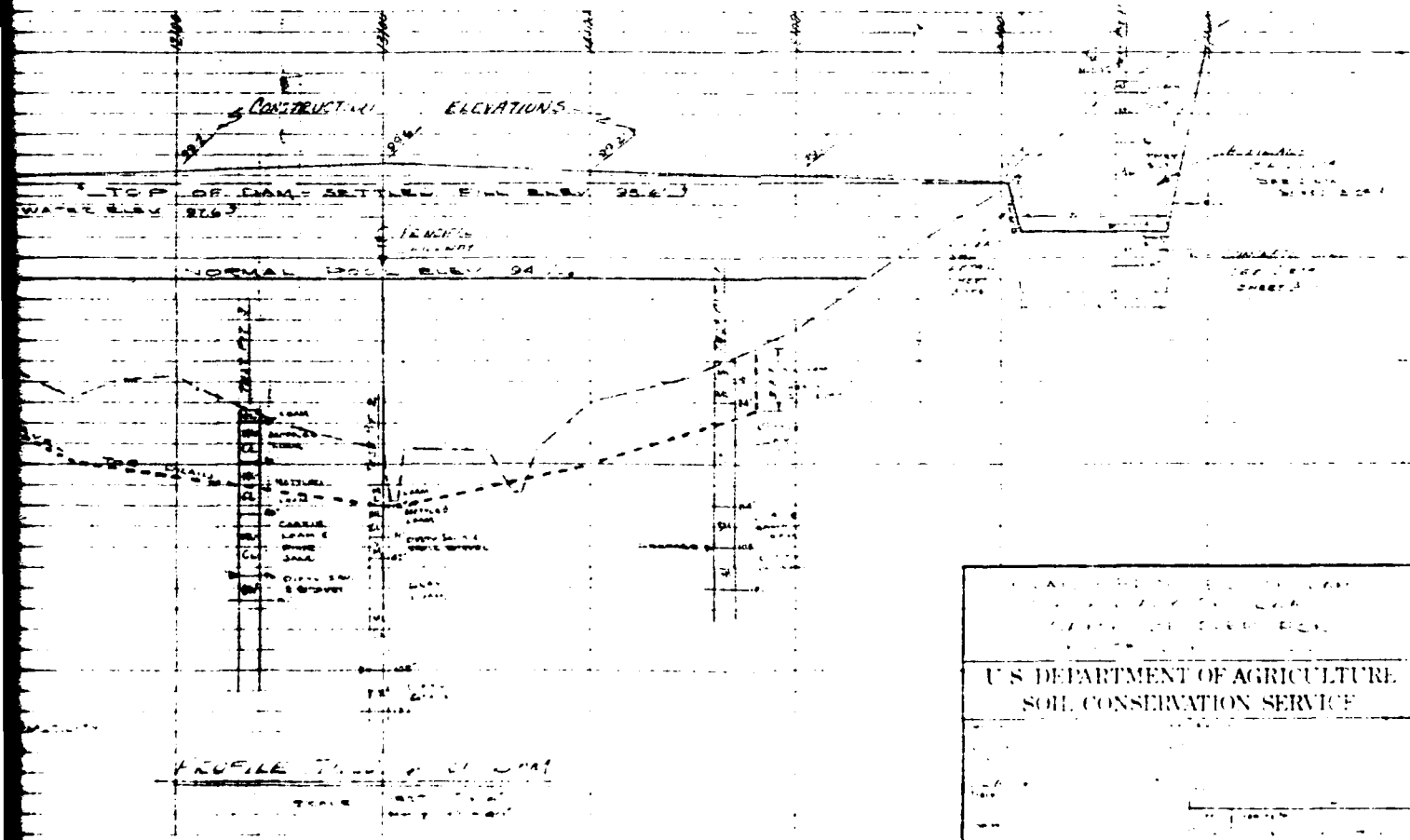
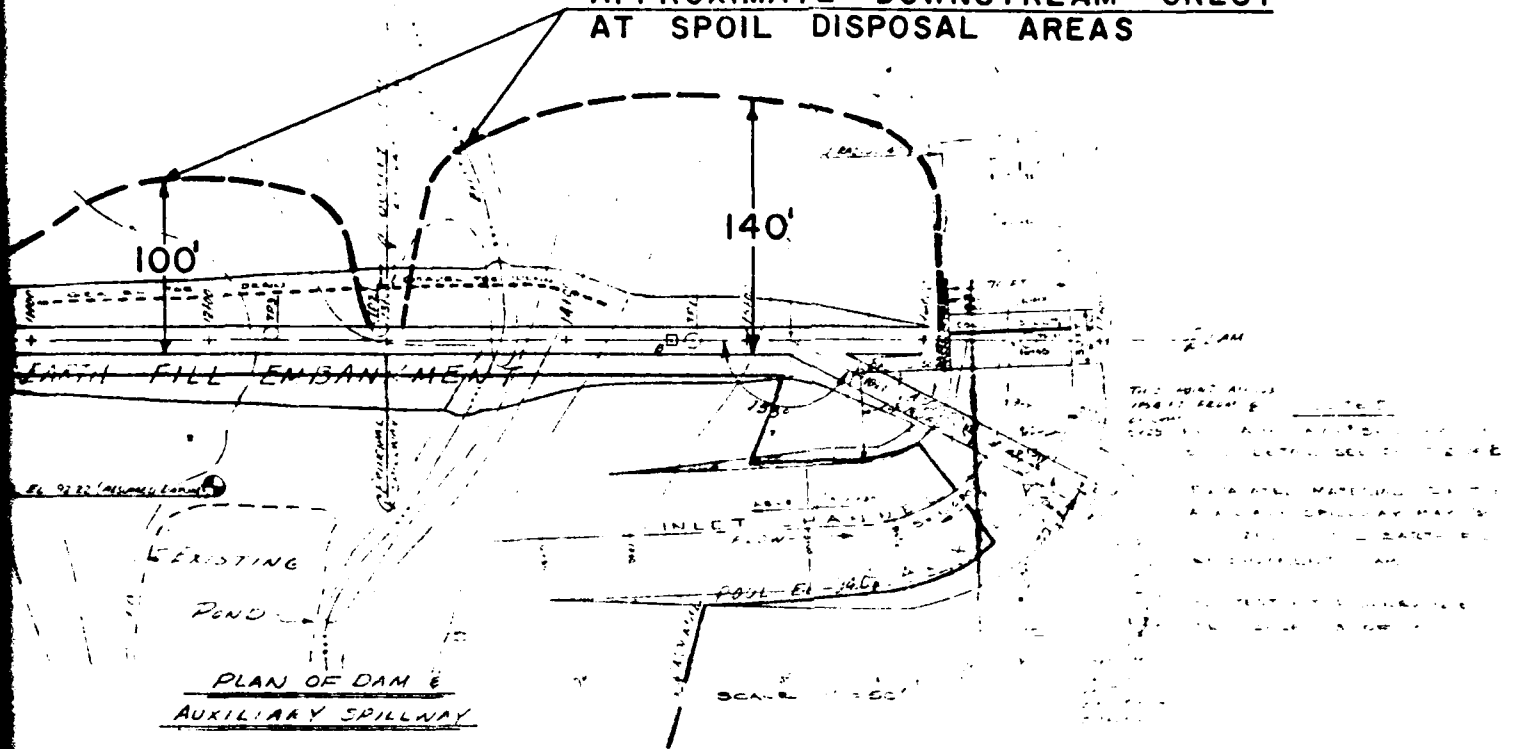
...the fact that the *in vitro* and *in vivo* results are in good agreement. The *in vitro* results are in good agreement with the *in vivo* results, which are in good agreement with the *in vitro* results.

EARTH FILL - ALL TOP SOIL SHALL BE STRIPPED FROM BORROW AREAS & DAM FOUNDATION AREA. ALL FILL SHALL BE PLACED IN LAYERS NOT TO EXCEED 5" IN THICKNESS AND SHALL BE COMPACTED BY AT LEAST 4 PASSES OF A PNEUMATIC ROLLER, TAMPING ROLLER, OR AT LEAST 2 PASSES WITH A VIBRATORY ROLLER. THE MOST IMPERVIOUS SOIL FOUND IN THE BORROW AREAS SHALL BE PLACED NEAR THE E OF THE EARTH FILL EMBANKMENT; THE MORE PERMEABLE SOILS ARE TO BE PLACED IN THE UPSTREAM & DOWNSTREAM SLOPES.

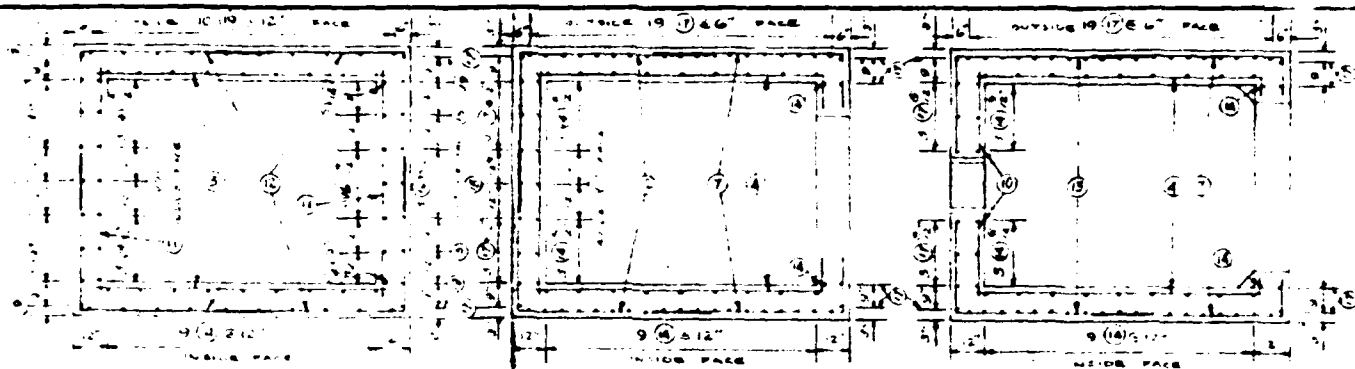


- LEGEND
- G1 - SILTY GRAVEL, SAND, SILT, AND FINE GRAVEL
 - G2 - SILTY GRAVEL, SAND, SILT, AND FINE GRAVEL
 - G3 - SILTY SAND, SAND, SILT, AND FINE GRAVEL
 - ML - SILTY SAND, SAND, SILT, AND FINE GRAVEL
 - CL - SILTY SAND, SAND, SILT, AND FINE GRAVEL

