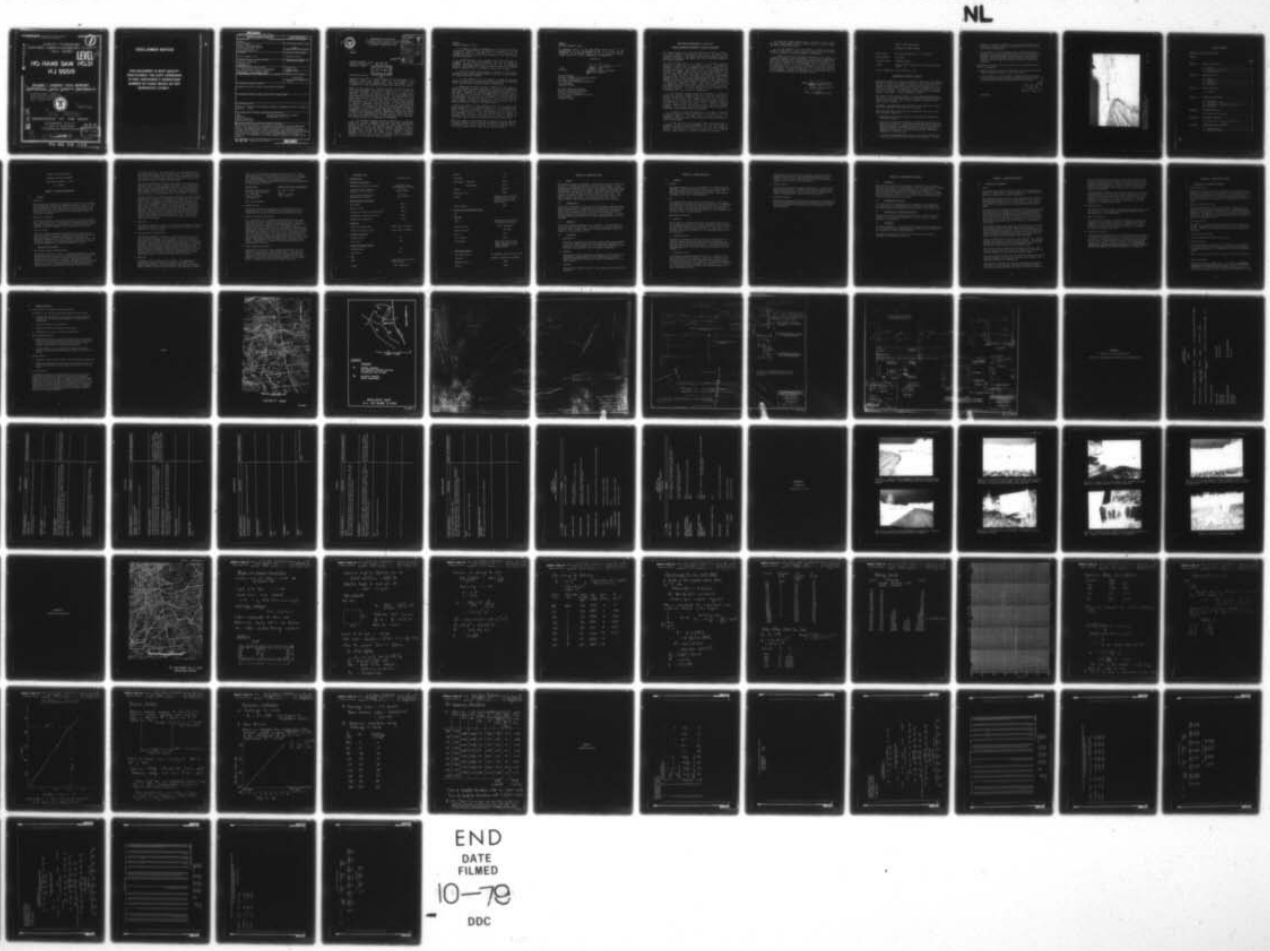
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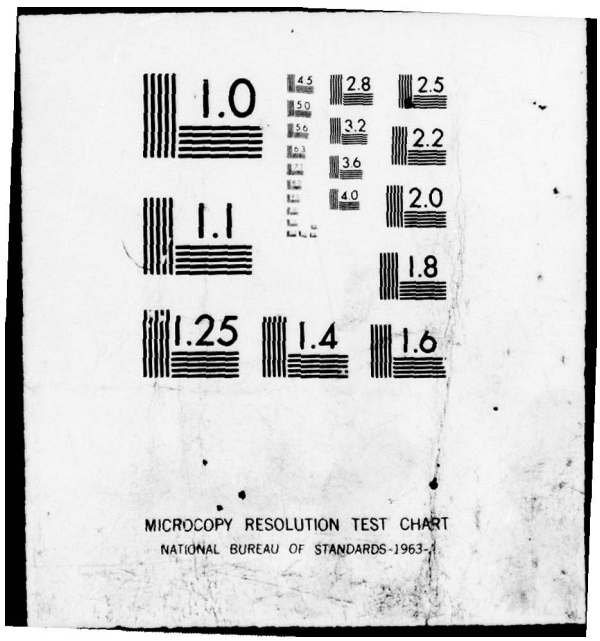
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RARITAN RIVER BASIN
CRAMERS CREEK, HUNTERDON COUNTY
NEW JERSEY

LEVEL III

# NO NAME DAM NO.31
# NJ 00519

## PHASE 1 INSPECTION REPORT
## NATIONAL DAM SAFETY PROGRAM.

No Name Dam Number 31 (NJ-00519).
Raritan River Basin, Cramers Creek,
Hunterdon County, New Jersey.
Phase 1 Inspection Report.

(15) DACW61-79-C-0011

(9) Final rept.

(10) Anthony G. /Posch

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Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

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| 1. REPORT NUMBER<br>NJ00519 | 2. GOVT ACCESSION NO. | 3. RECIPIENT'S CATALOG NUMBER |
| 4. TITLE (and Subtitle)<br>Phase I Inspection Report<br>National Dam Safety Program<br>NJ No. Name Dam No. 31<br>Hunterdon County, N.J. | | 5. TYPE OF REPORT & PERIOD COVERED<br>FINAL<br>6. PERFORMING ORG. REPORT NUMBER |
| 7. AUTHOR(s)<br>Posch, Anthony G. P.E. | | 8. CONTRACT OR GRANT NUMBER(s)<br>DACW61-79-C-0011 |
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dams
Spillways
Visual inspection
Structural analysis
National Dam Inspection Act Report
No Name Dam No. 31, 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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NAPEN-D

20 SEP 1979

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

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Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for No Name Dam No. 31 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, New Jersey No Name Dam No. 31, listed as a high hazard potential structure, is judged to be in good overall condition. At present the reservoir is not filled, and Cramers Creek flows through the open low-level sluice gate. The low-level outlet is always kept open and the reservoir remains empty except after very heavy rainfall. The reservoir then fills and slowly drains through the low-level outlet over a period of hours. The dam's box spillway is considered inadequate since 89 percent of the Spillway Design Flood--SDF - would overtop the dam. (The Spillway Design Flood, in this instance, is one-half of the PMF.) The spillway is considered "inadequate" instead of "seriously inadequate" because dam failure resulting from overtopping would not significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure. To insure 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. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980. In the interim, a detailed emergency operation plan and warning system, should be promptly developed. Also, during periods of unusually heavy precipitation, around the clock surveillance should be provided.

b. It should be established immediately if the owner is permitted to close the low-level sluice and thus fill the reservoir. If this information cannot be confirmed, then an agreed procedure for informing all concerned parties of his intention to fill the reservoir should be established.

c. If the reservoir is to be filled, install observation wells or piezometers in the downstream embankment, and log the borings to determine engineering properties of the dam fill and foundation material. This program and a stability analysis based on the findings should be completed within six months of flooding the reservoir.

d. Within six months from the date of approval of this report, the owner should remove sediment deposits from the low-level outlet and from the downstream channel.

e. If the reservoir is to be flooded, a bridge and platform should be constructed to provide access for operation of the low-level outlet, and operational procedures should be established.

f. Within one year from the date of approval of this report, a formalized program of annual inspections of the dam by an experienced party should be initiated, utilizing the standard visual check list in this report. Headwater and tailwater gages should be installed in the dam, and read out during severe rainstorms and at routine operating and maintenance visits to the dam. A permanent log should be kept of all maintenance and operating events of the dam, the lake and the outlet passages. Movement and settlement of the embankment should be monitored regularly by means of surveying monuments.

