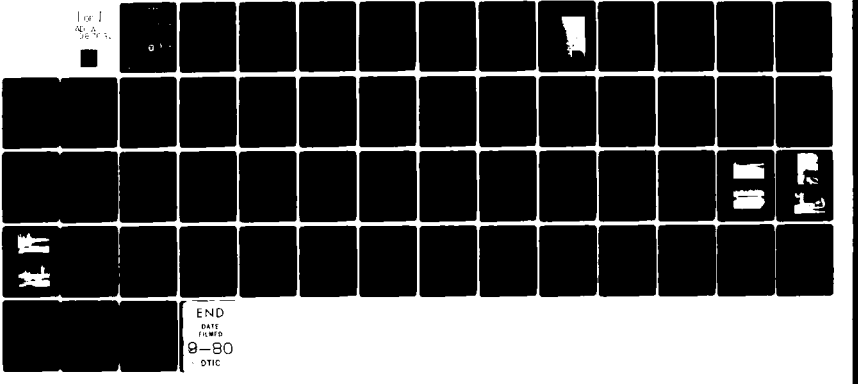
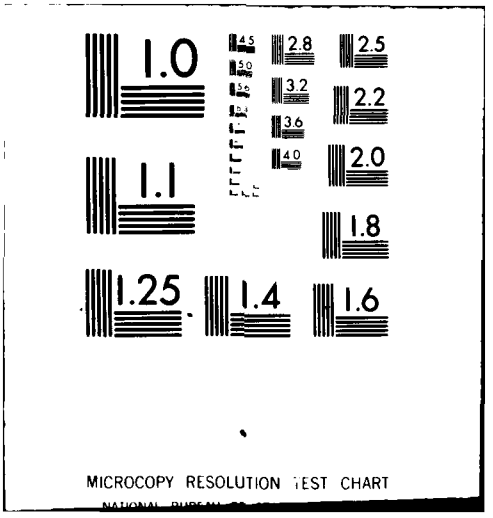
AD-A087 632 NEW JERSEY DEPT OF ENVIRONMENTAL PROTECTION TRENTON F/G 13/13
NATIONAL DAM SAFETY PROGRAM. CENTRETON LAKE DAM (NJ00439), ATLA--ETC(U)
MAR 80 R WRUBEL DACW61-79-C-0011

UNCLASSIFIED NL



END
DATE FILMED
9-80
DTIC


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6
MICROCOPY RESOLUTION TEST CHART

ATLANTIC COAST BASIN
MUDDY RUN, SALEM COUNTY
NEW JERSEY

CENTRETON LAKE DAM
NJ 00439

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

MARCH 1980

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER NJ00439	2. GOVT ACCESSION NO. AD-A087 632	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Inspection Report National Dam Safety Program Centreton Lake Dam NJ00439 Salem County, New Jersey		5. TYPE OF REPORT & PERIOD COVERED FINAL 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) RUDOLPH WRUBEL		8. CONTRACT OR GRANT NUMBER(s) DACW61-79-C-0011
9. PERFORMING ORGANIZATION NAME AND ADDRESS Louis Berger & Associates 100 Halstead St. East Orange, N.J. 07019		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS NJ Department of Environmental Protection Division of Water Resources P.O. Box CN029 Trenton, NJ 08625		12. REPORT DATE March, 1980 13. NUMBER OF PAGES 51
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) U.S. Army Engineer District, Philadelphia Custom House, 2d & Chestnut Streets Philadelphia, PA 19106		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)

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
Strucutral Analysis
National Dam Safety Program
Centreton Lake Dam, New Jersey
Spillways

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.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

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

04 AUG 1980

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

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Centreton Lake Dam in Salem 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, Centreton Lake 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 25 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 six months from the date of approval of this report. Within six months of the consultant's findings, remedial measures to ensure spillway adequacy should be initiated.

b. Within one year from the date of approval of this report, the following remedial measures should be completed:

(1) The upstream and downstream slopes of the dam embankment in the vicinity of the spillway wingwalls should be regraded, compacted and topped with suitable slope paving or stone riprap.

(2) Dead trees and underbrush should be removed from the backslopes and the disturbed areas regraded, compacted and seeded.

(3) The downstream stilling basin should be filled in with heavy stone at the edge of the timber splash apron to prevent continual scouring and preclude the undermining of the spillway structure.

(4) Clean up the fallen trees and timber drift in the river channel south of the highway bridge.

(5) Replace the rotted timbers in the spillway superstructure.

c. The owner should develop an emergency action plan and downstream warning system within six 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 Hughes of the Second 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,

1 Incl
As stated

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

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

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Regulation
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

CENTRETON LAKE DAM (NJ00439)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 4 December 1979 by Louis Berger and Associates, Inc. under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Centreton Lake 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 25 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 six months from the date of approval of this report. Within six months of the consultant's findings, remedial measures to ensure spillway adequacy should be initiated.

b. Within one year from the date of approval of this report, the following remedial measures should be completed:

(1) The upstream and downstream slopes of the dam embankment in the vicinity of the spillway wingwalls should be regraded, compacted and topped with suitable slope paving or stone riprap.

(2) Dead trees and underbrush should be removed from the backslopes and the disturbed areas regraded, compacted and seeded.

(3) The downstream stilling basin should be filled in with heavy stone at the edge of the timber splash apron to prevent continual scouring and preclude the undermining of the spillway structure.

(4) Clean up the fallen trees and timber drift in the river channel south of the highway bridge.

(5) Replace the rotted timbers in the spillway superstructure.

c. The owner should develop an emergency action plan and downstream warning system within six 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: [signature] LTC
JAMES G. TON
Colonel, Corps of Engineers
for District Engineer

DATE: 17 July 80

(6) National Dam Safety Program. Centerton Lake Dam (NJ00439), Atlantic Coast Basin, Muddy Run Tributary of Maurice River, Salem County, New Jersey. Phase I Inspection Report.

(11) Mar 80

(10) Rudolph/Wrotel

(9) Final rept.

(12) 54

(15) DACW61-79-C-0011

410811

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Name of Dam: Centreton Lake Dam Fed ID# NJ00434, NJ ID# 466 (35-3)

State Located New Jersey
County Located Salem
Coordinates Lat. 3931.5 - Long. 7510.2
Stream Muddy Run Tributary of Maurice River
Date of Inspection 4 December 1979

ASSESSMENT OF GENERAL CONDITIONS

Centreton Lake Dam is assessed to be in a fair overall condition and is recommended to be downgraded to a significant hazard category. No detrimental findings were uncovered to jeopardize the structural stability. Remedial actions to be undertaken in the future consist of regrading and protecting the embankment sideslopes from erosion, removing dead trees and underbrush roots, refilling the stilling basin below the splash apron, clearing the downstream channel and replacing the rotted timbers in the spillway.

The dam has an inadequate spillway, being able to accomodate 24% of the 1/2 PMF design storm. Hence, further hydraulic studies are recommended to be undertaken in the future.

Rudolph Wrübel
Vice President
Louis Berger & Associates, Inc.

OVERVIEW OF CENTRETON LAKE DAM

December, 1979

TABLE OF CONTENTS

FIGURES

APPENDIX

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

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

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

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
NAME OF DAM: CENTRETON LAKE DAM FED #NJ00434

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

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

b. Purpose of Inspection

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

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

The dam consists of a low irregular earth embankment with a maximum height of twelve feet and length of approximately 1500 feet. A 12-gated timber spillway is located within the 640 foot central portion which actually dikes off the southerly end of the natural flood plain. The timber gates are operable and each is 3'-8" wide. There is an ill-defined auxiliary overflow spillway positioned above the left abutment zone which discharges into a lagoon immediately below the center portion of the embankment. A timber bulkhead extends across most of the upstream face of the dam crest.

b. Location

Centreton Dam is located on the Muddy Run tributary of the Maurice River in Pittsgrove Township, Salem County, N.J. It lies just above the intersection of the Centerton-Bridgeton Road (Route 553) and the Deerfield Station Road (Route 540), west of the Centreton village center. The dam discharges into the headwaters of the Parvin State Park.

c. Size Classification

The maximum height of the dam is 12 feet and the maximum storage is estimated to be 576 acre-feet. Therefore, the dam is classified as small, as defined by the Corps of Engineers criteria (storage less than 1000 acre-feet and height less than 40 feet).

d. Hazard Classification

Based upon Corps of Engineers criteria, the hazard class is recommended to be downgraded to significant as in the event of failure, the only damage would be to the dam itself and possibly the heavily travelled Centreton-Bridgeton Road bridge and embankment which lies immediately downstream. Further, a few lives could be endangered should there be passing traffic. There are no homes in the downstream flood plain as most of the lands are within the Parvin State Park.

e. Ownership

The dam, or major portions thereof, are presently owned by the Centreton Lake Park Association, Inc., RD #1, Centerton, of which Mr. Ted Grouber is President and Mr. Rene Lanusse, the previous owner is a corporate stockholder.

f. Purpose of Dam

The impoundment is used solely for recreation although vestiges of an early millrace exist at the site. Further, the side channel spillway immediately below the center of the dam originally served as a fish breeding pond.

g. Design and Construction History

The original installation date of this structure is unknown as the first recorded documentation uncovered in State Water Policy records are a 1942 inspection. Archeological traces of an earlier millrace exist in the vicinity of the left abutment where an abandoned roadway culvert exists. The dam crest was originally at a lower elevation and was overtopped in September 1940 but did not fail. The timber-gated spillway collapsed in 1952 and was rebuilt in 1953 (under Dam Application No. 466) when the embankment crest was raised three feet and the present spillway installed. Division of Water Resources inspection in 1963 uncovered "bulging" in the timber apron but this problem was apparently remedied although as late as 1971, the Division had not been notified of the completion. However, the dam was inspected that year by the owner's Engineer who found it in satisfactory condition.