APPROXIMATE DOWNSTREAM CREST AT SPOIL DISPOSAL AREAS



U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

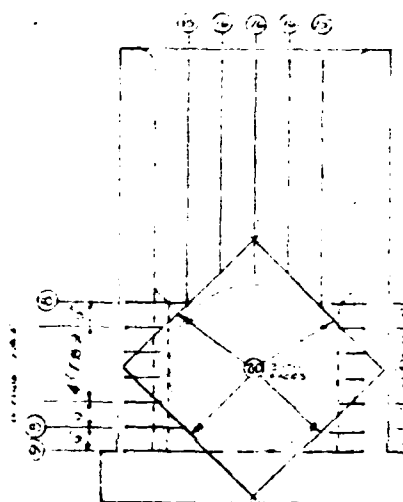


SECTION A-A

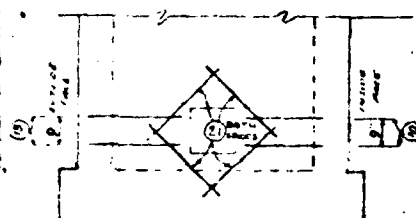
SECTION B-B

SECTION C-C

RISE TO 1
WITH GOLF
WATER IN
DEVICE 1

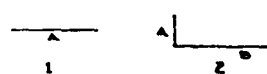


SECTION G-G



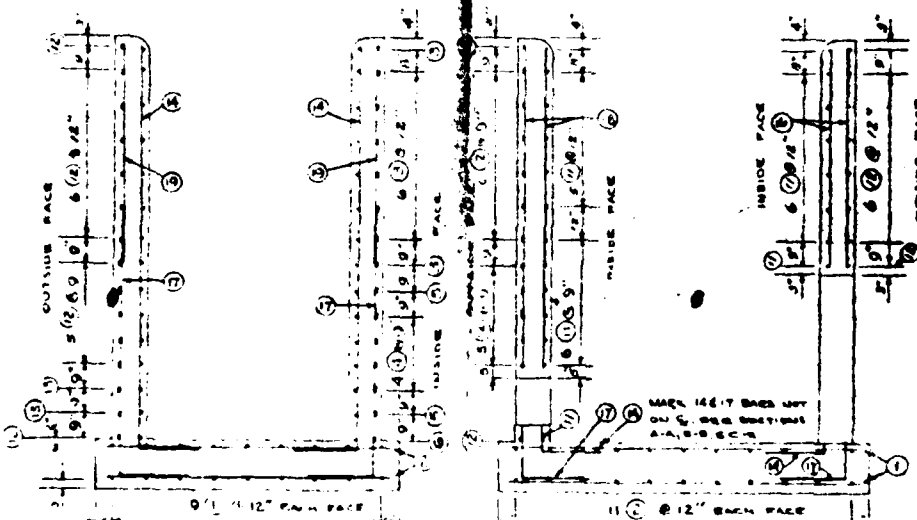
SECTION F-F

BAR TYPES

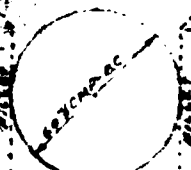


SPICE LENGTH

NO. 6 BARS 19\"/>



SECTION D-D

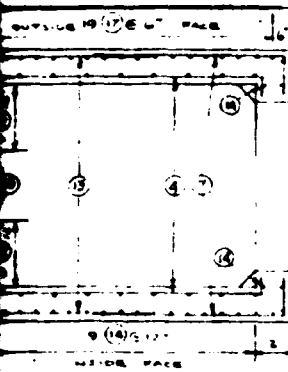


BASE

DOWNSTREAM ELEVATION

RISE-STEEL SCHEDULE

MARK	LOCATION	SIZE	QTY	WGT	TYPE
1	BASE	6	18	10.5	1
2	"	6	22	8.5	1
3	"	6	16	6.75	1
4	"	6	6	2.0	2
5	"	6	4	3.5	2
6	"	6	2	1.05	2
7	"	6	6	6.75	2
8	"	6	4	7.5	2
9	"	6	2	11.2	2
10	ENDWALL	1/2"	5	2.5	1
11	"	"	5	2.7	1
12	"	6	5	10.5	2
13	"	6	4	6.75	2
14	"	6	24	12.5	2
15	"	6	4	7.5	2
16	"	6	4	6.75	1
17	"	6	20	10.5	2
18	"	6	2	1.0	1
19	"	6	16	6.75	1
20	"	6	3	1.5	1
21	"	6	5	2.5	1



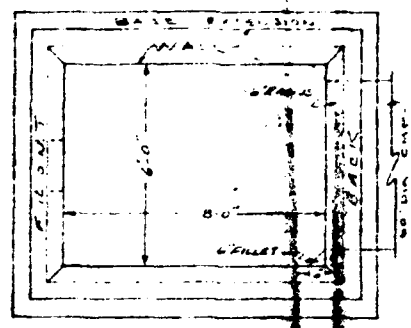
CONCRETE

CONCRETE SHALL BE 3000 PSI COMPRESSIVE STRENGTH OF 3000 PSI MINIMUM AND NOT LESS THAN 5% AIR ENTRAINMENT. THE REQUIREMENTS OF CLASS C CONCRETE SHALL BE MET. STAIN HIGHLY CORROSIVE. ALL REINFORCING STEEL SHALL BE EPOXY COATED. IF REINFORCING STEEL IS NOT EPOXY COATED, IT SHALL BE GALVANIZED.

All concrete shall be 3" minimum when placed in concrete poured against earth and 2" clear cover where forms are used.

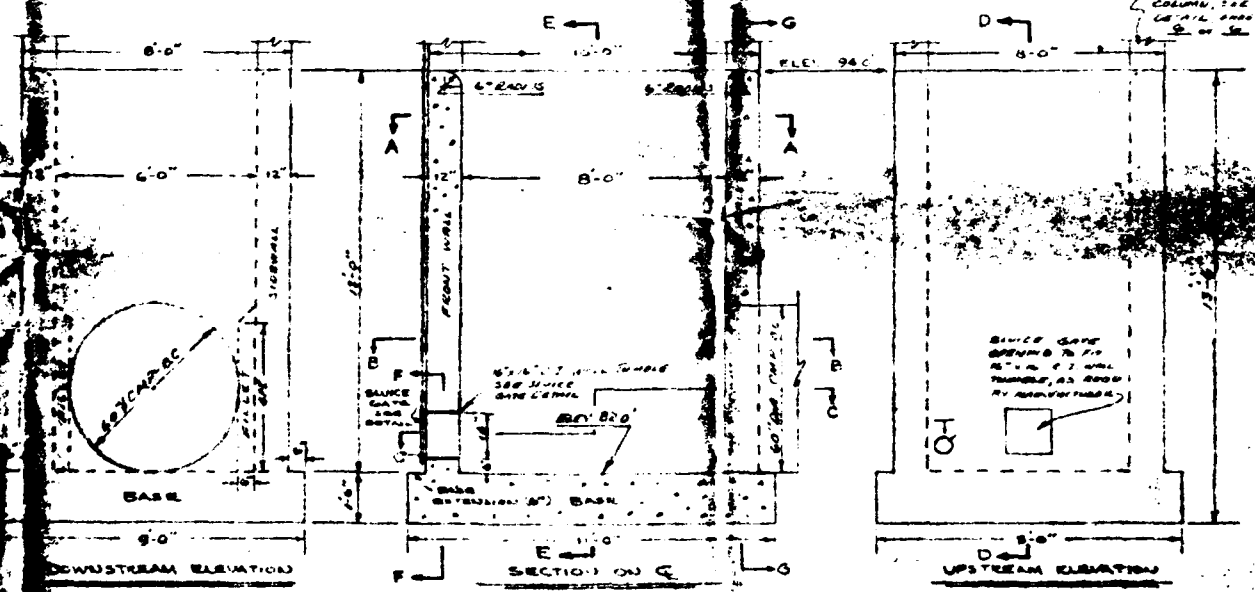
SECTION C-C

RISE TO BE BUILT WITH COLD WATER. WATER CONTROL DEVICE. SEE SHEET 6.



NOTE: RISER SHALL BE BUILT WITH ANTI-VORTEX PLUG, FOR DETAILS, SEE SHEET 2 OF 2.

PLAN



DETAIL OF CONCRETE RISER

SCALE 3/8" = 1'-0"

RISER - STEEL SCHEDULE

MARK	LOCATION	SIZE	QUANTITY	TYPE	A	B	PRICE PER FT
1	BASE	1/2"	18	105	1	12-6	109.00
2	"	1/2"	22	85	1	8-6	197.00
3	"	1/2"	19	85	1	8-9	140.00
4	"	1/2"	6	80	2	0-9	78.00
5	"	1/2"	4	35	2	1-0	30.00
6	"	1/2"	2	105	2	8-0	21.00
7	"	1/2"	6	615	2	1-9	88.00
8	"	1/2"	4	75	2	1-9	30.00
9	"	1/2"	2	115	2	2-9	17.00
10	SIDEWALL	1/2"	5	25	1	2-6	10.00
11	"	1/2"	27	675	1	2-9	141.75
12	"	1/2"	22	1050	2	4-8	441.00
13	"	1/2"	9	875	2	3-0	28.00
14	"	1/2"	26	1325	2	1-9	357.50
15	"	1/2"	4	725	2	7-3	47.00
16	"	1/2"	6	610	1	8-0	16.00
17	BASE	1/2"	30	1050	1	3-0	135.00
18	"	1/2"	7	110	1	7-6	130.00
19	"	1/2"	38	25	1	6-9	70.00
20	"	1/2"	5	75	1	5-6	44.00
21	"	1/2"	8	50	1	5-0	28.00

CONCRETE QUANTITY
RISER ONLY = 1093 CY

RISER STEEL SUMMARY
NO. 0 BARS 376.00 360.75
NO. 16 BARS 2210.15 2315.72

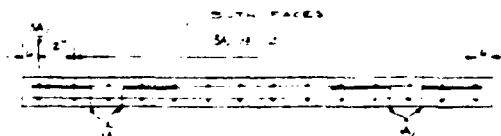
NOTE: THIS SUMMARY
LINES NOT A CLOSE
TOLERANCE. ANTI
VORTEX PLUG
SEE SHEET 2 OF 2

CONCRETE RISER & STEEL DETAIL
CAMP BEISLER POND
HUNTERDON COUNTY, N.J.