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

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

NAPEN-D
Honorable Brendan T. Byrne

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

Sincerely,

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

1 Incl
As stated

Copies furnished:
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 Management
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

## NEW JERSEY NO NAME DAM NO. 31 (NJ00519)

## CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 2 May and 24 May 1979 by Frederic R. Harris, 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.

New Jersey No Name Dam No. 31, listed as a high hazard potential structure, is judged to be in good overall condition. At present the reservoir is not filled, and Cramers Creek flows through the open low-level sluice gate. The low-level outlet is always kept open and the reservoir remains empty except after very heavy rainfall. The reservoir then fills and slowly drains through the low-level outlet over a period of hours. The dam's box spillway is considered inadequate since 89 percent of the Spillway Design Flood--SDF - would overtop the dam. (The Spillway Design Flood, in this instance, is one-half of the PMF.) The spillway is considered "inadequate" instead of "seriously inadequate" because dam failure resulting from overtopping would not significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure. To insure 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. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980. In the interim, a detailed emergency operation plan and warning system, should be promptly developed. Also, during periods of unusually heavy precipitation, around the clock surveillance should be provided.

b. It should be established immediately if the owner is permitted to close the low-level sluice and thus fill the reservoir. If this information cannot be confirmed, then an agreed procedure for informing all concerned parties of his intention to fill the reservoir should be established.

c. If the reservoir is to be filled, install observation wells or piezometers in the downstream embankment, and log the borings to determine engineering properties of the dam fill and foundation material. This program and a stability analysis based on the findings should be completed within six months of flooding the reservoir.

d. Within six months from the date of approval of this report, the owner should remove sediment deposits from the low-level outlet and from the downstream channel.

e. If the reservoir is to be flooded, a bridge and platform should be constructed to provide access for operation of the low-level outlet, and operational procedures should be established.

f. Within one year from the date of approval of this report, a formalized program of annual inspections of the dam by an experienced party should be initiated, utilizing the standard visual check list in this report. Headwater and tailwater gages should be installed in the dam, and read out during severe rainstorms and at routine operating and maintenance visits to the dam. A permanent log should be kept of all maintenance and operating events of the dam, the lake and the outlet passages. Movement and settlement of the embankment should be monitored regularly by means of surveying monuments.

APPROVED: Jas G. Ton

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 17 September 1975

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

| | |
|---|---|
| Name of Dam: | New Jersey No Name No. 31, I.D. NJ00519 |
| State Located: | New Jersey |
| County Located: | Hunterdon County |
| Stream: | Cramers Creek, tributary to South Branch Raritan River |
| Date of Inspection: | May 2 and May 24, 1979 |

## Assessment of General Condition

New Jersey No Name No. 31 Dam is an earth-fill embankment, approximately 60 feet in length, with a maximum height of 23 feet. The dam is equipped with a concrete box spillway. At present the reservoir is not filled, and Cramers Creek flows through the open low-level sluice gate. The dam is in good overall condition. There is no evidence of instability or deterioration of the embankment, box spillway, or discharge culvert. The hazard potential is rated as "high."

The safety of New jersey No Name No. 31 is considered questionable in view of its lack of spillway capacity to pass one half the PMF without overtopping of the dam. The spillway is capable of passing a flood equal to 44% of the PMF.

At present, the engineering data available is not sufficient to make a definitive statement on the stability of the dam.

The following actions, therefore, are recommended along with a timetable for their completion.

1. Establish a flood warning system for the downstream communities within three months.

2. Carry out a more precise hydrologic and hydraulic analysis of the dam within six 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.

3. It should be established immediately if the owner is permitted to close the low-level sluice and thus fill the reservoir. If this

information cannot be confirmed, then an agreed procedure for informing all concerned parties of his intention to fill the reservoir should be established.

4. If the reservoir is to be filled, install observation wells or piezometers in the downstream embankment, and log the borings to determine engineering properties of the dam fill and foundation material. This program and a stability analysis based on the findings should be completed within six months of flooding the reservoir.

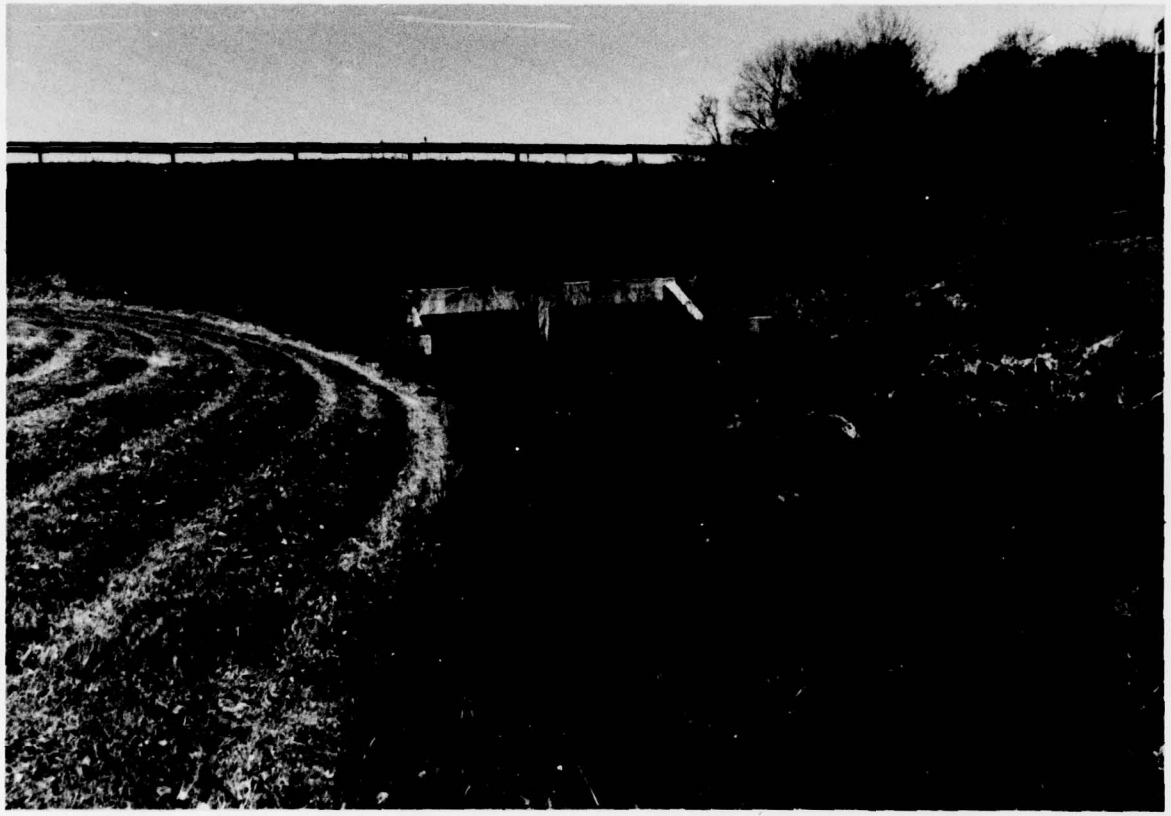
Furthermore, while of a less urgent nature, the following additional action is recommended.