The name of the adjacent village is Centerton but the spelling of the dam name is recorded as both Centerton and Centreton and appears to be used interchangeably.

h. Normal Operating Procedures

See Section 4.

1.3 PERTINENT DATA

a. Drainage Area

The dam has a drainage area of 39.4 square miles which consists mainly of farm and woodland with some residential development.

b. Total combined spillway capacity - 1170 cfs.

c. Elevations (ft above MSL)

Top of dam - 82.5
Recreation pool - 79.0
Streambed at centerline of dam - 71 ±

d. Reservoir

Length of maximum design pool - 4000 ± feet
Length of recreation pool - 3500 feet

e. Storage (acre-feet)

Top of dam - 576
Recreation pool - 132

f. Reservoir Surface (acres)

Top of dam - 216
Recreation pool - 37

g. Dam

Type - Earth embankment with timber sluicegate and auxiliary spillway
Length - 1500 feet
Maximum Height - 12 feet
Top Width - Varies (8 - 20 feet)
Side Slopes - Varies (2 to 1H:1V) (vertical along bulkhead)
Zoning - Unknown

h. Diversion and Regulating Tunnel - None

i. Spillway

Type - timber narrow crested weir with 12 gates (3'-8"x6')
Crest Elevation - 79.0
U/S Channel - main lake reservoir
D/S Channel Width - 40 $\pm$ feet

Auxiliary spillway: 100 feet x 1.0 $\pm$ foot depression in west embankment.

j. Regulating Outlets - removable stoplogs in main spillway.

2.1 DESIGN

The only information available for design review were microfilm drawings of Encroachment Application No. 466 prepared in 1953 by Mr. James S. Sparks, P.E. for the reconstruction of the main timber spillway. The spillway is founded on timber piles and protected from undercutting by wood sheeting on all sides. Work appears to have been carefully detailed.

As previously stated, the 1953 reconstruction replaced an earlier timber spillway at this location. The trapezoidal embankment was already in place. However, additional fill was placed on the sideslopes and crest which raised the crest height approximately three feet. No test boring data was available but this site is located in the southeastern part of Salem County and is within the outer zone of the Coastal Plain physiographic province. The most predominant surficial soils are comprised of alluvial silty and clayey sands and gravel of the Bridgeton Formation. In places these soils have been locally solidified by iron oxide. The solidified areas are generally present as a capping on the higher hills in the area. Stratified alluvial silts, silty sand and sandy silts of the Cape May, Pensauken and Bridgeton formation are also present at the surface near the southwest side of the lake. In the immediate vicinity, the surficial soils consist of recent alluvium that is mixed with and overlies swampy soils. This alluvium is comprised of sand and silt with some clay and gravel and often occurs as discontinuous intermingled layers.

2.2 CONSTRUCTION

No information is available regarding construction except that Division of Water Resources engineers monitored the installation and reported on its progress as being satisfactory.

2.3 OPERATION

The spillway operates as an uncontrolled weir (see Section 4) and the gates are periodically adjusted by members of the Park Association.

2.4 EVALUATION

a. Availability

In view of the dam assessment and recommendations contained in Section 7, it is believed that sufficient engineering data is available for the following assessment without recourse to obtaining additional design data or the original contract plans.

b. Adequacy

In view of the dam configuration and recommendations contained in Section 7, it is felt the field inspection provided adequate engineering data upon which to base a reliable evaluation of the dam's condition.

c. Validity

The validity of the 1953 plans is not challenged.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General

The visual inspection was conducted on December 4, 1979 at which time the water level in the lake was producing a moderate flow through the gate at the far left of the spillway (which prevented close inspection of the spillway walls). The overall physical condition of the dam is fair but the embankment slopes appeared to be very irregular and poorly graded.

b. Dam

The main portion of the embankment is approximately 660 feet long; the remainder of the length being contiguous perimeter dikes along the low-lying sides of the reservoir. The slopes are very irregular and most of the lakeside crest is protected with an aged timber bulkhead. Judging from its condition, it was installed before the timber spillway. There are numerous live and dead trees on the crest and the embankment surface consists of coarse to fine sand with very little fines or cohesive material. The auxiliary spillway area is located on the dam crest near the left edge of the lake and discharges into an irregular side channel or lagoon which flows westward back into the main downstream channel. The older bridge/culvert (Salem County No. 1257) located immediately south of the auxiliary overflow is almost completely plugged up.

There are numerous sloughed areas and swales along the backslope zones and it appears nothing has been done to maintain the design slopes for many years.

Although the ground was partially frozen at the time of inspection, it appears that there may be a perched water table in the vicinity of the lagoon just below the dam. The exact cause could not be ascertained. Consequently, little evidence of seepage was observed. The average height of most of the embankment is between 6 and 8 feet with the perimeter dike zones being 2.5 to 3 feet high.

c. Appurtenant Structures

The timber spillway structure is in fair condition and well-maintained in view of its age. There are some rotted sections and individual members which should be replaced but all twelve gates appear operable. The head beam over the stop logs is solid as are the access walkway planking and painted railings. The fill behind the parallel downstream wingwalls is eroded away, exposing most of the 15 foot wings. The downstream apron is approximately two feet above the natural streambed but does not appear to be undercut. Three diagonal braces have been expediently installed above the downstream apron, apparently to brace the access walkway bridge.

d. Reservoir

Centreton Lake has stable, wooded natural banks that slope up gradually from the shoreline and are left in a natural state befitting the parkland environment. Heavy debris appears to have been removed as a continuing part of maintenance. However, nothing appears to have been done regarding the lake's siltation. It was noted that the Palatine Dam lies about one mile upstream and that the juncture of Muddy Run and Indian Run occurs at the reservoir headwaters. It appears the seasonal lake level during winter months is maintained about two feet below the normal recreation pool.

e. Downstream Channel

The downstream riverbed is fairly clear and straight after passing under County Bridge No. 1235 which is situated about 150 feet below the spillway. This two span bridge was built in 1944 and it appears that the bridge and roadway to the east are flooded during extreme heavy storms. A considerable stilling basin has been created between the spillway and bridge and eddy currents have contributed to the erosion behind the downstream wingwalls. Immediately below the bridge, Muddy Run flows into the undeveloped woodland environment of Parvin State Park.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

Operational procedures were not observed by the inspection team. Mainteance responsibility is undertaken by Mr. Rene Lanusse, the prior owner of record who is obligated under legal agreement with the N.J. Division of Water Policy and Supply to maintain the operation of the gates. As best as can be determined, this agreement, dated March 20, 1953, is still in effect, although part of the property has been sold to the present owner.

4.2 MAINTENANCE OF DAM

Except for the operational aspects of the spillway, there has apparently been little or no continual maintenance of the remaining structural aspects of the dam.

4.3 MAINTENANCE OF OPERATING FACILITIES

The stoplogs in the 12 gated sections are periodically raised and lowered by Mr. Lanusse or his authorized representatives. Overall maintenance is conducted each spring but appears to consist of a clean-up of drift and freeing the gates as required.

4.4 DESCRIPTION OF WARNING SYSTEM IN EFFECT

There is no formalized warning system in effect but because the road just below the spillway is quite heavily travelled, it appears local Municipal and County forces monitor the site during heavy storms.