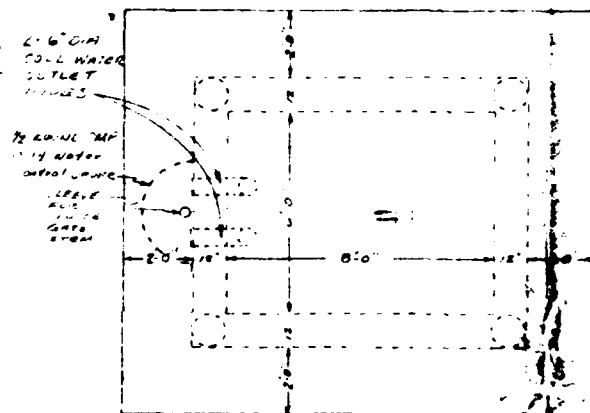
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed by: E. H. MAXWELL, JR. 2-67
Drawn by: J. L. ALLEN 2-67
Checked by: J. L. ALLEN 2-67
Date: 11-01-78

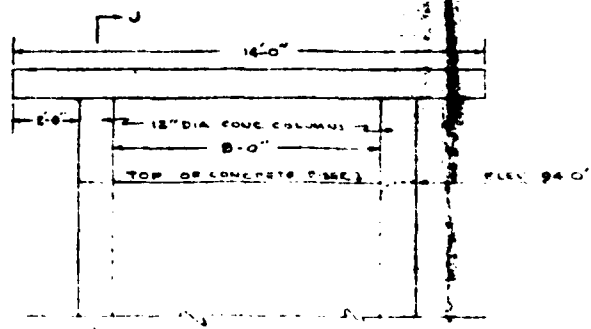
10-10-68



LECT. IN P.K



FLAN-ANTI VORTEX DEVICE



2101 E. EVAN ROAD

100-443887-1

APPENDIX A

CHECK LIST - VISUAL OBSERVATIONS

CHECK LIST - ENGINEERING, CONSTRUCTION
MAINTENANCE DATA

CHECK LIST
VISUAL INSPECTION
PHASE 1

Name Dam Camp Beisler Dam County Hunterdon State New Jersey Coordinators NJ-DEP

Date(s) Inspection January 12, 1981 Weather Clear Temperature 0°F
February 3, 1981 Clear 15°F

Pool Elevation at Time of Inspection 879.2 NGVD Tailwater at Time of Inspection 867.5 NGVD

Inspection Personnel:

January 12, 1981 February 3, 1981
 William Birch Thomas Moroney
 Thomas Moroney
 Joseph Sirianni (Recorder)

OWNER/REPRESENTATIVE

January 12, 1981
 Mark Burkhardt
 Camp Director
 Beisler Camping & Retreat Center
 R.D.I. Box 106
 Port Murray, NJ 07865

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
SURFACE CRACKS	None noticed. Embankment covered with snow.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None noticed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None noticed. Slopes are grass covered and in good condition.	
VERTICAL & HORIZONTAL ALIGNMENT OF THE CREST	Vertical alignment is good. Horizontal alignment of upstream edge of crest is good. Downstream edge of crest is irregular due to left and right sides of the discharge channel being used as spoil disposal areas during construction.	
RIPRAP FAILURES	None	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
EARTH EMBANKMENT Embankment is grass covered with a heavy growth of brush on the upstream face.		Remove brush.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM Junction of the embankment and the auxiliary spillway is in good condition.		
ANY NOTICEABLE SEEPAGE Minor flow was observed at the downstream toe approximately 100 feet from left end of dam. Since section is in the spoil disposal area the source of water may be other than seepage from the dam.		Try and determine if flow is seepage from dam. If so, monitor for clearness and quantity.
STAFF GAGE AND RECORDER None		
DRAINS Plans call for toe drains left and right of low-level outlet. Outlets for drains were not found.		Determine the location of the outlets.

OUTLETS WORKS:

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CRACKING & SPALLING OF CONCRETE SURFACES IN STILLING BASIN	N/A - Main spillway (also outlet works) discharges directly into downstream channel. Auxiliary spillway discharges onto existing ground at embankment toe and then into downstream channel.	
INTAKE STRUCTURE	Main spillway is concrete drop inlet with a sluice gate and is in good condition with only minor spalling of concrete. N/A to auxiliary spillway.	
OUTLET STRUCTURE	A 60-inch corrugated metal pipe in good condition. There is no headwall at outlet end of pipe. Riprap of slope along sides of pipe is missing. Operation of the sluice gate was not performed as the handwheel was missing. The owner's representative stated the gate is not use.	Provide concrete headwall and apron at outlet end. Check sluice gate to determine if operable.
OUTLET FACILITIES		
None		
EMERGENCY GATE		
None		

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CONCRETE WEIR	Main spillway is concrete drop inlet with a sluice gate and two-6-inch steel pipes cold water outlets. The spillway is in good condition with only minor spalling. Auxiliary spillway is a grass channel, with concrete sill. There is one crack in crest approximately 25 feet from left end.	
APPROACH CHANNEL	The lake is the approach channel for both spillways.	
DISCHARGE CHANNEL	Main spillway: 60-inch corrugated metal pipe, in good condition, is the discharge channel and low-level outlet. Auxiliary spillway: The existing ground along the downstream toe of the embankment is the discharge channel and is in good condition.	
BRIDGE AND PIERS	4 - 12-inch concrete columns supporting the concrete anti-vortex cover for the main spillway. Columns and cover are in good condition. N/A for auxiliary spillway	

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
MONUMENTATION/SURVEYS		
None		
OBSERVATION WELLS		
None		
WEIRS		
None		
PIEZOMETERS		
None		
OTHER		
None		

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
SLOPES	Moderately steep and wooded. A swimming area is along the right shore line. There is no indication of slope instability.	
SEDIMENTATION	None observed. Lake covered with ice and snow.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Channel meanders from outlet past spoil disposal section into a wooded area. The bottom is rocky with no debris.	
SLOPES	The slopes of the channel through the spoil disposal section are moderately steep with brush growing on the banks. Also, there is some erosion along the right bank. Slopes in the wooded area are flat.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	A housing development with more than a dozen homes is located left of the downstream channel approximately 500 feet downstream of the dam. The homes are above the flood plain.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Available on microfilm at NJ Department of Environmental Protection (NJ-DEP), 1474 Prospect Street, P.O. Box CN-029, Trenton, NJ 08625 Available at U.S. Department of Agriculture Soil Conservation Service (SCS) 1370 Hamilton Street, Somerset, NJ 08873
REGIONAL VICINITY MAP	Available. Hunterdon County Map and U.S.G.S. Quadrangle sheet for Hackettstown, N.J.
CONSTRUCTION HISTORY	No formal history exists, but can deduced from available microfilm at NJ-DEP.
TYPICAL SECTIONS OF DAM	Available on microfilm at NJ-DEP and SCS files.
HYDROLOGIC/HYDRAULIC DATA	Limited data available at NJ-DEP and SCS files.
OUTLETS - PLAN	Available on microfilm, NJ-DEP and SCS files.
- DETAILS	Available on microfilm, NJ-DEP and SCS files.
- CONSTRAINTS	None.
- DISCHARGE RATINGS	Not available.
RAINFALL / RESERVOIR RECORDS	Not available.

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
(continued)

ITEM	REMARKS
DESIGN REPORTS	None available.
GEOLOGY REPORTS	Available U.S.G.S. Geologic Overlay Sheet for Hunterdon County and Engineering Soils Survey of New Jersey, Report No. 6 - Hunterdon County, by Rutgers University (New Brunswick, NJ).
DESIGN COMPUTATIONS	Limited data available on microfilm, NJ-DEP and SCS files.
HYDROLOGY & HYDRAULICS	
DAM STABILITY	None available.
SEEPAGE STUDIES	
MATERIALS INVESTIGATIONS	Test pit results available on microfilm, NJ-DEP and SCS files.
BORING RECORDS	None available.
LABORATORY	
FIELD	
POST-CONSTRUCTION SURVEYS OF DAM	None.
BORROW SOURCES	Unknown.
SPIILLWAY PLAN - SECTIONS	Available on microfilm, NJ-DEP and SCS files.
- DETAILS	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
(continued)

ITEM	REMARKS
OPERATING EQUIPMENT PLANS AND DETAILS	Available on microfilm, NJ-DEP and SCS files.
MONITORING SYSTEMS	None available.
MODIFICATIONS	None
HIGH POOL RECORDS	Not kept.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Existing condition report, July 1973 Available on microfilm, NJ-DEP.
PRIOR ACCIDENTS OF FAILURE OF DAM - DESCRIPTION - REPORTS	None known to exist.
MAINTENANCE OPERATION RECORDS	None known to exist.

APPENDIX B

PHOTOGRAPHS

(Taken on January 12 and February 3, 1981)

CAMP BEISLER DAM



Photo 1 - View of main spillway from top of dam. (Photo taken on January 12, 1981.)