1. Sediment deposits should be removed from the low-level outlet and from the downstream channel, in the near future.

2. If the reservoir is to be flooded, a bridge and platform should be constructed to provide access for operation of the low-level outlet, and operational procedures should be established.

Anthony G. Posch, P.E.

AGP/REJ/ak



New Jersey No Name No. 31 Dam
General view of embankment and spillway
discharge culvert from downstream.

May 2, 1979

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ASSESSMENT OF GENERAL CONDITIONS

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CHECK LIST - ENGINEERING, CONSTRUCTION, MAINTENANCE DATA

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## PREFACE

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

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

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest 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 SAFETY PROGRAM

NEW JERSEY NO NAME NO. 31 DAM

I.D. NJ00519

## SECTION I: 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.

b. Purpose of Inspection

The visual inspection of New Jersey No Name No. 31 Dam was made on May 2 and May 24, 1979. 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

New Jersey No Name No. 31 Dam is an earth-fill embankment, approximately 560 feet in length, with a maximum height of 23 feet. The top of the dam is 22 feet wide and the upstream and downstream slopes are 2 horizontal to 1 vertical. The upstream slope is faced with a 12 inch thick clay blanket extending from 3 feet below the top of the dam. The upstream slope is also protected with broken stone rip rap extending from 10 feet below the crest to 2

feet below the crest. All other areas of the embankment slopes are covered with grass and very light brush. The embankment forms part of a paved roadway which leads to the Hamden Pumping Station (no relation to this dam and reservoir, other than the fact that the entrance road runs across the embankment).

The dam is equipped with a reinforced concrete box spillway and outlet culvert. The box spillway is located in the reservoir at the toe of slope of the embankment and has an effective spillway crest length (box perimeter) of 70.5 feet. The reinforced concrete culvert runs from the box spillway, through the embankment and terminates at the downstream toe in the original stream bed.

The box spillway has a single, manually operated, 24 inch diameter, circular sluice gate on its upstream face, which serves as a low-level outlet. The gate is installed at the bottom of the box spillway and is equipped with a stem extension, adjustable stem guides and a handwheel. Access to the gate handwheel requires a boat (reservoir full) or ladder (reservoir empty). The gate and operating stem are enclosed in a gate-well of corrugated steel sheeting. The owner of the spillway and reservoir basin stated that the low-level outlet is always kept open and the reservoir remains empty except after very heavy rain fall. The reservoir then fills and slowly drains through the the low-level outlet over a period of hours.

b. Location

New Jersey No Name No. 31 Dam is located in the Township of Clinton, Hunterdon County, New Jersey. It is accessible by means of County Highway No. 2 (Allerton Road).

c. Size and Hazard Classification

New Jersey No Name No. 31 Dam has a structural height of 23 feet and a reservoir storage of 132 acre-feet. Since its storage is less than 1,000 acre-feet and its height is less than 40 feet, it is classified in the dam size category as being "small." A hazard potential classification of "high" has been assigned to the dam on the basis that failure would result in excessive damage to the only access road to Hamden Pumping Station, and also to public and private property downstream. Within 700 feet downstream of the dam are more than 10 occupied buildings and Route 513, and the possibility exists of the loss of more than a few lives.

d. Ownership

Ownership of this facility is well defined. The embankment, including the roadway and culvert are within the grounds of the Hamden Pumping Station, which are owned by the State of New Jersey Bureau of Water Facilities and Operations. The spillway, low-level

outlet, and the reservoir area are owned by Mr. Paul C. Wirtz. The property line is just upstream of the upstream toe of slope. Some correspondence, including permit applications, and contractual agreements defining the responsibilities of the various parties, are available on microfilm from the New Jersey Department of Environmental Protection.

| Owner of Dam | Owner of Spillway and Reservoir |
|---|---|
| New Jersey Bureau of Water<br>Facilities and Operations<br>P. O. Box 5196<br>Clifton, NJ 08809<br>(202) 638-6121 | Mr. Paul C. Wirtz<br>RD 1<br>Lebanon, NJ 08833<br>(201) 735-7814 |

ATT: Mr. Abe Shaika

e. Purpose of Dam

The original purpose of the dam was to provide access to the pumping station. By the amendment to the spillway culvert, it is possible to use the dam for retaining a recreational lake.

f. Design and Construction History

N. J. No Name No. 31 was designed and constructed in the years 1962-1964, by Havens & Emerson Consulting Engineers, New York, under Contract PS-1. Originally the embankment was intended only to provide an access roadway to the state pumping station. However, before the design work was completed, Mr. Wirtz obtained permission to impound the stream, and the design of the embankment was modified to enable it to serve as a dam. The design modifications included the addition of a clay facing and protective rip rap on the upstream slope. The double culvert was extended beyond the upstream slope, and the box spillway and low-level outlet were added. These modifications were made during the design stage prior to construction. No major work has been performed on the facility since this time.

g. Normal Operating Procedure

According to the owner of the spillway and reservoir area, the reservoir has never been filled intentionally. The low-level outlet is always open and the reservoir normally remains empty. Occasionally the outlet becomes partially blocked by sediment or debris and a heavy rain will cause the reservoir to fill temporarily. Eventually the pool drains through the outlet.

## 1.3 Pertinent Data

| | |
|---|---|
| a. Drainage Area | 2.3 square miles |
| b. Discharge at Dam Site | |
| Maximum known flood at dam site: | spillway crest (Discharge not recorded) |
| Ungated spillway capacity at elevation of top of dam: | 3127 cfs (elev. 186.0') |
| Total spillway capacity at maximum pool elevation: | 3636 cfs (elev. 186.23') |
| c. Elevation (Feet Above MSL) | |
| Top of dam: | 186.0' |
| Spillway crest: | 180.0' |
| Maximum pool design surcharge (SDF): | 186.23' |
| Streambed at centerline of dam: | 163.2' |
| Tailwater at inspection: | 164.0' |
| d. Reservoir | |
| Length of maximum pool: | 2500 ± feet (estimate) |
| Length of recreation pool: | 2000 ± feet (estimate) |
| e. Storage (acre-feet) | |
| Spillway crest: | 40 |
| Top of dam: | 132 |
| f. Reservoir Surface (acres) | |
| Spillway crest: | 7.4 |
| Top of Dam: | 25.1 |
| g. Dam | |
| Type: | Earth fill with concrete box spillway. |
| Length: | 550' (effective) |

| | |
|---|---|
| Height: | 23' |
| Top Width: | 22' |
| Side Slopes - Upstream: | 2H:1V |
| - Downstream: | 2H:1V |
| Zoning: | Unknown |
| Impervious core: | None |
| Cutoff: | Compacted clay in 3' deep trench at toe of slope and clay blanket on upstream slope. |
| Grout curtain: | None |

h. Diversion and Regulating Tunnel

N/A

i. Spillway

| | |
|---|---|
| Type: | Unregulated box spillway of reinforced concrete. |
| Length of weir: | 70.5' (perimeter) |
| Crest elevation: | 180' MSL |
| Gates: | None |
| U.S. Channel: | None |
| D/S Channel: | Two 11'-0" x 6'-6" concrete culverts 100' long under embankment; then Cramers Creek. |

j. Regulating Outlets

| | |
|---|---|
| Low level outlet: | 24" diameter circular sluice gate. |
| Controls: | Manually operated by handwheel. |
| Emergency gate: | None |
| Outlet: | None |

## SECTION 2: ENGINEERING DATA

### 2.1 Design

Two drawings showing the embankment, spillway and discharge culvert are on file at the NJDEP and have been included in this report. A topographic plan was supplied by the owner. No stability calculations for the embankment could be found. Micro film records available from NJDEP contain some correspondence including a spillway capacity design calculation, and some soil boring records taken at the dam site. The borings revealed the presence of a hard red shale layer about 6 feet below original ground level. The consulting engineers, Havens & Emerson, report that they have design documents in their archives.