4.5 EVALUATION OF OPERATIONAL ADEQUACY

Present safeguards are deemed to be adequate in view of performance record and the level of hazards relating to the dam. However, it is felt that the ownership responsibility of maintenance should be clarified in the future by state authorities in view of the agreement between the State and the prior owner. See Para. 7.2)

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data

Based on the criteria in the Recommended Guidelines for Safety Inspection of Dams, one-half the probable maximum flood (PMF) was selected as the design storm by the inspecting engineer. Precipitation data was obtained from Hydrometeorological Report #33. The inflow hydrograph and reservoir routing were calculated utilizing the HEC-1 computer program. The discharge for the SDF was calculated to be 4898 cfs. The spillways have a maximum combined discharge capacity of approximately 1170 cfs before overtopping occurs and can therefore accommodate only 24% of the design flood.

b. Experience Data

Nothing was located regarding the past hydrologic history of the dam. It appears the spillway (especially with all flashboards in place) was not designed by any normally accepted engineering procedure to accommodate the design flow of the drainage area. The previous 1952 failure of the spillway occurred mainly due to deterioration and undermining of the foundation support.

c. Visual Observations

There are two dams (Lakes Elmer and Palantine) above and two below (Parvin and Rainbow) the study dam which have similar spillway capacities. Further it was estimated that in extreme floods, the roadway below the dam could be overtopped and although not damaged, would be closed to traffic.

d. Overtopping Potential

There are no indications that the dam has been recently overtopped and records indicate that the 1940 overtopping did little damage. However, the overtopping potential continues to exist as the appended calculations indicate that the dam would be overtopped by approximately 1 foot during the the design storm. Such a flood would almost certainly overtop the adjacent road and much of the surrounding property.

e. Drawdown Potential

Using all the stoplog gates, the reservoir could theoretically be drawn down the full height of gates in approximately three hours.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

The timber spillway contains elements which will require replacement within the next few years. All major members, especially those supporting the gates and beams are satisfactory but there is a possibility that there is hidden structural (internal) damage to the access walkway bridge. Also from the uniform high level of tailwater, the trailing edge of the outfall splash apron could not be observed and some concern was expressed (in view of the excess exit energy) that the timber sheeting may be undercut. This 3" T & G sheeting was installed untreated and is over 25 years old.

The timber bulkhead along the front edge of the dam crest is even older and in a more advanced stage of deterioration but its condition is of less concern regarding the overall dam safety, except where it frames into the wingwalls of the spillway. Excessive erosion has occurred here and the embankment should be replaced, especially in the vicinity of the earlier bulkheads around the stilling basin (these are completely demolished). Judging from the large size of trees on the embankment, this portion of the dam structure is exceedingly old and probably served as the river crossing prior to building the highway in the 1920's. Consequently, the lack of an impervious core and proper compaction make the spillway somewhat susceptible to hydrostatic pressures or dangerous piping action around the ends of the wingwalls. The remainder of the embankment is of less concern although there has been no engineering maintenance for many years.

b. Design and Construction Data

The review of the 1953 spillway plans reveal the design to be conservatively executed although no computations were available. The construction conforms closely to the design except for the diagonal braces which have been installed at the access bridge pile bents.

c. Operating Records

There are no formal records in existence although the spillway stoplogs are adjusted yearly to facilitate maintenance. It appears the lake is maintained at the normal recreation pool only during the summer months.

d. Post Construction Changes

Except for the braces mentioned previously, there have been no post-construction modifications since the 1953 reconstruction of the spillway.

e. Seismic Stability

The dam appears to have an adequate factor of safety against static loadings and experience indicates that it will therefore have adequate stability against Zone 1 dynamic loadings. The height of the embankment is so low it will have negligible vulnerability due to any type of loading.

SECTION 7 - ASSESSMENTS/RECOMMENDATIONS/ REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety

Subject to the inherent limitations of the Phase I visual inspection, the Centerton Lake Dam is classified as being in a sound and overall fair condition insofar as its embankment structure is concerned but the timber spillway is in need of selected repairs. No seriously detrimental findings were revealed in this inspection to render a questionable judgement as to the structural stability. The spillway is inadequate hydraulically, being able to accommodate only 24% of the selected design flood. The overtopping potential is considerable due to the hydraulically substandard spillway width and the ease with which the narrow sluiceway openings under the access bridge can be blocked with debris. There is little that can be done to increase the present spillway capacity without undertaking major reconstruction. It appears that the County Road 540 immediately below the dam can be frequently flooded by heavy storms. However, as there is only moderate downstream hazard to human life or property should the dam collapse, its hazard category is recommended to be downgraded to significant.

b. Adequacy of Information

The information gathered for the Phase I inspection is deemed to be adequate regarding the structural stability of the dam. However, no surveys or inspections have been recorded since 1971 and the dam has undergone deterioration since that time.

c. Urgency

No urgency is attached to implementing further studies in view of the dam hazard assessment. It is recommended that the remedial measures set forth below be taken under advisement in the future except that the backfilling of the spillway wingwalls should be undertaken this coming spring or summer.

d. Necessity for Further Study

Due to the significant hazard classification and the present spillway capacity, further engineering studies, under the purview of the P.L. 92-367, are believed to be necessary to ascertain more precisely the hydraulic conditions.

7.2 RECOMMENDATIONS/REMEDIAL MEASURES

It is recommended that the ownership and responsibility for maintenance be clarified especially regarding the legal agreement between the previous owner and the State of New Jersey.

a. Remedial Measures

- The upstream and downstream slopes of the dam embankment in the vicinity of the spillway wingwalls should be regraded, compacted and topped with suitable slope paving or stone riprap.
- Dead trees, underbrush, and dead roots should be removed from the backslopes and the disturbed areas regraded, compacted and seeded.
- The downstream stilling basin should be filled in with heavy stone at the edge of the timber splash apron to prevent continual scouring and preclude the undermining of the spillway structure.
- Although it is beyond the owner's property, it would be advisable to clean up the fallen trees and timber drift in the river channel south of the highway bridge.
- Replace the rotted timbers in the spillway superstructure.

b. O&M Maintenance and Procedures

In the near future the owner should develop written operating procedures and a periodic maintenance plan to insure the safety of the dam. In addition, an emergency action plan to minimize downstream effects of an emergency together with a warning system should be developed.