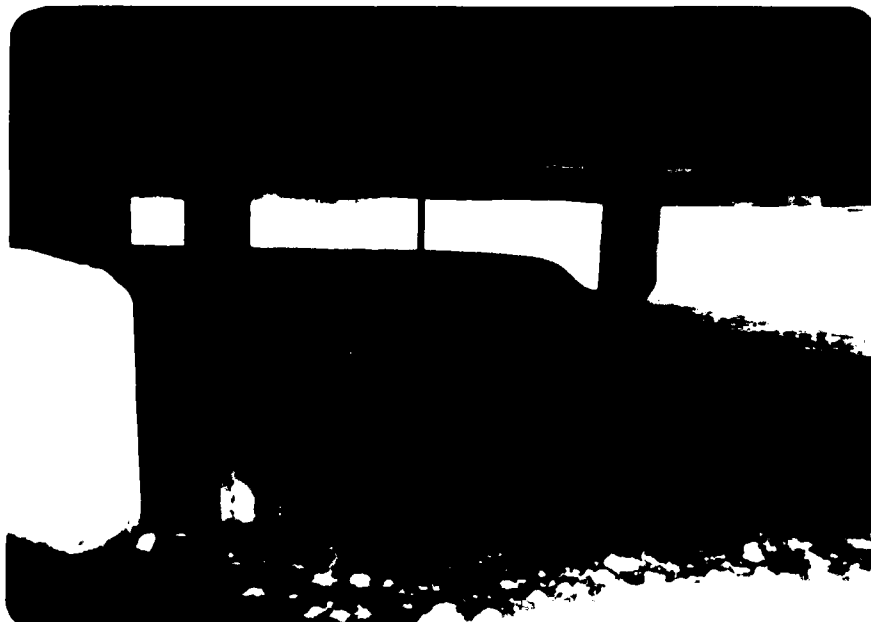


Photo 2 - View of main spillway showing two 6-inch steel cold water outlets. (Photo taken on January 12, 1981.)

CAMP BEISLER DAM



Photo 3 - View of auxiliary spillway approach channel from right end of dam. Note concrete sill wall lower right of photo. (Photo taken on February 3, 1981)



Photo 4 - View of auxiliary spillway discharge channel along toe of downstream slope looking from top of embankment toward right end of dam. (Photo taken on January 12, 1981.)

CAMP BEISLER DAM



Photo 5 - View of upstream slope from left end of dam.
Note growth of brush along slope. (Photo taken
on February 3, 1981.)



Photo 6 - View of downstream slope from left end of dam.
Heavy area of grass in left center is the location
of the discharge channel. (Photo taken on February
3, 1981.)

CAMP BEISLER DAM



Photo 7 - View of downstream channel taken from top of dam
(Photo taken on January 12, 1981.)



Photo 8 - View of low-level outlet discharge. (Photo taken
on February 3, 1981.)

CAMP BEISLER DAM



Photo 9 - View of discharge channel from top of embankment looking toward left spoil disposal area. Note houses in upper center of photo. (Photo taken on January 12, 1981.)



Photo 10 - View of downstream channel in wooded area. (Photo taken on January 12, 1981.)

APPENDIX C

SUMMARY OF ENGINEERING DATA

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

Name of Dam: CAMP BEISLER DAM

Drainage Area Characteristics: 1.21 square miles

Elevation Top Normal Pool (Storage Capacity): 879 NGVD (20 acre feet)

Elevation Top Flood Control Pool (Storage Capacity): N/A

Elevation Maximum Design Pool: 884.45 NGVD (SDF pool: 65 acre-feet)

Elevation Top Dam: 884.1 NGVD (61 acre-feet)

SPILLWAY CREST:

	Main:	879.0 NGVD
a. Elevation	Auxiliary:	881.3 NGVD
	Main:	Concrete Drop Inlet
b. Type	Auxiliary:	Earth Channel
	Main:	8.0 feet
c. Width	Auxiliary:	30.0 feet
	Main:	28.0 feet
d. Length	Auxiliary:	70.0 feet
		All four sides - Main
e. Location Spillover		Entire length - Auxiliary
f. No. and Type of Gates		None

OUTLET WORKS:

a. Type	<u>60-inch C.M.P.</u>
b. Location	<u>At main spillway</u>
c. Entrance Inverts	<u>867.0 NGVD</u>
d. Exit Inverts	<u>867.0 NGVD</u>
e. Emergency Draindown Facilities	<u>16-inch sluice gate-60-inch C.M.P.</u>

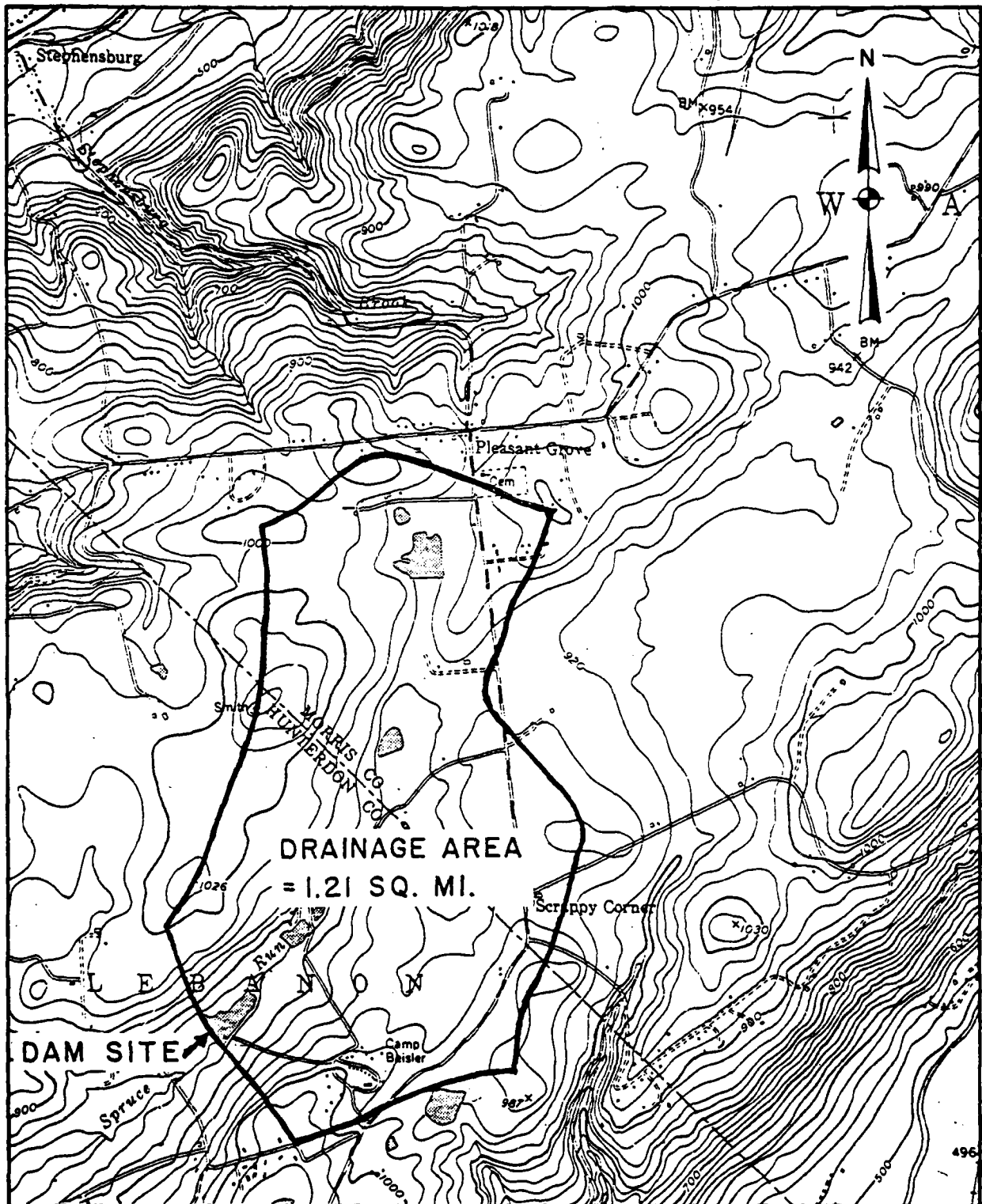
HYDROMETEOROLOGICAL GAGES:

a. Type	<u>None</u>
b. Location	<u>None</u>
c. Records	<u>None</u>

MAXIMUM NON-DAMAGING DISCHARGE: 1416 cfs at elevation 884.1 NGVD.

APPENDIX D

HYDROLOGIC COMPUTATIONS



2,000 0 2,000 4,000

Scale: 1" = 2,000 FT.

CAMP BEISLER DAM
DRAINAGE BASIN

Determination of PMP

Probable Maximum ppt. (inches) for an area of
10 square miles and 6 hour duration
= 26"

D.A. = 1.21 sq miles

ZONE = C

The corps of Engineers recommended that
20 % reduction to be applied to the
report value for a 10 sq miles drainage
area in order to provide for the imperfect
fit of the storm isohyetal patterns to the
shape of the particular basin.

Because of the unlikelihood of a perfect
strike of a storm center on any particular
small basin, no variation is assumed between
point and 10 square miles precipitation

P.M.P. = $26" \times (1 - 0.2) = 20.8"$ (computer
adopted this value after making adjustments.

Depth area duration relationship.

Percentage to be applied to the above 6 hr PMP

6 hr = 100 %

12 hr = 108 %

24 hr = 117 %

48 hr = 127 % (Not necessary)

INFILTRATION :

Initial Infiltration = 1 in

Const. Infiltration = 0.1 in / hr.

DETERMINATION OF T_c

1. Estimating T_c from velocity estimate and watercourse length (Ref. Design of Small Dam Fig 30)

	Slope	Vel	Remarks
Overland Flow	$\frac{1000-900}{4000} \times 100 = 2.5\%$	1.5	Postures upper portion of watershed

Reach 1	$\frac{900-876}{1800} \times 1.3\%$	1.0	Natural Channel (Neglect flow through channel)
---------	-------------------------------------	-----	--

$$T_c = \frac{4000}{1.5 \times 3600} + \frac{1800}{1 \times 3600} = 1.24 \text{ hrs.}$$

2. Estimating T_c assuming same velocity

$$T_c = \frac{5800}{1 \times 3600} = 1.61 \text{ hrs.}$$

3. From Nomograph of design of small dam (S.C.S. Guide) - same as Kirpich

$$T_c = \left(\frac{11.9 L^3}{H} \right)^{.385} \quad \begin{array}{l} L \text{ in miles} = 1.1 \text{ miles} \\ H \text{ in Ft} = 124 \text{ Ft} \end{array}$$

$$= \left(\frac{11.9 \times 1.1^3}{124} \right)^{.385}$$

$$= .45 \text{ hrs.}$$

Use $T_c = 1.24 \text{ hrs}$

$$Lag = 0.6 \times 1.24 = .74 \text{ hrs.}$$

Area of Lake at normal pool level
= 5.0 AC

(Information from the file)

Height of the Dam = 17.1'

Small Dam

Hazard: Potential - Significant

S.D.F. = $\frac{1}{2}$ PMF

Hydrologic Analysis

Drainage Area = 1.21 sq miles

Inflow Hydrograph at Reservoir was determined using HEC 1 DB program. Inflow routed through the reservoir.