### 2.2 Construction

The dam was constructed at the same time as the Hamden Pumping Station (Round Valley project). Excavation for the pumping station and intake pond, located on the south branch of the Raritan River, provided material for the embankment fill. The fill was described as having a high percentage of clay; quantitative data is not available. Contract documents describing contractor and owner responsibilities are on file at NJDEP.

### 2.3 Operation

No records concerning operation of the dam exist. No information on reservoir levels has been kept. The reservoir is normally empty and only fills after a heavy rain when the inflow temporarily exceeds the capacity of the low-level outlet.

### 2.4 Evaluation

a. Availability

Good data is available giving plans, cross-sections and topography of the dam, however, information describing the embankment fill material is not available. A list of available engineering, construction and maintenance data is included in Appendix A.

b. Adequacy

The engineering data available was adequate to perform hydrologic and hydraulic computations, but was insufficient to perform stability computations because the nature of embankment material is not known.

c. Validity

The plans and sections included in this report, are valid as-built drawings.

## SECTION 3: VISUAL INSPECTION

### 3.1 Findings

a. General

The visual inspection of N. J. No Name No. 31 revealed that the embankment, spillway and discharge culvert are in good condition. Some sedimentation has occurred at the low-level outlet, the discharge culvert and in the downstream channel. The reservoir was empty at the time of the inspection.

b. Dam

The embankment was found to be in good condition. Both slopes were regular and covered with grass and light brush. No sloughing or erosion was found, and the rip-rap protection on the upstream face was intact. Two wet areas were found on the downstream slopes, however, the reservoir was empty and it was concluded that the water was due to past rainfall.

c. Appurtenant Structures

1. Spillway

The spillway is a reinforced concrete box spillway above the toe of the upstream slope and was in good condition. The structure was inspected visually and no cracking or spalling of the concrete could be found inside or outside of the box. The floor of the spillway could not be observed as it was submerged under one foot of silty water.

2. Discharge Culvert

The double, rectangular discharge culvert is constructed of reinforced concrete and carries the flow from the spillway and low-level outlet through the embankment to the downstream channel. The right half of the discharge culvert is partially blocked by sediment deposited at the culvert exit and is otherwise in good condition.

3. Low-Level Outlet

A 24" diameter manually operated sluice gate, installed on the upstream face of the box spillway, serves as a low-level outlet. The gate appears to be in good condition, but no proper means of access is provided for its operation. At present the handwheel can be operated only by standing on the spillway crest, which in turn can only be reached by ladder (with reservoir empty) or by boat (with reservoir full).

Occasionally the low level outlet becomes partially blocked by sediment from the creek. The corrugated steel gate-well was blocked at the top with branches and other debris, indicating a flood to spillway crest in the recent past.

d. Reservoir Area

At present the reservoir is empty, and the basin is covered with grass, brush and trees. The rim of the basin is moderately to steeply sloped and varies from wooded to grassy. An artificial island of approximately 1 acre was noted in the basin.

e. Downstream Channel

The downstream channel winds through a wooded area containing more than ten residences before passing under Route 513, it eventually joins the south branch of the Raritan River approximately 2,000 feet downstream.

## SECTION 4: OPERATIONAL PROCEDURES

### 4.1 Procedures

According to the owner of the spillway and reservoir area, the reservoir has never been filled intentionally. The low-level outlet is always open and the reservoir normally remains empty. Occasionally the outlet becomes partially blocked by sediment and or debris and a heavy rain will cause the reservoir to fill temporarily. Eventually the pool drains through the outlet. It is not clear if the owner is permitted to close the low-level outlet at will.

### 4.2 Maintenance of the Dam

The facility is in good condition but at present, is not maintained on a regular basis. Responsibility for maintenance lies partly with the state of New Jersey and partly with Mr. Wirtz, the spillway owner.

### 4.3 Maintenance of Operating Facilities

The low-level outlet is maintained by Mr. Wirtz. At the time of the inspection, the outlet was operational, but not subject to regular operation or maintenance.

### 4.4 Evaluation

The project appears to be well maintained under present procedures, but it is recommended that a formal program of inspection and maintenance be initiated, to ensure continued upkeep.

The present operational procedures are satisfactory, but must be reviewed if the reservoir is filled.

## SECTION 5: HYDRAULIC/HYDROLOGIC

### 5.1 Evaluation of Features

a. Design

The drainage area above New Jersey No Name No. 31 Dam is approximately 2.3 square miles. A drainage map of the watershed of the dam site is presented on plate 1, Appendix D.

The topography within the basin is moderately sloped. Elevations range from approximately 600 feet above MSL at the east end of the watershed to about 180 feet at the dam site. Land use patterns within the watershed are mostly agricultural and lightly wooded.

The evaluation of the hydraulic and hydrologic features of the dam and lake was based on criteria set forth in the Corps Guidelines and additional guidance provided by the Philadelphia District, Corps of Engineers. The Spillway Design Flood 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 HEC1-DB Flood Hydrograph Computer Program.

Initial and infiltration loss rates were applied to the Probable Maximum Precipitation to obtain rainfall excesses. The rainfall excesses were applied to the unit hydrographs to obtain the PMF and various ratios of PMF utilizing program HEC1-DB.

The SDF peak inflow calculated for the dam is 3,636 cfs. This value is derived from the 1/2 PMF, and results in overtopping of the dam, assuming that the lake was originally empty.

The stage outflow relation for the spillway and dam was determined from the geometry of the spillway and dam, and is shown in the Hydrologic Computations (Appendix D).

The reservoir stage-storage capacity relationship was computed directly by the conic method, utilizing the HEC1-DB program. The conic method assumes that the reservoir capacity resembles a

series of vertically stacked cones. The reservoir surface areas at various elevations were measured by planimeters from U.S.G.S. Quadrangle topographic maps. 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.

A breach analysis indicates that the hazard potential for loss of life downstream, due to dam failure from overtopping, is not significantly greater than that which exists without failure, and therefore, the spillway is assessed as "inadequate." Drawdown calculations indicate that the lake would empty in 18.5 hours, assuming a 2 cfs/square mile inflow.

b. Experience Data

No records of reservoir stage or spillway discharge are maintained for this site. It was evident that water had flowed over the spillway crest in the recent past.

c. Visual Observation

The valley below the dam is partially developed with residential properties. The remainder is wooded. It appeared that the accumulated sediment in the culvert and channel would be easily washed out in the event of a high flood, making it reasonable to ignore the effect of blockage.

d. Overtopping Potential

A storm of magnitude equivalent to the SDF would cause overtopping of the dam to a height of 0.23 feet. Computations indicate that the dam can pass approximately 44% of the PMF without overtopping the dam crest. Since one half the PMF is the minimum 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: STRUCTURAL STABILITY

### 6.1 Evaluation of Structural Stability

a. Visual Observation

There are no signs of structural instability or settlement of the embankment or spillway-culvert structure. No sloughing, cracking, or local slumps are evident on either slope of the embankment. The reinforced concrete of the spillway and discharge culvert show no signs of cracking or spalling due to settlement or any other cause.

b. Design and Construction Data

No design computations concerning structural stability were uncovered during the report preparation phase. No embankment soil parameters are available for carrying out a conventional stability analysis on the embankment. No construction data or specifications relating to the degree of embankment compaction are available for use in the stability analysis.

c. Operating Records

No operating records are available relating to the stability of the dam. The dam has served satisfactorily since it construction in 1964. However, the reservoir has been empty for almost all of this time.

d. Post Construction Changes

No post construction changes have been made.

e. Static Stability

A static stability analysis was not performed for N.J. No Name No. 31 Dam because the lack of data on which to base assumptions of material properties in the embankment might produce misleading results.