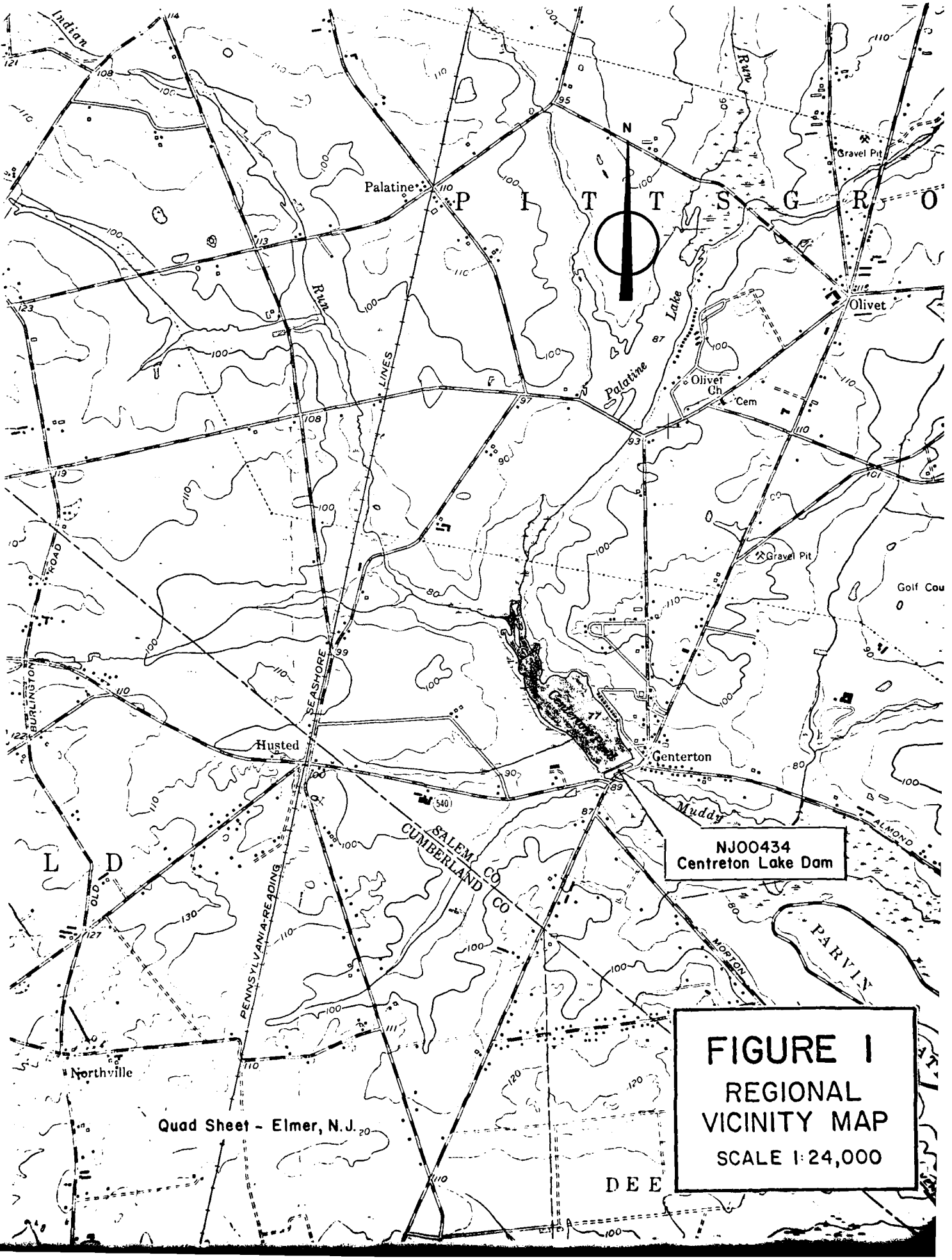
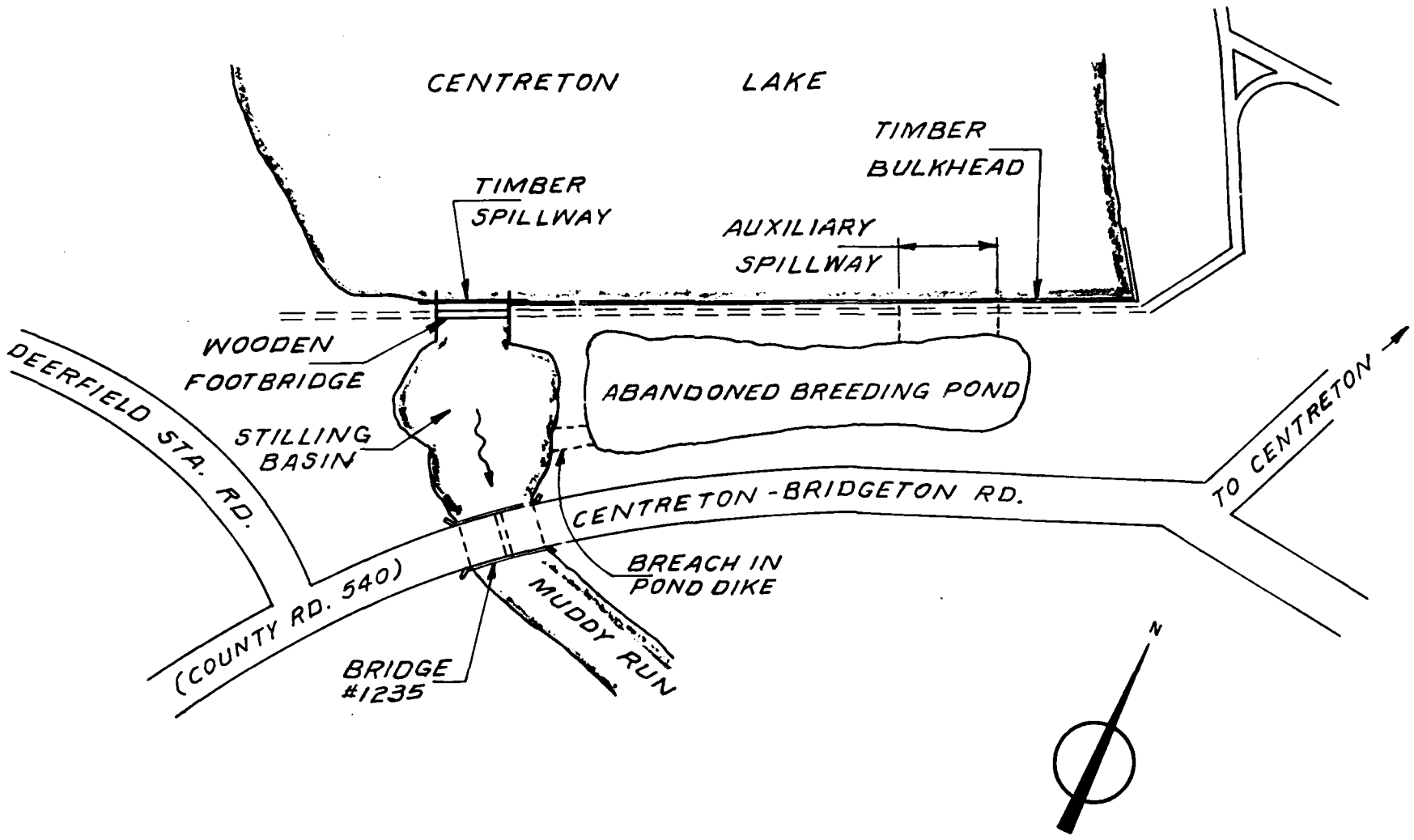
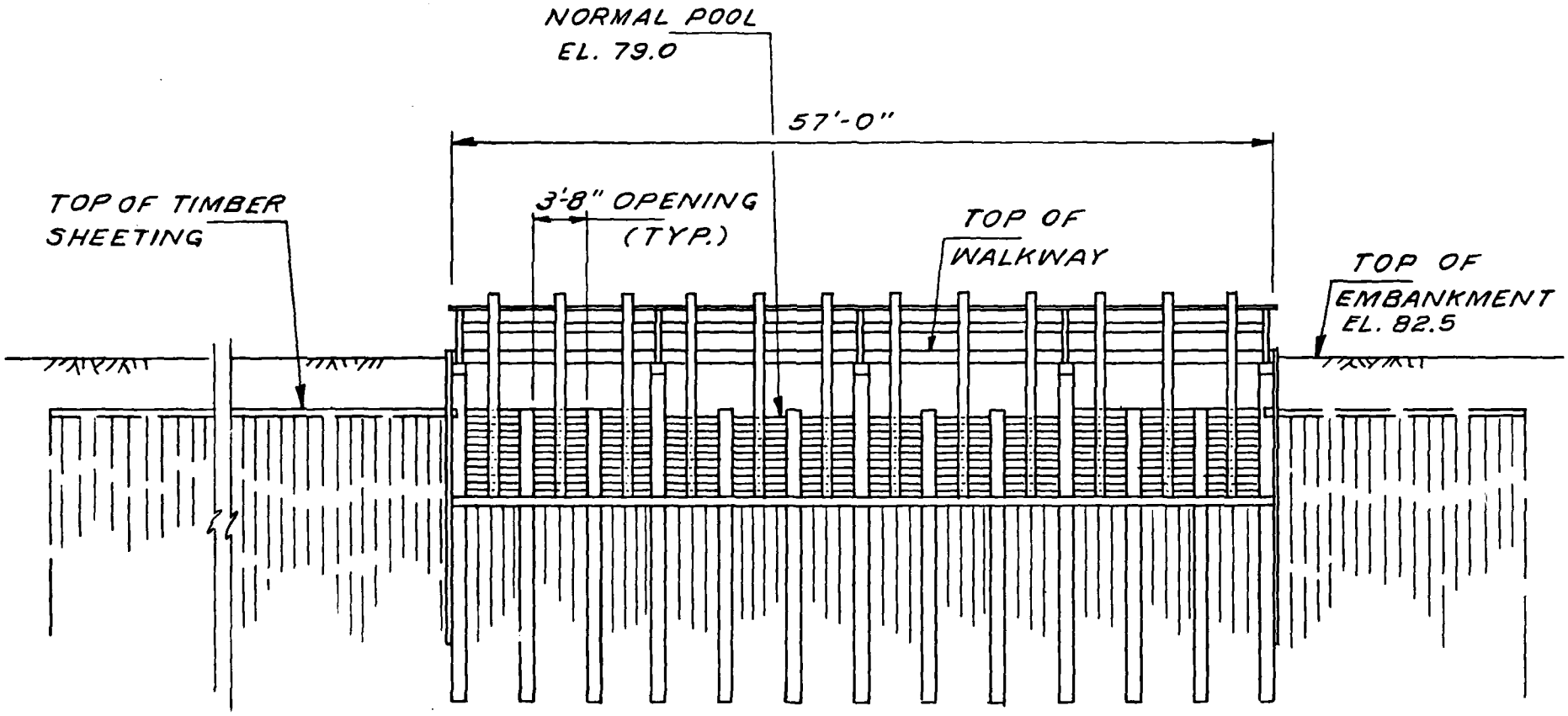


FIGURE 1
REGIONAL VICINITY MAP
SCALE 1:24,000



LOCATION PLAN
NOT TO SCALE

FIGURE 2



UPSTREAM SPILLWAY ELEVATION

NOT TO SCALE

FIGURE 3

Check List
Visual Inspection
Phase 1

Name Dam Centerton Lake County Salem State New Jersey Coordinators NJDEP

Date(s) Inspection 12-4-79, 1-11-80 Weather Sunny Temperature 40°F

Pool Elevation at Time of Inspection 77± M.S.L. Tailwater at Time of Inspection 72± M.S.L.