SPILLWAY AND DAM

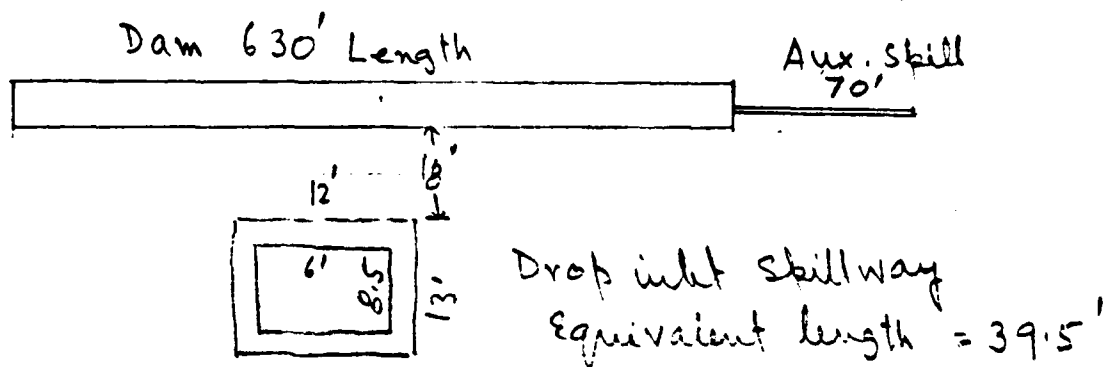
The drawings by U.S. Dept. of Agriculture, S.C.S., are used in the study.

Channel invert at the bottom of Dam
= 82' (S.C.S. drawing)

Channel invert at the dam location
= 867.

∴ 785' is added with all the S.C.S. drawing elevations to get the U.S.G.S. elevation.

PLAN OF THE DAM (Schematic



(Measured in the field)

Elevation of Dam = 5.1 ft above main spillway (from field)

$$\text{Elev.} = 94.0 (\text{S.C.S. drawing}) + 5.1 = 99.1$$

Elevation of Dam in U.S.G.S datum = 884.1 Ft

Elevation of Aux. Spillway = 96.3 (S.C.S. drawing)
= 881.3 Ft (U.S.G.S)

Elevation of drop inlet spillway = 94 (S.C.S. drawing)
= 879 Ft (U.S.G.S)

Length of Pipe = 86 Ft

60" ϕ Bituminous coated
Corrugated Metal

For the Drop inlet spillway, water could enter through all sides of the inlet

Effective length of spillway = $L_s = 39.5'$

$$Q_s = C L_s H^{1.5} \\ = 3.3 \times 39.5 H^{1.5} = 130.35 H_s^{1.5}$$

Considering flow through the tube (5' ϕ)

$$Q_o = C_d \cdot A_o \sqrt{2g H_o} \\ = .63 \times \left(\frac{\pi}{4} \times 5^2 \right) \times 8 \sqrt{H_o} \\ = 99 \sqrt{H_o}$$

H_o = Diff of elevation between H.W and T.W

Tailwater is assumed = 870

Elevation of Water	Head over spillway H_s	Q Through spillway $130.35 H_s^{1.5}$	Head for Orifice flow H_o	Flow through Orifice $Q_o = 90 \sqrt{H_o}$	
879	0	-	-	-	
880	1	130	→ spillway 10	284	
881.3	2.3	455	control 11.3	302	
882	3	677	12	311	
883	4	1043	13	324	
884.1	5.1	1501	14.1	334	
886	7	2414	16	360	
888	9	3579	18	382	
890	11	4755	20	403	
895	16	8342	25	450	
900	21	12544	30	493	

Flow regulated by pipe

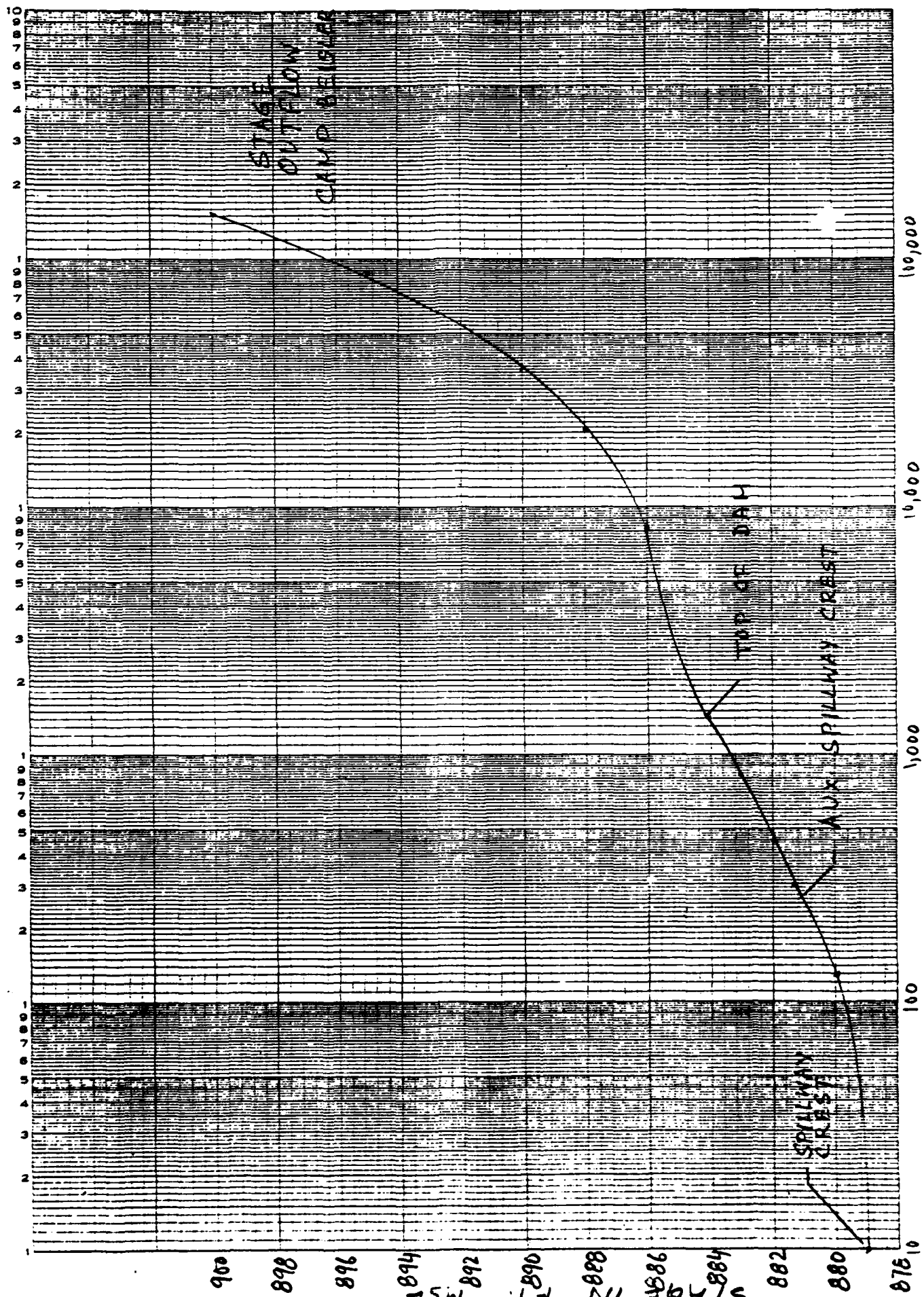
Stage - Outflow relationship :-

① Flow through Drop inlet = Q_0

② Flow through Aux spillway = $Q_A = 3.3 L_A H_A^{1.5}$
 $= 3.3 \times 70 H_A^{1.5} = 231 H_A^{1.5}$

③ Flow through Dam = $Q_D = 2.75 L_D H_D^{1.5} = 3.3 \times 630 H_D^{1.5}$
 $= 2079 H_D^{1.5}$

Stage ①	Inlet Q_0 ②	H_A ③	Q_A $231 H_A^{1.5}$ ④	H_D ⑤	Q_D $2079 H_D^{1.5}$ ⑥	Q_{Total} ② + ④ + ⑥
Drop inlet → 879	0					0
880	130					130
Aux. spill → 881.3	302	0				302
882	311	0.7	135			446
883	324	1.7	512			836
Dam → 884.1	334	2.8	1082	0		1416
886	360	4.7	2354	1.9	5,445	6,159
888	382	6.7	4006	3.9	16,012	20,400
890	403	8.7	5928	5.9	29,794	36,125
895	450	13.7	11,714	10.9	74,816	86,980
900	493	18.7	18,680	15.9	131,810	150,983