There is no observable evidence to suggest structural instability.

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 o, 1 and 2 may be assumed to present no hazard from earthquake, provided

the static stability conditions are satisfactory and conventional safety margins exist. The last two conditions are deemed to be fulfilled, based on the visual inspection, and thus the seismic stability is considered satisfactory.

## SECTION 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 I report.

The safety of N. J. No Name No. 31 Dam is in question because the dam does not have adequate spillway capacity to pass the PMF or even one-half of the PMF without overtopping. Overtopping of the dam carries with it the danger of possible progressive failure of the dam. The dam's present spillway capacity can pass about 44% of the PMF.

No definitive statement pertaining to the safety of the embankment can be made without acquisition of embankment material engineering properties and determination of phreatic levels in the downstream part of the embankment, in the event of filling the reservoir.

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 dam's stability. A preliminary assessment of the dam could be made by visual observation only.

c. Urgency

1. Carry out a more precise hydrologic and hydraulic analysis of the dam within 12 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.

2. If the reservoir is to be filled, observation wells or piezometers should be installed in the downstream embankment to determine the location of the phreatic surface. The borings should be logged according to the Unified Soil Classification system by qualified personnel and samples taken to determine the values of pertinent soil parameters for stability. This information should be obtained within six months of filling, and should be evaluated immediately upon acquisition to perform stability analyses in accordance with Chapter 4.4 of the Corps Guidelines.

## 7.2 Remedial Measures

a. Alternatives for Increasing Spillway Capacity

Alternatives for increasing spillway capacity are as follows:

1. Increase the dam height, 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. Other Remedial Measures

1. Sedimentation which the stream has deposited at the upstream side of the low-level outlet and in the natural channel downstream of the discharge culvert, should be removed. This sediment removal will be necessary periodically.

2. If the reservoir is to be flooded, a bridge and platform should be constructed to provide easy access to the low-level outlet.

c. Recommendations

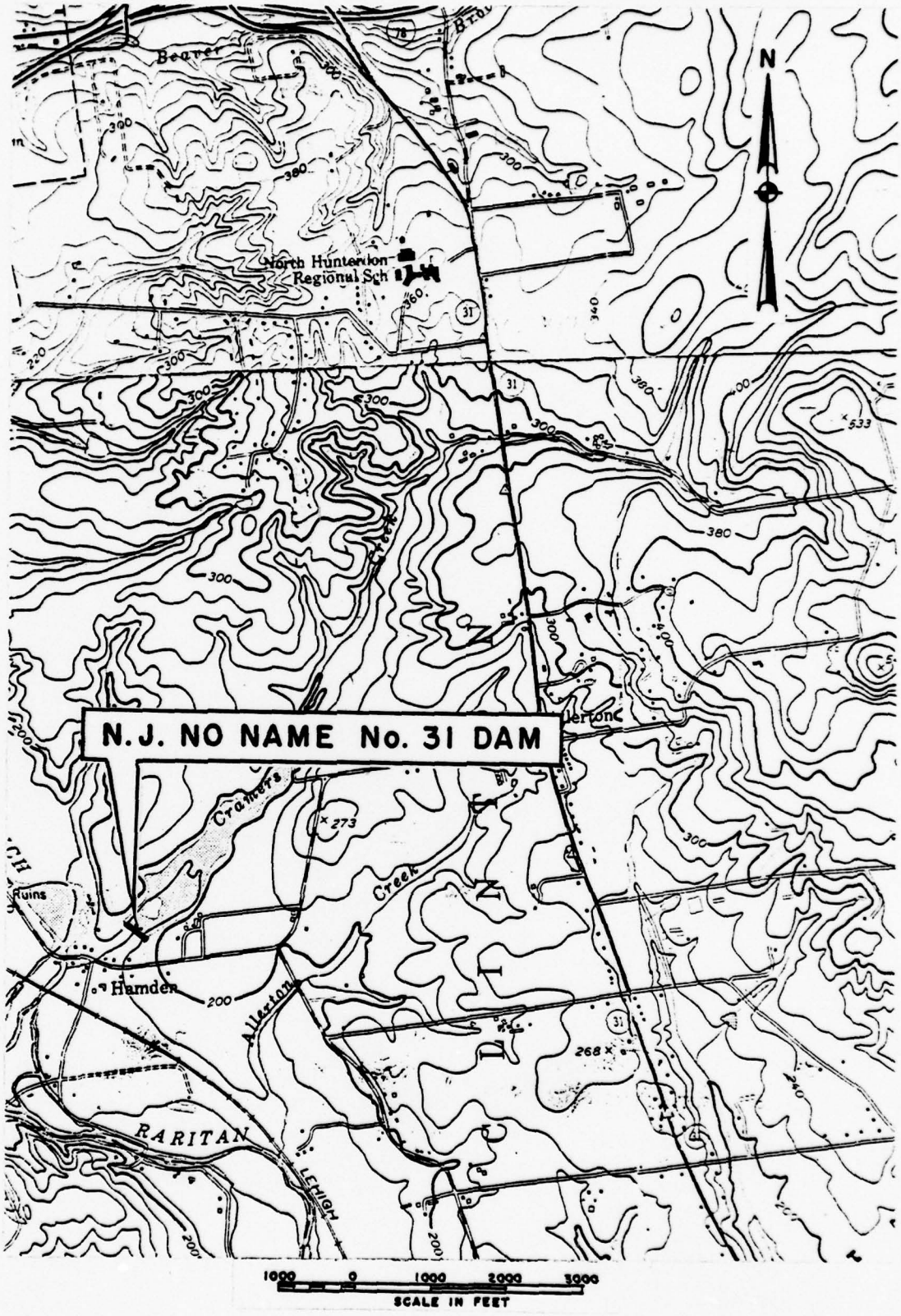
1. Establish a flood warning system for the downstream communities.

2. Establish operational procedures for the low-level outlet, defining the obligations of the owner if he wishes to fill the lake.