Inspection Personnel:

M. Carter
D. Lang
L. Baines
K. Jolls
J. Voorhees

D. Lang Recorder

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	Upstream face has timber bulkhead from NE end to spillway, alignment fair, timber in fair to poor condition. Embankment extends around south shore for 300'±, 2½ - 3' high.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Erosion evident around right wingwall. Numerous large trees on embankment 12"-20"Ø. Many of them are dead and rotting.	
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	Horizontal good, vertical good. Dam appears to have fairly uniform elevation throughout.	
RIPRAP FAILURES	Yes at NE wingwall, riprap not placed, but dumped.	Appears to be a continual problem.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Poor, severe erosion problem behind both spillway wingwalls, probably due to surface runoff and pedestrian traffic.	Regrade and protect with slope paving or stone riprap.
ANY NOTICEABLE SEEPAGE	Seepage possible 60' southwest of spillway. Possibly at breeding pond.	
STAFF GAGE AND RECORDER	None	
DRAINS	None	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	None	
APPROACH CHANNEL	Centerton Lake	Free and clear of debris.
DISCHARGE CHANNEL	50' ± wide, through heavily wooded area after county bridge.	
BRIDGE AND PIERS	County Bridge 150' downstream. Abutments from previous bridge still evident.	Bridge constructed in 1944
GATES AND OPERATION EQUIPMENT	12-vertical lift timber gates. All gates appear operable.	Much of the timber in poor condition.

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Mild 1:3 to 1:4. Park facilities on North shore. Southwest shore is heavily wooded. Marshy area up at head of lake.	
SEDIMENTATION	Yes, along upstream face of embankment	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	County of Salem Bridge 1944, 2-25' spans, 2½' freeboard. Numerous large trees fallen across channel. High pressure gas line. Storm sewer inlet at SE wingwall	Fallen trees could cause backwater.
SLOPES	2' high embankment, then low heavily wooded flood plain on either side.	
APPROXIMATE NO. OF HOMES AND POPULATION	Some stores at north end. Old roadway abutment still evident on both sides of banks.	Appear to be away from any flooding.

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Available - NJDEP - Division of Water Resources - Bureau of Flood Plain Management.
REGIONAL VICINITY MAP	Available - U.S. G.S. Quad - Elmer, N.J.
CONSTRUCTION HISTORY	None available
TYPICAL SECTIONS OF DAM	None available
HYDROLOGIC/HYDRAULIC DATA	Some available - NJDEP - 1953 Encroachment Application
OUTLETS - PLAN	Some Available - NJDEP
- DETAILS	None available - NJDEP
-CONSTRAINTS	Unknown
-DISCHARGE RATINGS	Some available - NJDEP 1953 Encroachment Application
RAINFALL/RESERVOIR RECORDS	None available

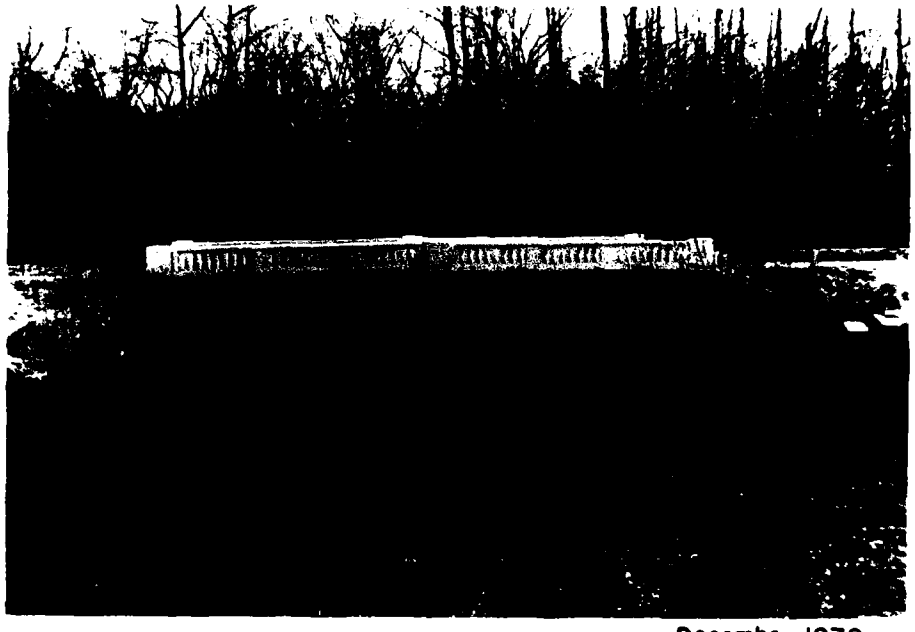
ITEM	REMARKS
SPILLWAY PLAN	Available - NJDEP - 1953 Encroachment Application
SECTIONS	Available - NJDEP - 1953 Encroachment Application
DETAILS	Available - NJDEP - 1953 Encroachment Application
OPERATING EQUIPMENT PLANS & DETAILS	None available

ITEM	REMARKS
DESIGN REPORTS	None available
GEOLOGY REPORTS	None available
DESIGN COMPUTATIONS	Not available
HYDROLOGY & HYDRAULICS	Not available
DAM STABILITY	Not available
SEEPAGE STUDIES	Not available
MATERIALS INVESTIGATIONS	Not available
BORING RECORDS	Not available
LABORATORY	Not available
FIELD	Non available
POST-CONSTRUCTION SURVEYS OF DAM	Not available
BORROW SOURCES	Unknown

ITEM	REMARKS
MONITORING SYSTEMS	None
MODIFICATIONS	None since 1953
HIGH POOL RECORDS	None available
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None available
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	1952 spillway failure None available None available
MAINTENANCE OPERATION RECORDS	None available

December, 1979

View of Spillway



December, 1979

View of Bridge Immediately Downstream of Dam

December, 1979

View of Crest Looking Northeast

December, 1979

View of Left Abutment

December, 1979

View of Timber Bulkhead Along Upstream Face of Dam

December, 1979

Downstream View of Dam

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 39.4 suare miles

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): +79.0 M.S.L. (132 acre-ft.)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): Not applicable

ELEVATION MAXIMUM DESIGN POOL:

ELEVATION TOP DAM: +82.5 M.S.L. (576 acre-feet)

CREST:

a. Elevation +82.5 M.S.L.
b. Type Earth embankment with timber sluicegates
c. Width varies (8'-20')
d. Length 1500'±
e. Location Spillover 1100' ± from left abutment
f. Number and Type of Gates 12-3'-8"x6' timber gates

OUTLET WORKS: Auxiliary spillway

a. Type Depressed embankment
b. Location left abutment
c. Entrance inverts +81.5 M.S.L.
d. Exit inverts +71.5 ± M.S.L.
e. Emergency draindown facilities

HYDROMETEOROLOGICAL GAGES: None

a. Type
b. Location
c. Records

MAXIMUM NON-DAMAGING DISCHARGE: 1170 cfs

BY [illegible] DATE [illegible] **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A1 OF

CHKD. BY ______ DATE ______ [illegible] LAKE DAM PROJECT [illegible]

SUBJECT

UNITGRAPH DATA

LENGTH OF LONGEST WATERCOURSE $L = 10.44$

LENGTH TO CENTROID $L_{CA} = 4.25$

$LL_{CA} = 10.44 \times 4.25 = 44.40$

USING CURVE 2 FROM COE PLATE VI FROM CIVIL WORKS PROJECT MEMO 434 ∴ $t_p = 25.1$

USE SNYDER COEFFICIENT FURNISHED BY COE ∴ $C_p = 0.43$

PRECIPITATION

PMP FOR 200 SQ. MI & 24 HOUR DURATION = 24"

MAXIMUM 6 HOUR PERCENTAGE = 99%

MAXIMUM 12 HOUR PERCENTAGE = 108%

MAXIMUM 24 HOUR PERCENTAGE = 115%

MAXIMUM 48 HOUR PERCENTAGE = 130%

BY [illegible] DATE 1-22-8[illegible]

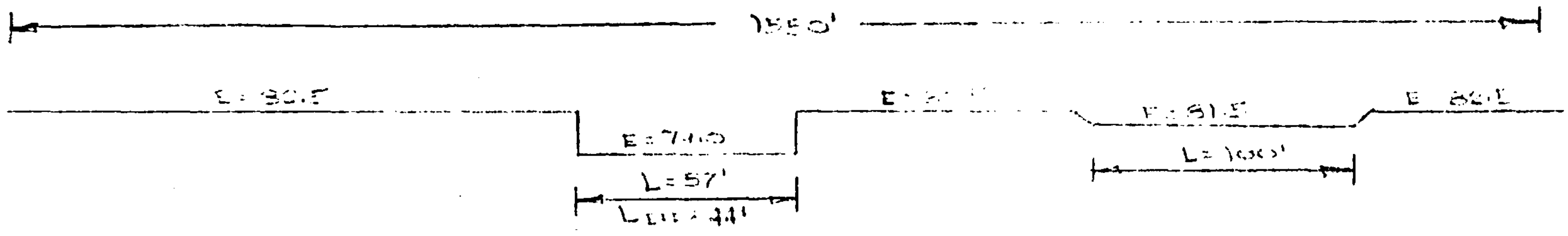
LOUIS BERGER & ASSOCIATES INC.