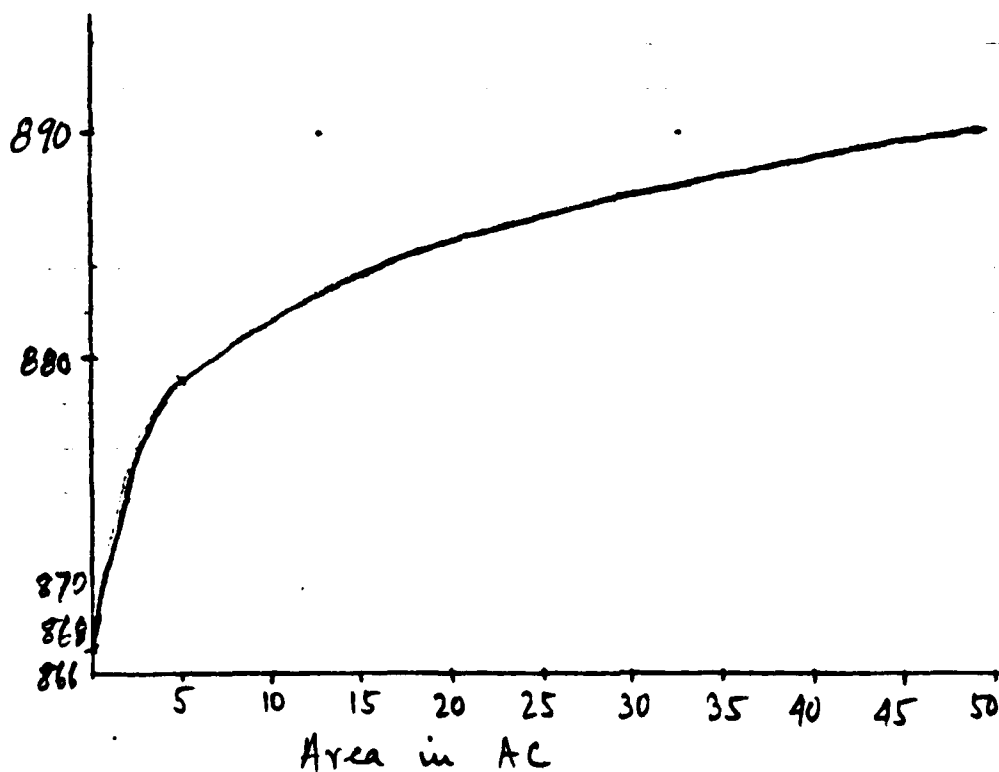
OUTFLOW (CFS)

Elevation Area - Capacity relationship.

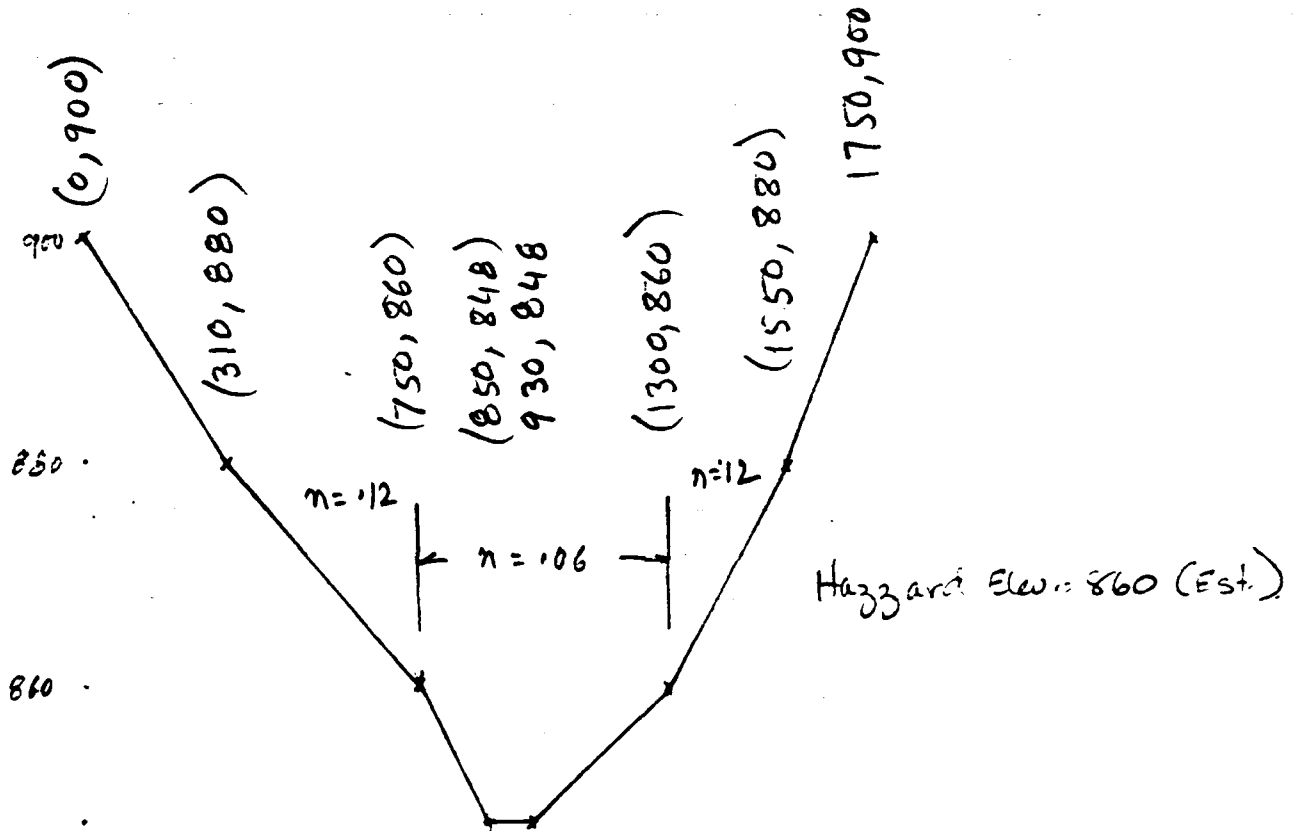
Information obtained from U.S.G.S Quad.

Ele.	867 (Bottom of Dam)	879	900
Surface Area (Ac)	0	5.0	49.6

HEC 1 DB program will develop storage capacity from surface area elevation



Cross-Section at D/S Reach



Reach 1

$$L = 1,000 \text{ Ft}$$

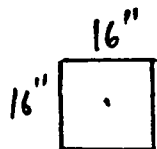
$$S = \frac{20}{1000} = 0.02$$

DRAWDOWN TIME COMPUTATION

94 EL = 879

When the gate is open

Normal Elevation to start
= 879



— EL = 867.5

$$\text{Inflow} = \frac{2 \text{ cfs}}{\text{mi}^2} \times 1.24 = 2.42 \text{ cfs}$$

$$Q = CA \sqrt{2gH} \quad C = 0.62$$

$$Q = 8.8 \sqrt{H}$$

Assume T.W. Depth = 867

$$A_2 = \left(\frac{h_2}{h_1} \right)^2 A_1$$

$$= \left(\frac{h_2}{12} \right)^2 5$$

$$A_1 = 5 \quad h_1 = 12$$

$$\text{Drawdown time} = \frac{\text{Vol in AF} \times 43560}{Q \times 3600}$$

$$= \frac{\text{Vol} \times 12.1}{Q}$$

RES EL	Area AC	AVG Area	Vol AF	AVG RES EL.	Q 8.8√H	Drawdown time $\frac{\text{Vol} \times 12.1}{Q}$	Cum time hrs	Drawdown with inflow $\frac{2.42 \times t}{Q}$	Cum time hrs
(Ft)	(Ac)	(Ac)	(AF)	Ft	CFS	(HRS)	HRS	(HRS)	(HRS)
879	5								
		4.235	8.47	878	29.2	3.5	3.5	.3	3.8
877	3.47								
		2.845	5.69	876	26.4	2.6	6.1	.2	6.6
875	2.22								
		1.735	3.47	874	23.3	1.8	7.9	.2	8.6
873	1.25								
		.905	1.81	872	19.7	1.1	9.0	.1	9.8
871	.56								
		.350	.70	870	15.2	.6	9.6	.1	10.5
869	.14								
		.070	.14	868	8.8	.2	9.8	.1	10.8
867.	0								

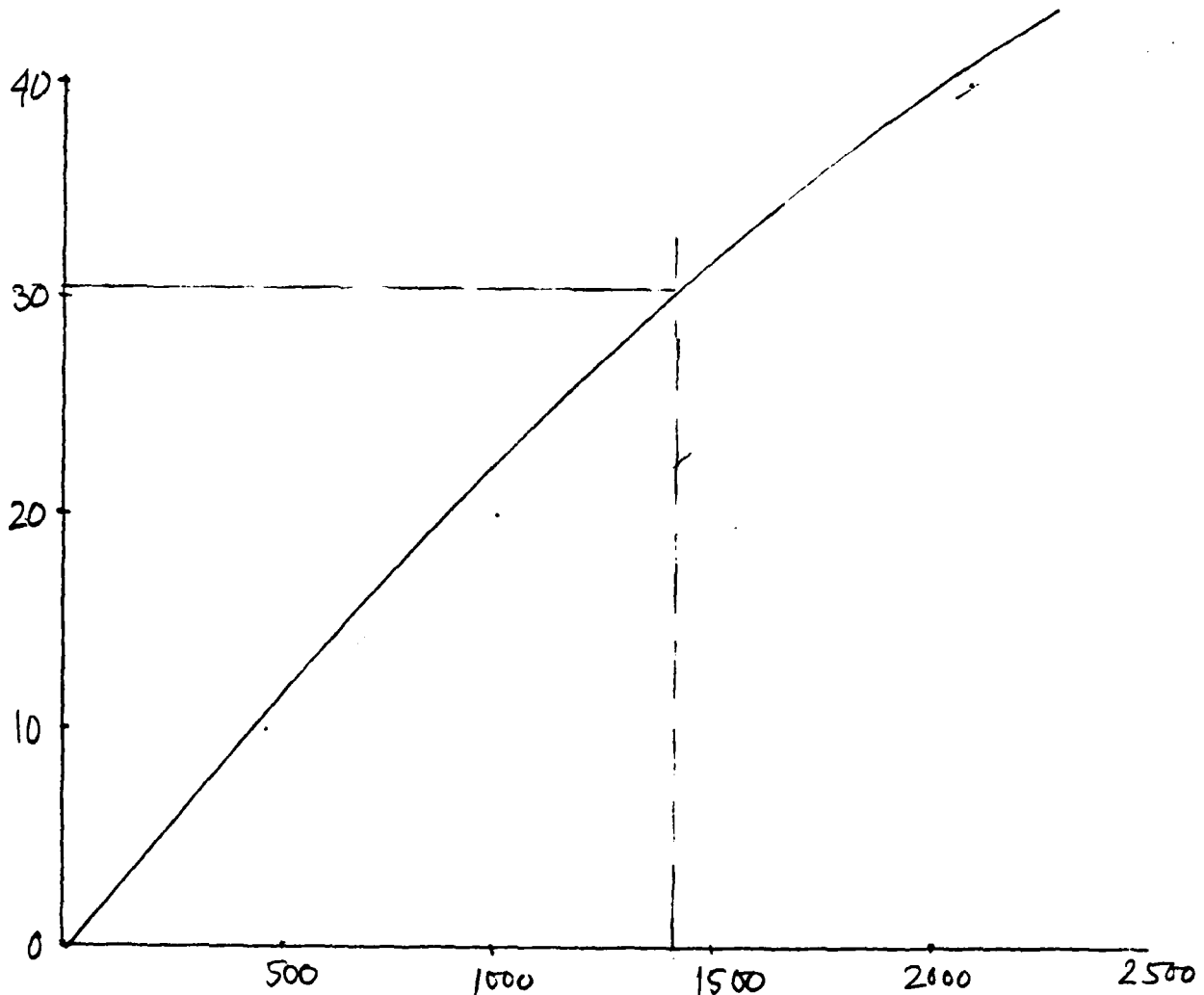
Time of Drawdown without inflow = 9.8 hrs.
Time of Drawdown with constant inflow = 10.8 hrs.