d. O & M Procedures

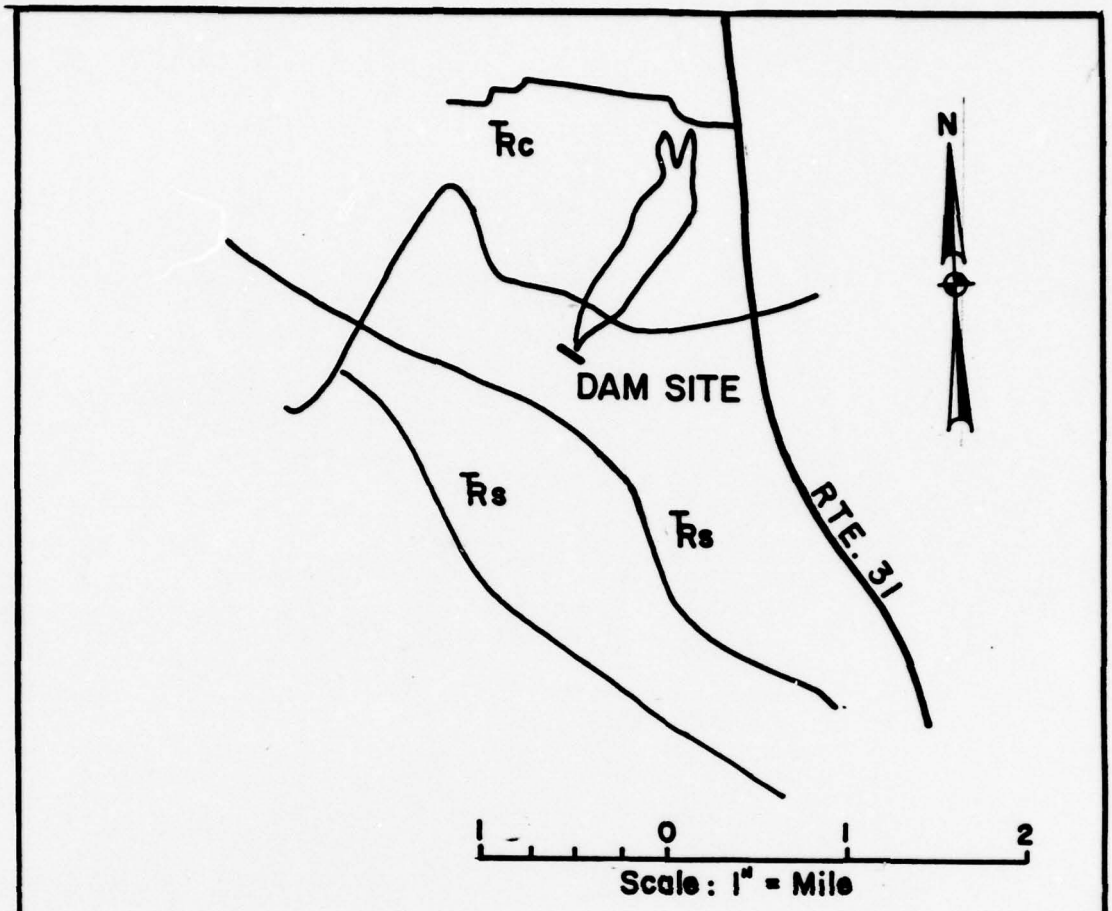
A formalized program of annual inspections of the dam by an experienced party should be initiated, utilizing the standard visual check list in this report. Headwater and tailwater gages should be installed in the dam, and read out during severe rain storms and at routine operating and maintenace visits to the dam. A permanent log should be kept of all maintenance and operating events of the dam, the lake and the outlet passages. Movement and settlement of the embankment should be monitored regularly by means of surveying monuments.