SHEET NO. [illegible] OF

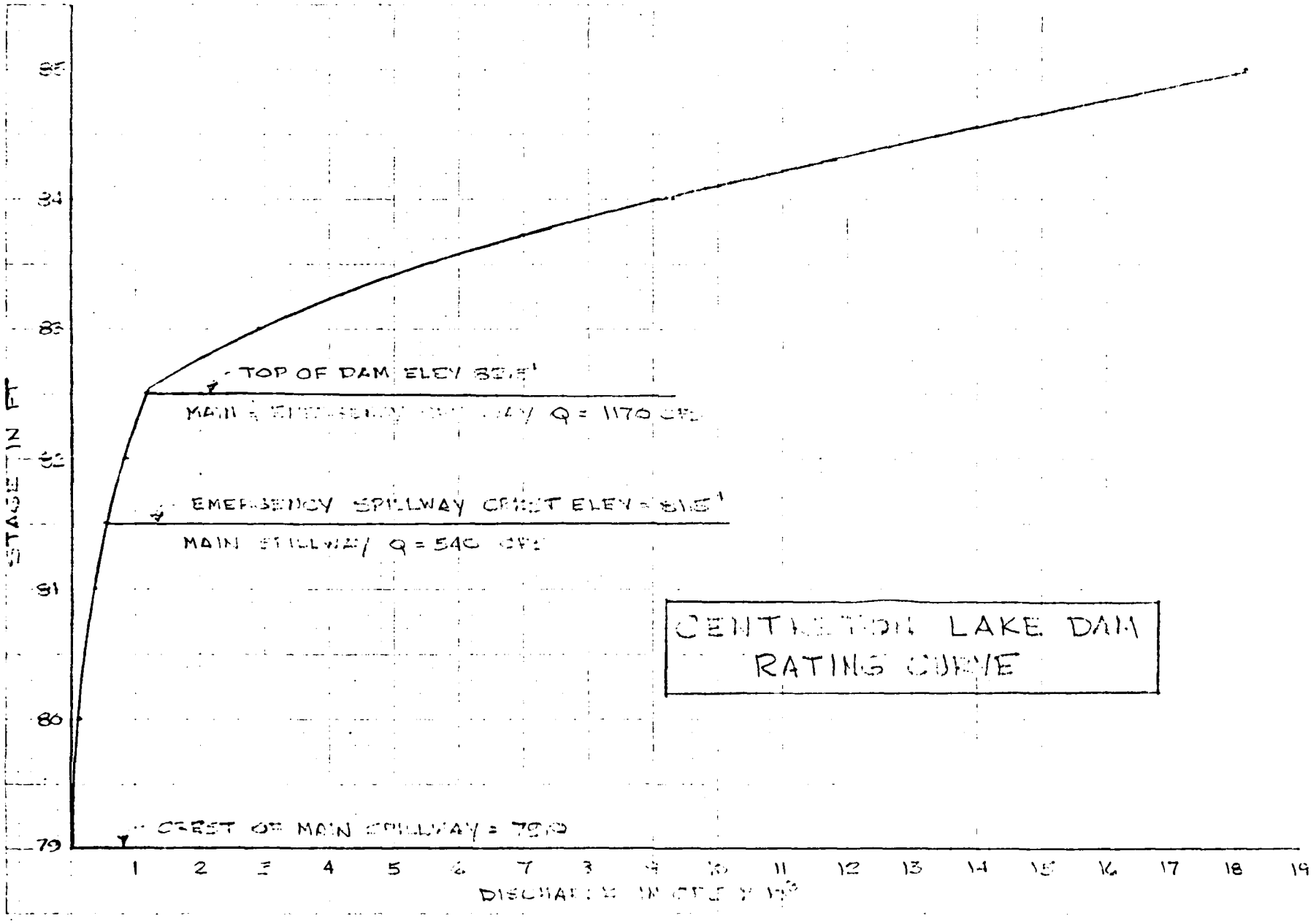
CHKD. BY ______ DATE ______ [illegible] Lake [illegible]

PROJECT [illegible]

SUBJECT [illegible]



ELEV.	M. SPILLWAY H	C	L	Q	E. SPILLWAY H	C	L	Q	[illegible] H	C	L	Q	Σ Q
79	0	3.1	44	0	0	2.6	100	0	0	2.6	1513	0	0
80	1	↓	↓	136	0	↓	↓	0	0	↓	↓	0	135
81	2			382	0			0	0			0	385
81.5	2.5			539	0			0	0			0	540
82	3			709	.5			99	0			0	810
82.5	3.5			813	1			280	0			0	1170
83	4			1011	1.5			514	.5			1280	2805
84	5			1525	2.5			1107	1.5			6654	9285
85	6			2007	3.5			1833	2.5			14816	18155
86	7			2526	4.5			2673	3.5			23715	28415



CENTENNIAL LAKE DAM
RATING CURVE

BY [illegible] DATE [illegible] **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. 14 OF

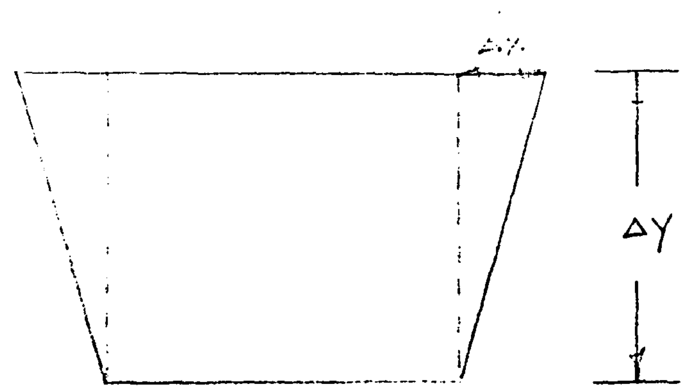
CHKD. BY ______ DATE ______ [illegible] PROJECT [illegible]

SUBJECT [illegible]