PRC Harris, Inc.
CONSULTING ENGINEERS

SUBJECT N. J. Dam Inspection
Camp Beisler Dam
COMPUTED BY S.B. CHECKED BY _____

SHEET NO. _____ OF 11
JOB NO. 10-1176-07
DATE Feb, 1981

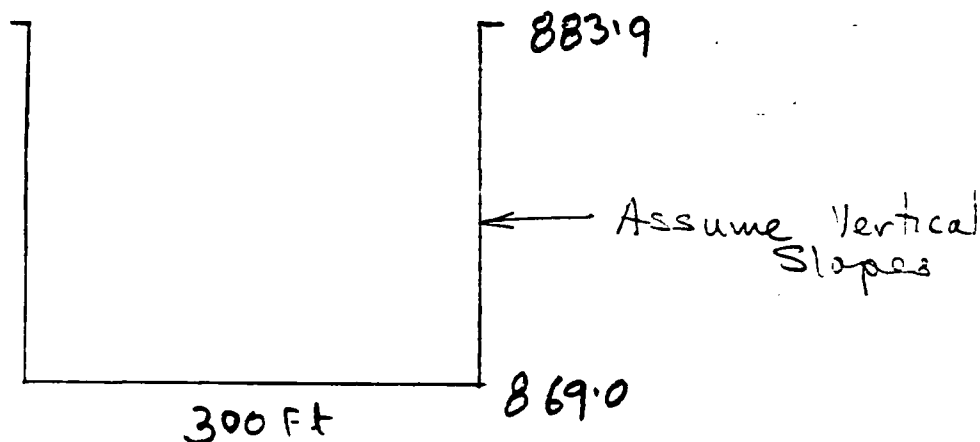
OVERTOPPING POTENTIAL



Overtopping of Dam occurs at
El 884.1 $Q = 1416$ (30.5% of
PMF

Breach Analysis

Assume breach analysis begins to develop when
reservoir stage reaches above the dam
Time of Failure = 16.0 hrs



Effect of breach was analysed 1000 Ft
Downstream of the Dam.

Max stage without Dam break = 850.8

Max stage with Dam break = 851.4

(∴) 0.6 ft change in W.S. El
Due to Dam break. at 0.4 PMF

PEAK FLOW AND STORAGE (EAD OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOOD IN FUTURE WITH PER-SECOND ECONOMIC RATIOS PER SECOND
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN RATIO	RATIOS APPLIED TO FLOODS			
				RATIO 1	RATIO 2	RATIO 3	RATIO 4
HYDROGRAPH AT	RES	1.21	1	0.50	0.70	0.70	0.70
				2.90	2.15	1.64	1.07
ADJUSTED TO	DAY	1.21	1	0.75	2.19	1.61	1.00
				7.76	6.17	4.59	2.83
ADJUSTED TO	REACH	1.21	1	2.67	2.24	1.92	1.04
				7.00	6.56	4.36	2.84

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1	ELEVATION	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM	RATIO	MAXIMUM	MINIMUM	STORAGE	AC-FT	CFS	OVER TOP	DURATION	TIME OF	TIME OF
OF	RESERVOIR	MAXIMUM	DEPTH	OVER DAM	RATIO	MAXIMUM	MINIMUM	STORAGE	AC-FT	CFS	OVER TOP	DURATION	TIME OF	TIME OF
0.50	884.45	0.35	0.21	0.05	0.50	2687	851.0	16.50	16.50	0.00	0.00	0.00	0.00	0.00
0.40	884.31	0.21	0.05	0.05	0.40	2687	851.0	16.50	16.50	0.00	0.00	0.00	0.00	0.00
0.30	884.15	0.05	0.05	0.05	0.30	1552	950.1	16.50	16.50	0.00	0.00	0.00	0.00	0.00
0.20	883.31	0.00	0.00	0.00	0.20	1004	849.4	16.75	16.75	0.00	0.00	0.00	0.00	0.00
0.10	882.03	0.00	0.00	0.00	0.10	456	844.6	16.75	16.75	0.00	0.00	0.00	0.00	0.00

PLAN 1 STATION REACH

PLAN 1	STATION	REACH	RATIO	MAXIMUM	MINIMUM	STORAGE	AC-FT	CFS	OVER TOP	DURATION	TIME OF	TIME OF
0.50	884.45	0.35	0.21	0.05	0.50	2687	851.0	16.50	16.50	0.00	0.00	0.00
0.40	884.31	0.21	0.05	0.05	0.40	2687	851.0	16.50	16.50	0.00	0.00	0.00
0.30	884.15	0.05	0.05	0.05	0.30	1552	950.1	16.50	16.50	0.00	0.00	0.00
0.20	883.31	0.00	0.00	0.00	0.20	1004	849.4	16.75	16.75	0.00	0.00	0.00
0.10	882.03	0.00	0.00	0.00	0.10	456	844.6	16.75	16.75	0.00	0.00	0.00

.....
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 24 FEB 79

RUN DATE: 10F. APR 27 1991
 TIME: 10:11:03

W.J.. DAM INSPECTION
CAMP DEYSLER DAM
DAM BREAK ANALYSIS

JOB SPECIFICATION									
LC	HR	NTH	DAY	YR	MIN	HTC	PLI	IPRI	NSIAN
10	0	15	0	0	5	0	0	0	0
			JOB/R	NMT	L/OPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
PLANES 1 NP10-1 LPT021

RT1032: 0.40

LINE-AREA RUNOFF COMPUTATION

[illegible]

PRECIP DATA				
SPFL	PMS	R12	R24	R48
3.00	26.00	100.00	117.00	0.00
0.00	0.00	0.00	0.00	0.00

TIME SPENT COMPUTED BY THE PROGRAM IS 0.000 3.00 22.

LOSS DATA										
STOCK	STARS	DLTKR	RTIOL	EMAIN	STGRK	NIJON	STRTL	CHSTL	ALSHX	MTYMP
0.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	0.10	0.00	0.00

0317 MYROGRAPH DATA
CC=0000 DATE=077

PRECISION DATA

STATION	1.00	DATE	-0.02	RTDP	2.00
---------	------	------	-------	------	------

UNIT HYDROGRAPH 17 END OF CRUDD ORDINATES, TC# 0.00 HOURS, IAG= 0.74 VOL= 1.00

NO.	WPM	PERIOD	PAID	CRCS	LOSS	COMP	MG/L	MG/100	MAIN	EXCS	LOSS	COMP
1	1.01	1	0.03	0.00	0.03	1.	1.01	12.45	51	0.52	0.49	177.
2	1.21	2	0.03	0.00	0.03	1.	1.01	13.00	52	0.52	0.49	169.
3	1.01	3	0.03	0.00	0.03	1.	1.01	13.11	53	0.62	0.60	1204.
4	1.00	4	0.03	0.00	0.03	1.	1.01	13.30	54	0.62	0.60	1381.