PLATES




# VICINITY MAP

PLATE 1




## LEGEND

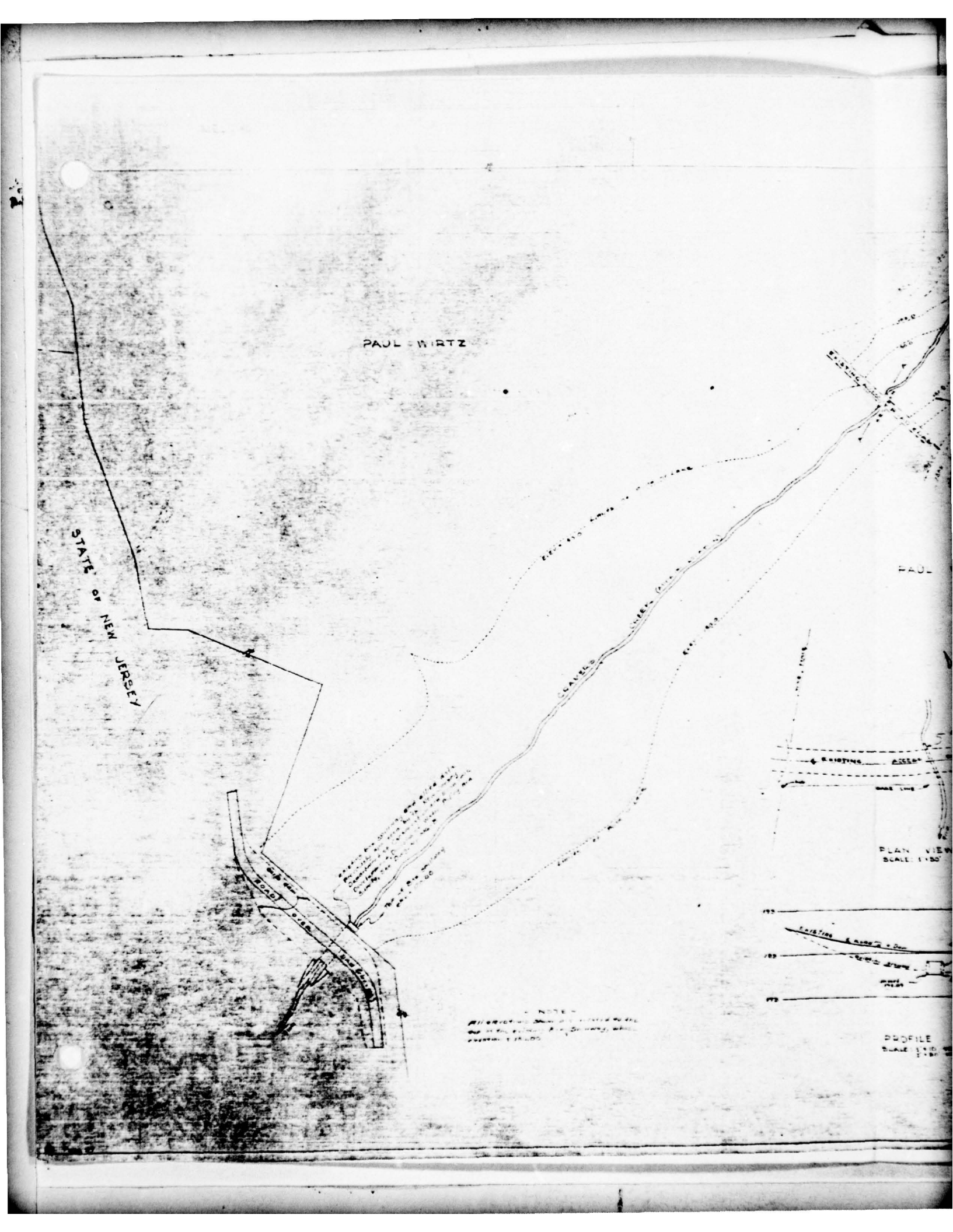
### TRIASSIC

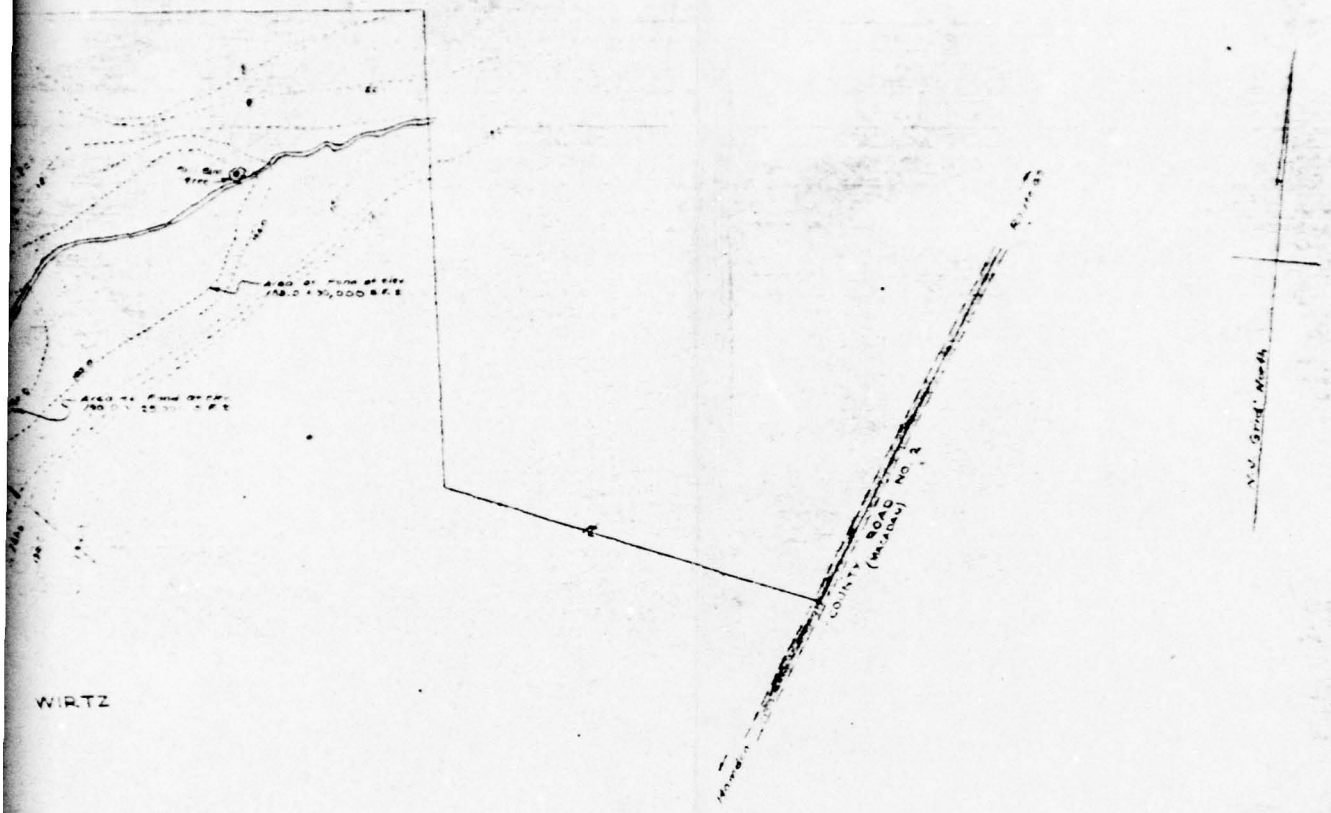
**TRs** — Stockton Formation
Gray feldspathic sandstone (Karkose),
Conglomerate and red shale

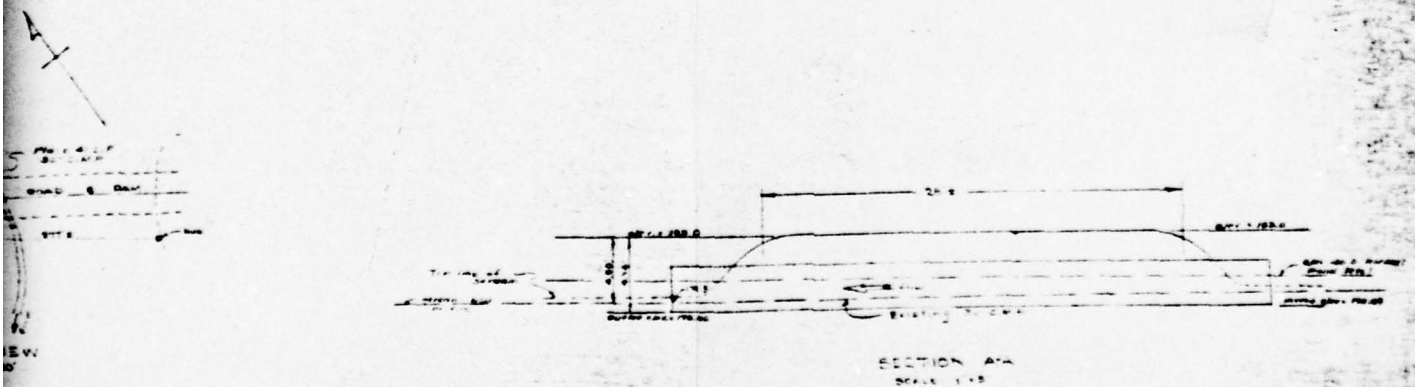
**TRc** — Brunswick Formation
Border Conglomerate