AREA OF LAKE @ ELEV. 19.0 = 37 ACRES

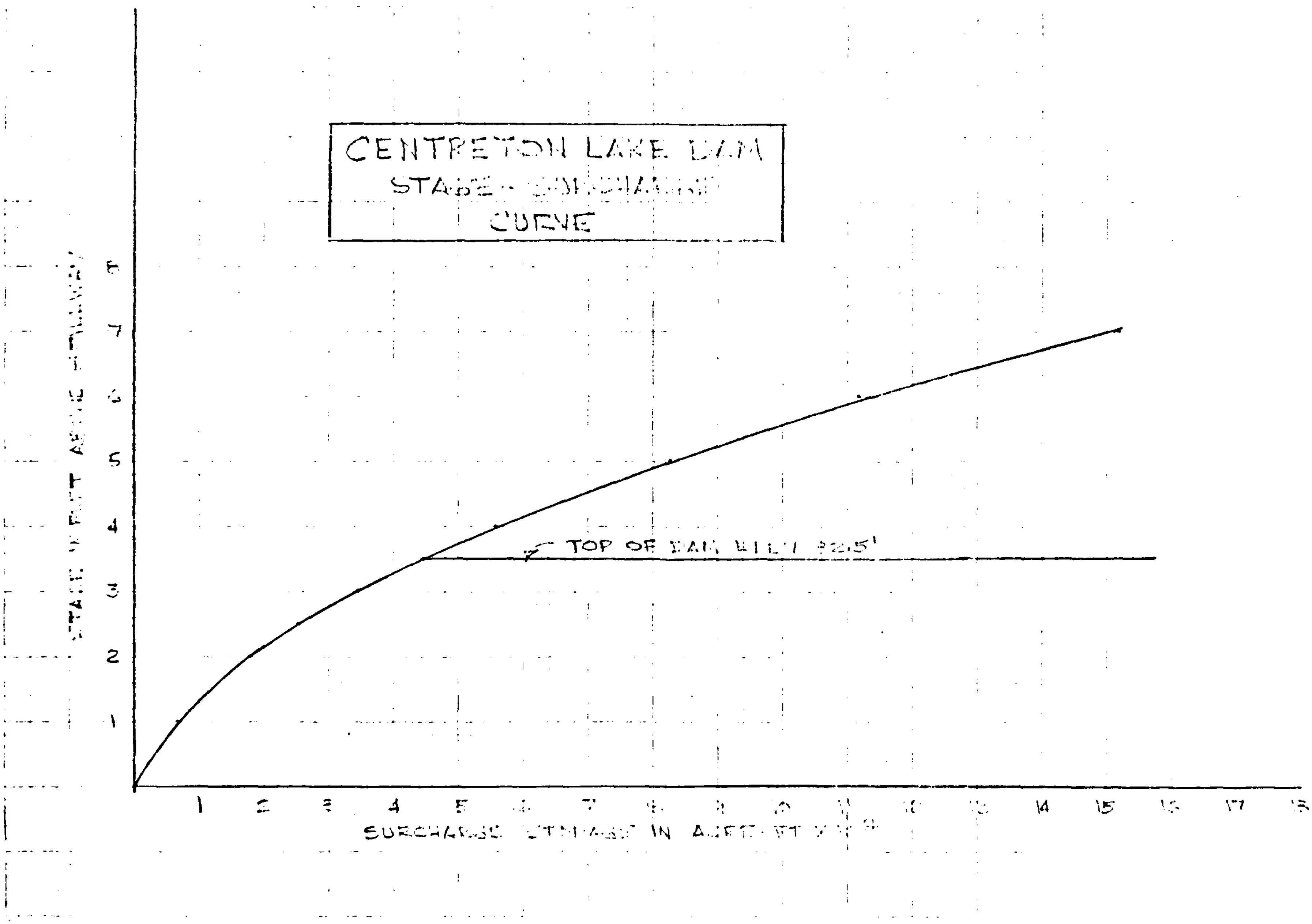
AREA OF 80 FT CONTOUR = 98.2 ACRES

ASSUME POOL AREA ABOVE 80 FT CONTOUR [illegible] AT SAME RATE



$\Delta V = \Delta Y (X + \Delta X)$

HEIGHT ABOVE SPILLWAY CREST	AREA ACRES	Δ VOL.	SURCHARGE STORAGE ACRE FT
0	47	0	0
1	88.2	62.6	63
2	131.6	[illegible]	177
2.5	[illegible]	76.2	[illegible]
3	[illegible]	[illegible]	342
3.5	216.[illegible]	101.4	444
4	24[illegible]	114.7	558
[illegible]	[illegible]	261.6	[illegible]
[illegible]	344.[illegible]	314.0	1145
[illegible]	346.1	370.[illegible]	1516


CENTRETON LAKE DAM
CURVE
TOP OF DAM
1
2
3
4
5
6
7
8
14
15
17
IN

BY [illegible] DATE [illegible]

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. A-6 OF

CHKD. BY ______ DATE ______

[illegible]

PROJECT [illegible]

SUBJECT [illegible]

ASSUME DRAWDOWN [illegible] ALL 12 STOPLOG [illegible]

$L = 12 \times 3.67' = 44$ [illegible]

ASSUME INFLOW OF 40 CFS

ASSUME DRAWDOWN IN TWO STAGES

STAGE 1

$H = 6'$

$Q = CL$ [illegible] $C = 3$ [illegible] $L = 44'$

$Q = 3$ [illegible] $(44)(6)^{3/2}$

$Q = 2005 - 40$

$= 1965$ CFS

$\therefore$ TIME $= \dfrac{132 \times 43560}{2 \times 1965 \times 3600}$

$= 0.4$ HRS

STAGE 2

$H = 2'$

$Q =$ [illegible] $(44)(2)$ [illegible]

$Q = 3$ [illegible] $- 40$

$Q =$ 3[illegible] CFS

$\therefore$ TIME $= \dfrac{13[illegible]}{2 \times [illegible]}$

$= 2.2$ [illegible]

T[illegible] SAY 3 [illegible]

```
A   CENTRETON LAKE DAM
```

```
A   CENTRETON LAKE DAM
A   BY R.F. BERRY
A   MAY, 1980
B    150       2
1      3
K      0       1                                          1
1   INFLOW HYDROGRAPH
M      1       1    39.4       0    39.4                 0.5
P      0      24      99     108     119     130
1                                                        0.5      0.1
W   25.1    0.43
X      0       0       1
K      1       1                                          1
1   ROUTING THROUGH RESERVOIR
Y                              1
1      1
2      0      63     177     253     342     444     558     826    1145    1516
3      0     135     385     540     810    1170    2885    9285   18155   28915
K     99
A
A
A
A
A
```

****
HEC-1 VERSION DATED JAN 1973
UPDATED AUG 74
CHANGE NO 01
****

CENTRALTON LAKE DAM
BY R.F. DERRY
MAY, 1980

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
150	2	0	0	0	0	0	0	0	0

JOPER	NWT
3	0

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

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH

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

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	39.40	0.00	39.40	0.00	0.500	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	24.00	99.00	108.00	119.00	130.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS 0.843

LOSS DATA

STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0.00	0.00	1.00	0.00	0.00	1.00	0.50	0.10	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 25.10 CP=0.43 NTA= 0

RECESSION DATA
STRTQ= 0.00 QRCSN= 0.00 RTIOR= 1.00

CLARK DID NOT CONVERGE TO GIVEN SNYDER COEFFICIENTS
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC=13.09 AND R=21.13 INTERVALS

UNIT HYDROGRAPH 100 END-OF-PERIOD ORDINATES, LAG= 25.19 HOURS, CP= 0.43 VOL= 0.99

9.	33.	68.	111.	158.	209.	264.	316.	360.	397.
424.	442.	448.	437.	417.	398.	380.	362.	345.	329.
314.	300.	286.	273.	260.	248.	237.	226.	215.	205.
196.	187.	178.	170.	162.	154.	147.	141.	134.	128.
122.	116.	111.	106.	101.	96.	92.	88.	84.	80.
76.	72.	69.	66.	63.	60.	57.	55.	52.	50.
47.	45.	43.	41.	39.	37.	36.	34.	32.	31.

29.	28.	27.	26.	24.	23.	22.	21.	20.	19.
18.	18.	17.	16.	15.	14.	14.	13.	13.	12.
11.	11.	10.	10.	9.	9.	9.	8.	8.	7.

END-OF-PERIOD FLOW

TIME	RAIN	EXCS	COMP Q
1	0.03	0.00	0.
2	0.03	0.00	0.
3	0.03	0.00	0.
4	0.06	0.00	0.
5	0.06	0.00	0.
6	0.06	0.00	0.
7	0.48	0.14	1.
8	0.98	0.78	11.
9	0.39	0.19	37.
10	0.04	0.00	75.
11	0.04	0.00	121.
12	0.04	0.00	173.
13	0.30	0.10	230.
14	0.30	0.10	292.
15	0.30	0.10	356.
16	0.61	0.41	419.
17	0.61	0.41	485.
18	0.61	0.41	558.
19	5.21	5.01	678.
20	10.62	10.42	964.
21	4.21	4.01	1492.
22	0.45	0.25	2226.
23	0.45	0.25	3105.
24	0.45	0.25	4091.
25	0.00	0.00	5153.
26	0.00	0.00	6241.
27	0.00	0.00	7270.
28	0.00	0.00	8163.
29	0.00	0.00	8882.
30	0.00	0.00	9413.
31	0.00	0.00	9733.
32	0.00	0.00	9796.
33	0.00	0.00	9587.
34	0.00	0.00	9213.
35	0.00	0.00	8806.
36	0.00	0.00	8408.
37	0.00	0.00	8022.
38	0.00	0.00	7651.
39	0.00	0.00	7297.
40	0.00	0.00	6960.
41	0.00	0.00	6638.
42	0.00	0.00	6331.
43	0.00	0.00	6039.
44	0.00	0.00	5760.
45	0.00	0.00	5493.
46	0.00	0.00	5239.
47	0.00	0.00	4997.
48	0.00	0.00	4766.
49	0.00	0.00	4546.

50	0.00	0.00	4336.
51	0.00	0.00	4135.
52	0.00	0.00	3944.
53	0.00	0.00	3762.
54	0.00	0.00	3588.
55	0.00	0.00	3422.
56	0.00	0.00	3264.
57	0.00	0.00	3113.
58	0.00	0.00	2969.
59	0.00	0.00	2832.
60	0.00	0.00	2701.
61	0.00	0.00	2576.
62	0.00	0.00	2457.
63	0.00	0.00	2344.
64	0.00	0.00	2235.
65	0.00	0.00	2132.
66	0.00	0.00	2033.
67	0.00	0.00	1939.
68	0.00	0.00	1850.
69	0.00	0.00	1764.
70	0.00	0.00	1683.
71	0.00	0.00	1605.
72	0.00	0.00	1531.
73	0.00	0.00	1460.
74	0.00	0.00	1393.
75	0.00	0.00	1328.
76	0.00	0.00	1267.
77	0.00	0.00	1208.
78	0.00	0.00	1152.
79	0.00	0.00	1099.
80	0.00	0.00	1048.
81	0.00	0.00	1000.
82	0.00	0.00	954.
83	0.00	0.00	910.
84	0.00	0.00	867.
85	0.00	0.00	827.
86	0.00	0.00	789.
87	0.00	0.00	753.
88	0.00	0.00	718.
89	0.00	0.00	685.
90	0.00	0.00	653.
91	0.00	0.00	623.
92	0.00	0.00	594.
93	0.00	0.00	567.
94	0.00	0.00	540.
95	0.00	0.00	515.
96	0.00	0.00	492.
97	0.00	0.00	469.
98	0.00	0.00	447.
99	0.00	0.00	427.
100	0.00	0.00	407.
101	0.00	0.00	388.
102	0.00	0.00	370.
103	0.00	0.00	353.
104	0.00	0.00	337.