1.01	1.15	1.31	1.47	1.63	1.79	1.95	2.11	2.27	2.43	2.59	2.75	2.91	3.07	3.23	3.39	3.55	3.71	3.87	4.03	4.19	4.35	4.51	4.67	4.83	4.99	5.15	5.31	5.47	5.63	5.79	5.95	6.11	6.27	6.43	6.59	6.75	6.91	7.07	7.23	7.39	7.55	7.71	7.87	8.03	8.19	8.35	8.51	8.67	8.83	8.99	9.15	9.31	9.47	9.63	9.79	9.95	10.11	10.27	10.43	10.59	10.75	10.91	11.07	11.23	11.39	11.55	11.71	11.87	12.03	12.19	12.35	12.51	12.67	12.83	12.99	13.15	13.31	13.47	13.63	13.79	13.95	14.11	14.27	14.43	14.59	14.75	14.91	15.07	15.23	15.39	15.55	15.71	15.87	16.03	16.19	16.35	16.51	16.67	16.83	16.99	17.15	17.31	17.47	17.63	17.79	17.95	18.11	18.27	18.43	18.59	18.75	18.91	19.07	19.23	19.39	19.55	19.71	19.87	20.03	20.19	20.35	20.51	20.67	20.83	20.99	21.15	21.31	21.47	21.63	21.79	21.95	22.11	22.27	22.43	22.59	22.75	22.91	23.07	23.23	23.39	23.55	23.71	23.87	24.03	24.19	24.35	24.51	24.67	24.83	24.99	25.15	25.31	25.47	25.63	25.79	25.95	26.11	26.27	26.43	26.59	26.75	26.91	27.07	27.23	27.39	27.55	27.71	27.87	28.03	28.19	28.35	28.51	28.67	28.83	28.99	29.15	29.31	29.47	29.63	29.79	29.95	30.11	30.27	30.43	30.59	30.75	30.91	31.07	31.23	31.39	31.55	31.71	31.87	32.03	32.19	32.35	32.51	32.67	32.83	32.99	33.15	33.31	33.47	33.63	33.79	33.95	34.11	34.27	34.43	34.59	34.75	34.91	35.07	35.23	35.39	35.55	35.71	35.87	36.03	36.19	36.35	36.51	36.67	36.83	36.99	37.15	37.31	37.47	37.63	37.79	37.95	38.11	38.27	38.43	38.59	38.75	38.91	39.07	39.23	39.39	39.55	39.71	39.87	40.03	40.19	40.35	40.51	40.67	40.83	40.99	41.15	41.31	41.47	41.63	41.79	41.95	42.11	42.27	42.43	42.59	42.75	42.91	43.07	43.23	43.39	43.55	43.71	43.87	44.03	44.19	44.35	44.51	44.67	44.83	44.99	45.15	45.31	45.47	45.63	45.79	45.95	46.11	46.27	46.43	46.59	46.75	46.91	47.07	47.23	47.39	47.55	47.71	47.87	48.03	48.19	48.35	48.51	48.67	48.83	48.99	49.15	49.31	49.47	49.63	49.79	49.95	50.11	50.27	50.43	50.59	50.75	50.91	51.07	51.23	51.39	51.55	51.71	51.87	52.03	52.19	52.35	52.51	52.67	52.83	52.99	53.15	53.31	53.47	53.63	53.79	53.95	54.11	54.27	54.43	54.59	54.75	54.91	55.07	55.23	55.39	55.55	55.71	55.87	56.03	56.19	56.35	56.51	56.67	56.83	56.99	57.15	57.31	57.47	57.63	57.79	57.95	58.11	58.27	58.43	58.59	58.75	58.91	59.07	59.23	59.39	59.55	59.71	59.87	60.03	60.19	60.35	60.51	60.67	60.83	60.99	61.15	61.31	61.47	61.63	61.79	61.95	62.11	62.27	62.43	62.59	62.75	62.91	63.07	63.23	63.39	63.55	63.71	63.87	64.03	64.19	64.35	64.51	64.67	64.83	64.99	65.15	65.31	65.47	65.63	65.79	65.95	66.11	66.27	66.43	66.59	66.75	66.91	67.07	67.23	67.39	67.55	67.71	67.87	68.03	68.19	68.35	68.51	68.67	68.83	68.99	69.15	69.31	69.47	69.63	69.79	69.95	70.11	70.27	70.43	70.59	70.75	70.91	71.07	71.23	71.39	71.55	71.71	71.87	72.03	72.19	72.35	72.51	72.67	72.83	72.99	73.15	73.31	73.47	73.63	73.79	73.95	74.11	74.27	74.43	74.59	74.75	74.91	75.07	75.23	75.39	75.55	75.71	75.87	76.03	76.19	76.35	76.51	76.67	76.83	76.99	77.15	77.31	77.47	77.63	77.79	77.95	78.11	78.27	78.43	78.59	78.75	78.91	79.07	79.23	79.39	79.55	79.71	79.87	80.03	80.19	80.35	80.51	80.67	80.83	80.99	81.15	81.31	81.47	81.63	81.79	81.95	82.11	82.27	82.43	82.59	82.75	82.91	83.07	83.23	83.39	83.55	83.71	83.87	84.03	84.19	84.35	84.51	84.67	84.83	84.99	85.15	85.31	85.47	85.63	85.79	85.95	86.11	86.27	86.43	86.59	86.75	86.91	87.07	87.23	87.39	87.55	87.71	87.87	88.03	88.19	88.35	88.51	88.67	88.83	88.99	89.15	89.31	89.47	89.63	89.79	89.95	90.11	90.27	90.43	90.59	90.75	90.91	91.07	91.23	91.39	91.55	91.71	91.87	92.03	92.19	92.35	92.51	92.67	92.83	92.99	93.15	93.31	93.47	93.63	93.79	93.95	94.11	94.27	94.43	94.59	94.75	94.91	95.07	95.23	95.39	95.55	95.71	95.87	96.03	96.19	96.35	96.51	96.67	96.83	96.99	97.15	97.31	97.47	97.63	97.79	97.95	98.11	98.27	98.43	98.59	98.75	98.91	99.07	99.23	99.39	99.55	99.71	99.87	100.03	100.19	100.35	100.51	100.67	100.83	100.99	101.15	101.31	101.47	101.63	101.79	101.95	102.11	102.27	102.43	102.59	102.75	102.91	103.07	103.23	103.39	103.55	103.71	103.87	104.03	104.19	104.35	104.51	104.67	104.83	104.99	105.15	105.31	105.47	105.63	105.79	105.95	106.11	106.27	106.43	106.59	106.75	106.91	107.07	107.23	107.39	107.55	107.71	107.87	108.03	108.19	108.35	108.51	108.67	108.83	108.99	109.15	109.31	109.47	109.63	109.79	109.95	110.11	110.27	110.43	110.59	110.75	110.91	111.07	111.23	111.39	111.55	111.71	111.87	112.03	112.19	112.35	112.51	112.67	112.83	112.99	113.15	113.31	113.47	113.63	113.79	113.95	114.11	114.27	114.43	114.59	114.75	114.91	115.07	115.23	115.39	115.55	115.71	115.87	116.03	116.19	116.35	116.51	116.67	116.83	116.99	117.15	117.31	117.47	117.63	117.79	117.95	118.11	118.27	118.43	118.59	118.75	118.91	119.07	119.23	119.39	119.55	119.71	119.87	120.03	120.19	120.35	120.51	120.67	120.83	120.99	121.15	121.31	121.47	121.63	121.79	121.95	122.11	122.27	122.43	122.59	122.75	122.91	123.07	123.23	123.39	123.55	123.71	123.87	124.03	124.19	124.35	124.51	124.67	124.83	124.99	125.15	125.31	125.47	125.63	125.79	125.95	126.11	126.27	126.43	126.59	126.75	126.91	127.07	127.23	127.39	127.55	127.71	127.87	128.03	128.19	128.35	128.51	128.67	128.83	128.99	129.15	129.31	129.47	129.63	129.79	129.95	130.11	130.27	130.43	130.59	130.75	130.91	131.07	131.23	131.39	131.55	131.71	131.87	132.03	132.19	132.35	132.51	132.67	132.83	132.99	133.15	133.31	133.47	133.63	133.79	133.95	134.11	134.27	134.43	134.59	134.75	134.91	135.07	135.23	135.39	135.55	135.71	135.87	136.03	136.19	136.35	136.51	136.67	136.83	136.99	137.15	137.31	137.47	137.63	137.79	137.95	138.11	138.27	138.43	138.59	138.75	138.91	139.07	139.23	139.39	139.55	139.71	139.87	140.03	140.19	140.35	140.51	140.67	140.83	140.99	141.15	141.31	141.47	141.63	141.79	141.95	142.11	142.27	142.43	142.59	142.75	142.91	143.07	143.23	143.39	143.55	143.71	143.87	144.03	144.19	144.35	144.51	144.67	144.83	144.99	145.15	145.31	145.47	145.63	145.79	145.95	146.11	146.27	146.43	146.59	146.75	146.91	147.07	147.23	147.39	147.55	147.71	147.87	148.03	148.19	148.35	148.51	148.67	148.83	148.99	149.15	149.31	149.47	149.63	149.79	149.95	150.11	150.27	150.43	150.59	150.75	150.91	151.07	151.23	151.39	151.55	151.71	151.87	152.03	152.19	152.35	152.51	152.67	152.83	152.99	153.15	153.31	153.47	153.63	153.79	153.95	154.11	154.27	154.43	154.59	154.75	154.91	155.07	155.23	155.39	155.55	155.71	155.87	156.03	156.19	156.35	156.51	156.67	156.83	156.99	157.15	157.31	157.47	157.63	157.79	157.95	158.11	158.27	158.43	158.59	158.75	158.91	159.07	159.23	159.39	159.55	159.71	159.87	160.03	160.19	160.35	160.51	160.67	160.83	160.99	161.15	161.31	161.47	161.63	161.79	161.95	162.11	162.27	162.43	162.59	162.75	162.91	163.07	163.23	163.39	163.55	163.71	163.87	164.03	164.19	164.35	164.51	164.67	164.83	164.99	165.15	165.31	165.47	165.63	165.79	165.95	166.11	166.27	166.43	166.59	166.75	166.91	167.07	167.23	167.39	167.55	167.71	167.87	168.03	168.19	168.35	168.51	168.67	168.83	168.99	169.15	169.31	169.47	169.63	169.79	169.95	170.11	170.27	170.43	170.59	170.75	170.91	171.07	171.23	171.39	171.55	171.71	171.87	172.03	172.19	172.35	172.51	172.67	172.83	172.99	173.15	173.31	173.47	173.63	173.79	173.95	174.11	174.27	174.43	174.59	174.75	174.91	175.07	175.23	175.39	175.55	175.71	175.87	176.03	176.19	176.35	176.51	176.67	176.83	176.99	177.15	177.31	177.47	177.63	177.79	177.95	178.11	178.27	178.43	178.59	178.75	178.91	179.07	179.23	179.39	179.55	179.71	179.87	180.03	180.19	180.35	180.51	180.67	180.83	180.99	181.15	181.31	181.47	181.63	181.79	181.95	182.11	182.27	182.43	182.59	182.75	182.91	183.07	183.23	183.39	183.55	183.71	183.87	184.03	184.19	184.35	184.51	184.67	184.83	184.99	185.15	185.31	185.47	185.63	185.79	185.95	186.11	186.27	186.43	186.59	186.75	186.91	187.07	187.23	187.39	187.55	187.71	187.87	188.03	188.19	188.35	188.51	188.67	188.83	188.99	189.15	189.31	189.47	189.63	189.79	18
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(.) POINTS AT NORMAL TIME INTERVAL

(c) INTERPOLATED BREACH HYDROGRAPH

COMPUTER PRACH HYPOGRAPH

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