105	0.00	0.00	321.
106	0.00	0.00	306.
107	0.00	0.00	291.
108	0.00	0 00	272.
109	0.00	0.00	258.
110	0.00	0.00	246.
111	0.00	0.00	235.
112	0.00	0.00	224.
113	0.00	0.00	213.
114	0.00	0.00	202.
115	0.00	0.00	192.
116	0.00	0.00	181.
117	0.00	0.00	169.
118	0.00	0.00	159.
119	0.00	0.00	116.
120	0.00	0.00	36.
121	0.00	0.00	6.
122	0.00	0.00	4.
123	0.00	0.00	2.
124	0.00	0.00	0.
125	0.00	0.00	0.
126	0.00	0.00	0.
127	0.00	0.00	0.
128	0.00	0.00	0.
129	0.00	0.00	0.
130	0.00	0.00	0.
131	0.00	0.00	0.
132	0.00	0.00	0.
133	0.00	0.00	0.
134	0.00	0.00	0.
135	0.00	0.00	0.
136	0.00	0.00	0.
137	0.00	0.00	0.
138	0.00	0.00	0.
139	0.00	0.00	0.
140	0.00	0.00	0.
141	0.00	0.00	0.
142	0.00	0.00	0.
143	0.00	0.00	0.
144	0.00	0.00	0.
145	0.00	0.00	0.
146	0.00	0.00	0.
147	0.00	0.00	0.
148	0.00	0.00	0.
149	0.00	0.00	0.
150	0.00	0.00	0.
SUM	26.36	22.83	286006.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	9796.	9705.	8747.	6115.	286007.
INCHES		2.29	8.26	17.32	22.51
AC-FT		4815.	17359.	36405.	47298.

RUNOFF MULTIPLIED BY 0.50

0.	0.	0.	0.	0.	0.	1.	6.	18.	37.
60.	86.	115.	146.	178.	209.	243.	279.	339.	482.
746.	1113.	1553.	2046.	2576.	3120.	3625.	4081.	4441.	4706.
4867.	4898.	4793.	4606.	4403.	4204.	4011.	3825.	3649.	3480.
3319.	3166.	3019.	2880.	2747.	2620.	2499.	2383.	2273.	2168.
2068.	1972.	1881.	1794.	1711.	1632.	1557.	1485.	1416.	1351.
1288.	1229.	1172.	1118.	1066.	1017.	970.	925.	882.	841.
802.	765.	730.	696.	664.	633.	604.	576.	550.	524.
500.	477.	455.	434.	414.	395.	376.	359.	342.	327.
311.	297.	283.	270.	258.	246.	234.	224.	213.	203.
194.	185.	176.	168.	161.	153.	146.	136.	129.	123.
117.	112.	106.	101.	96.	90.	85.	79.	58.	18.
3.	2.	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.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4898.	4853.	4374.	3057.	143004.
INCHES		1.15	4.13	8.66	11.25
AC-FT		2407.	8680.	18202.	23649.

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

HYDROGRAPH ROUTING

ROUTING THROUGH RESERVOIR

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

ROUTING DATA

GLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.000	0.00	1	0

NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.000	0.000	0.000	0.

STORAGE=	0.	63.	177.	253.	342.	444.	558.	826.	1145.	1516.
OUTFLOW=	0.	135.	385.	540.	810.	1170.	2885.	9285.	18155.	26915.

TIME	EOP STOR	AVG IN	EOP OUT
1	0.	0.	0.
2	0.	0.	0.
3	0.	0.	0.
4	0.	0.	0.
5	0.	0.	0.
6	0.	0.	0.
7	0.	0.	0.
8	0.	3.	1.
9	2.	12.	4.
10	5.	28.	11.
11	11.	49.	23.
12	18.	73.	38.
13	27.	101.	57.
14	37.	131.	79.

15	49.	162.	104.
16	61.	194.	131.
17	74.	226.	160.
18	89.	261.	191.
19	105.	309.	227.
20	131.	411.	283.
21	177.	614.	385.
22	254.	929.	543.
23	358.	1333.	866.
24	463.	1799.	1458.
25	526.	2311.	2404.
26	559.	2848.	2899.
27	585.	3378.	3535.
28	603.	3858.	3964.
29	620.	4261.	4358.
30	632.	4574.	4644.
31	640.	4786.	4833.
32	642.	4882.	4898.
33	639.	4846.	4828.
34	632.	4700.	4658.
35	624.	4505.	4454.
36	615.	4303.	4254.
37	607.	4107.	4059.
38	599.	3918.	3872.
39	592.	3737.	3693.
40	585.	3564.	3522.
41	578.	3400.	3359.
42	571.	3242.	3204.
43	565.	3093.	3056.
44	559.	2950.	2915.
45	552.	2813.	2797.
46	544.	2683.	2671.
47	536.	2559.	2547.
48	528.	2441.	2429.
49	520.	2328.	2317.
50	513.	2220.	2210.
51	506.	2118.	2108.
52	500.	2020.	2010.
53	494.	1927.	1917.
54	488.	1838.	1829.
55	482.	1753.	1744.
56	477.	1672.	1664.
57	472.	1594.	1587.
58	467.	1521.	1513.
59	462.	1450.	1443.
60	458.	1383.	1377.
61	454.	1319.	1313.
62	449.	1258.	1252.
63	446.	1200.	1195.
64	440.	1145.	1157.
65	432.	1092.	1128.
66	421.	1041.	1089.
67	409.	993.	1046.
68	396.	947.	1001.
69	384.	904.	957.

70	371.	862.	914.
71	360.	822.	872.
72	348.	784.	832.
73	337.	748.	796.
74	326.	713.	763.
75	316.	680.	730.
76	305.	649.	697.
77	294.	619.	666.
78	284.	590.	635.
79	275.	563.	606.
80	266.	537.	578.
81	257.	512.	552.
82	248.	488.	530.
83	239.	466.	512.
84	230.	444.	492.
85	220.	424.	472.
86	210.	404.	453.
87	201.	385.	433.
88	191.	368.	414.
89	182.	351.	396.
90	174.	334.	378.
91	165.	319.	360.
92	158.	304.	343.
93	150.	290.	327.
94	143.	277.	311.
95	137.	264.	297.
96	130.	252.	283.
97	124.	240.	270.
98	119.	229.	257.
99	113.	218.	245.
100	108.	208.	234.
101	103.	199.	223.
102	99.	190.	213.
103	94.	181.	203.
104	90.	172.	194.
105	86.	164.	185.
106	82.	157.	176.
107	78.	149.	168.
108	74.	141.	160.
109	70.	133.	151.
110	67.	126.	144.
111	64.	120.	136.
112	61.	115.	130.
113	58.	109.	124.
114	55.	104.	118.
115	52.	99.	112.
116	50.	93.	106.
117	47.	87.	101.
118	44.	82.	95.
119	41.	69.	87.
120	34.	38.	72.
121	25.	10.	54.
122	18.	2.	38.
123	13.	1.	27.
124	9.	0.	19.

125	6.	0.	13.
126	4.	0.	9.
127	3.	0.	7.
128	2.	0.	5.
129	1.	0.	3.
130	1.	0.	2.
131	1.	0.	2.
132	1.	0.	1.
133	0.	0.	1.
134	0.	0.	1.
135	0.	0.	0.
136	0.	0.	0.
137	0.	0.	0.
138	0.	0.	0.
139	0.	0.	0.
140	0.	0.	0.
141	0.	0.	0.
142	0.	0.	0.
143	0.	0.	0.
144	0.	0.	0.
145	0.	0.	0.
146	0.	0.	0.
147	0.	0.	0.
148	0.	0.	0.
149	0.	0.	0.
150	0.	0.	0.
SUM			143004.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4898.	4853.	4376.	3046.	143004.
INCHES		1.15	4.13	8.63	11.25
AC-FT		2408.	8685.	18134.	23649.

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

1

RUNOFF SUMMARY, AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	1	4898.	4853.	4374.	3057.	39.40
ROUTED TO	1	4898.	4853.	4376.	3046.	39.40