# GEOLOGIC MAP
# N.J. NO NAME 31 DAM

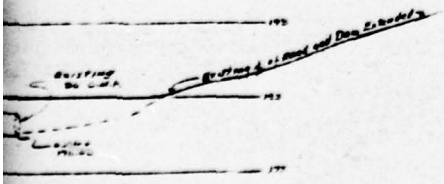
PLATE 2


PAUL WIRTZ
STATE OF NEW JERSEY
PAUL
PLAN VIEW
PROFILE



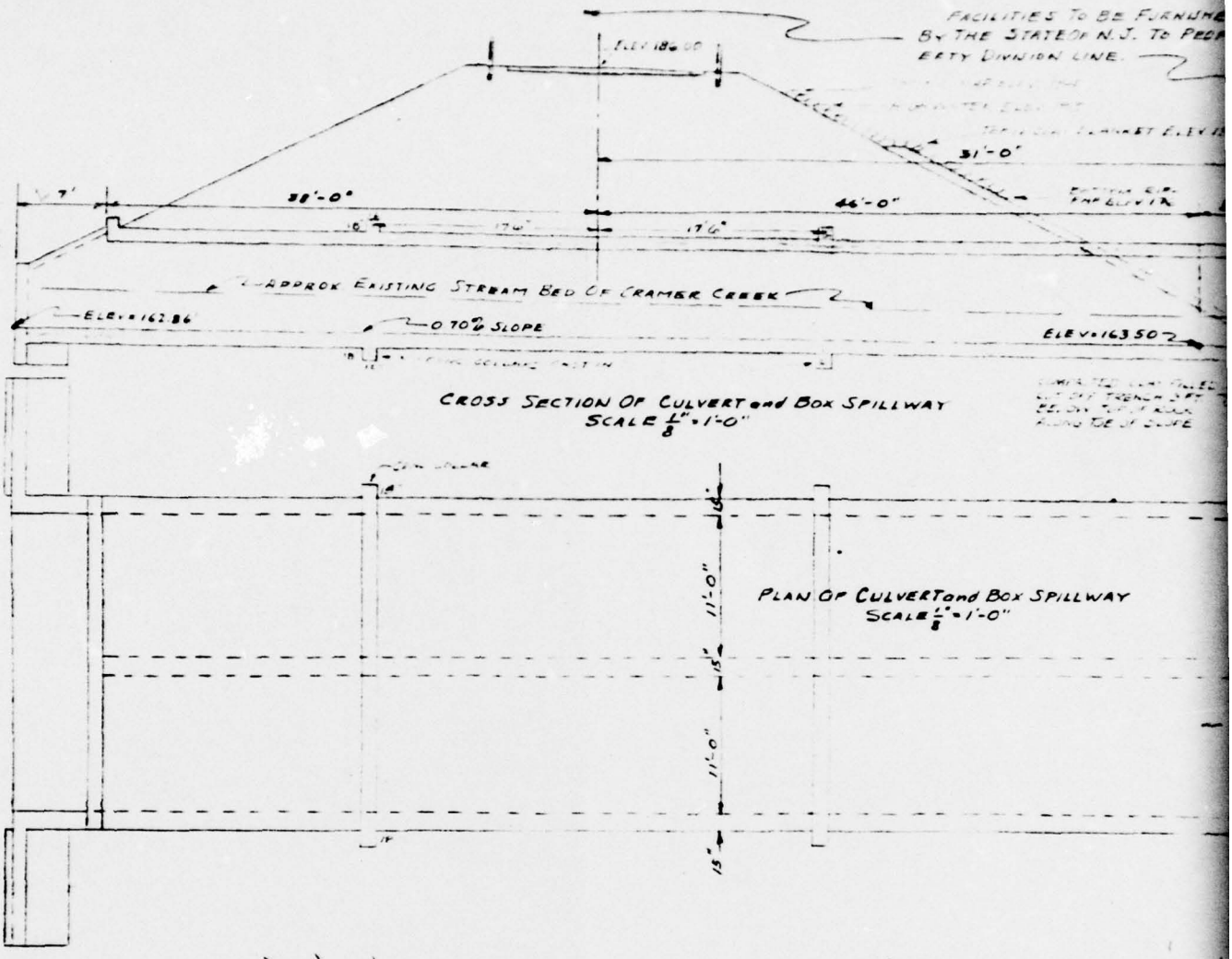
SECTION A-A

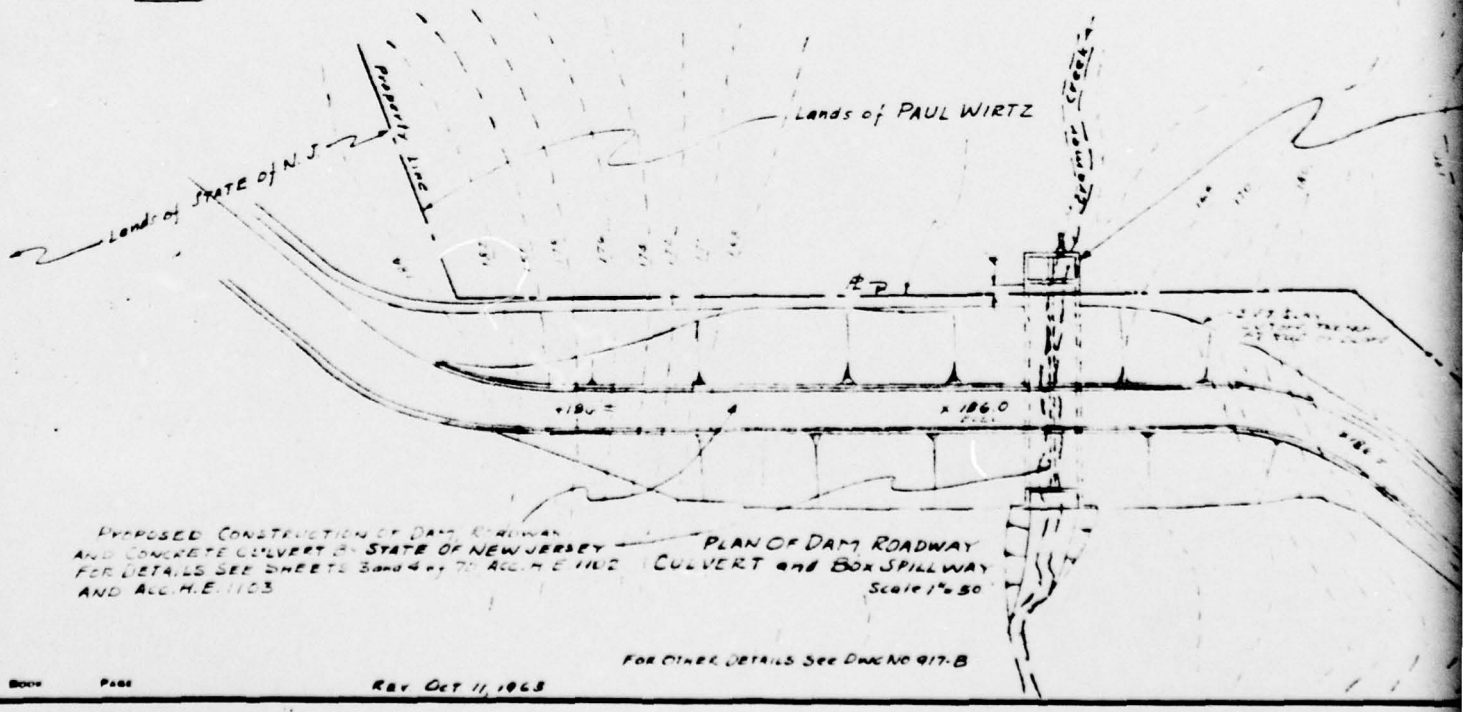


EXISTING LOCATION OF
ACCESS ROADWAY & POND LIMITS
FOR
PAUL WIRTZ
IN
CLINTON TOWNSHIP
HUNTERDON COUNTY, NEW JERSEY
PREPARED BY
JOHN E. STUDER
CIVIL ENGINEER & LAND SURVEYOR
CLINTON, NEW JERSEY

REVISED: 8/20/68

PLATE 3

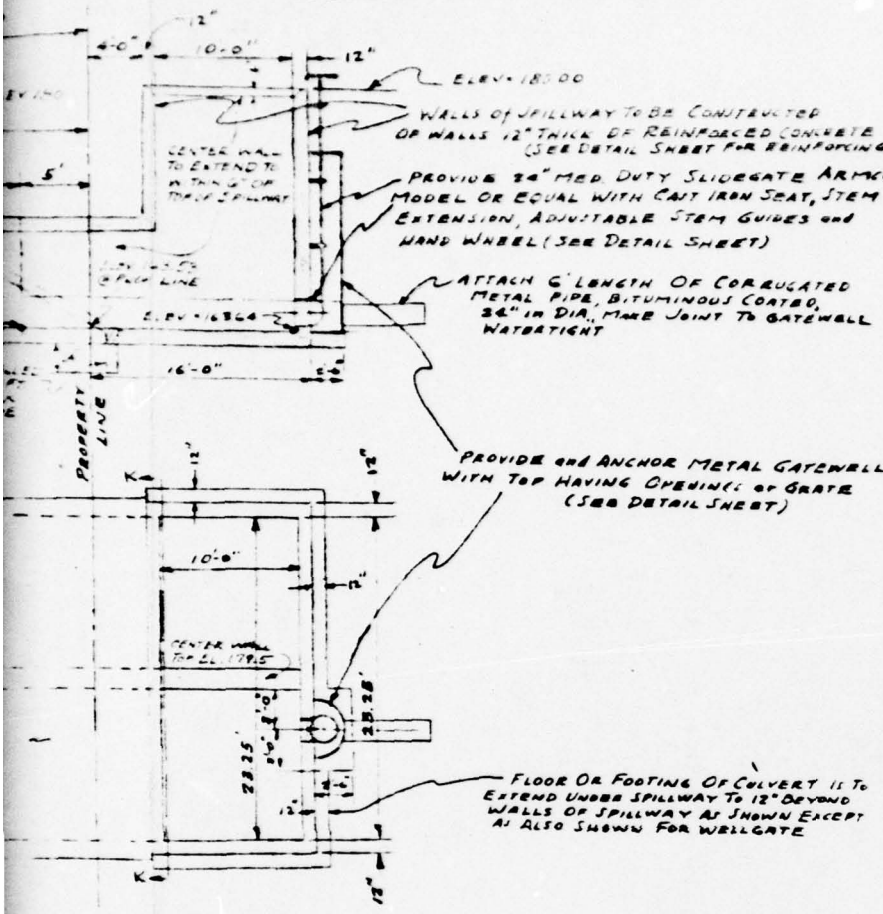



BOOK PAGE

REV OCT 11, 1963

EXTENSION OF CONCRETE CULVERT AND CONCRETE BOX SPILLWAY FROM PROPERTY DIVISION LINE TO BE CONSTRUCTED BY PAUL WIRTZ




PROPOSED CONCRETE CULVERT EXTENSION AND CONCRETE BOX SPILLWAY FROM PROPERTY DIVISION LINE IN NORTH-EASTERLY DIRECTION TO BE CONSTRUCTED AS SHOWN BY PAUL WIRTZ.



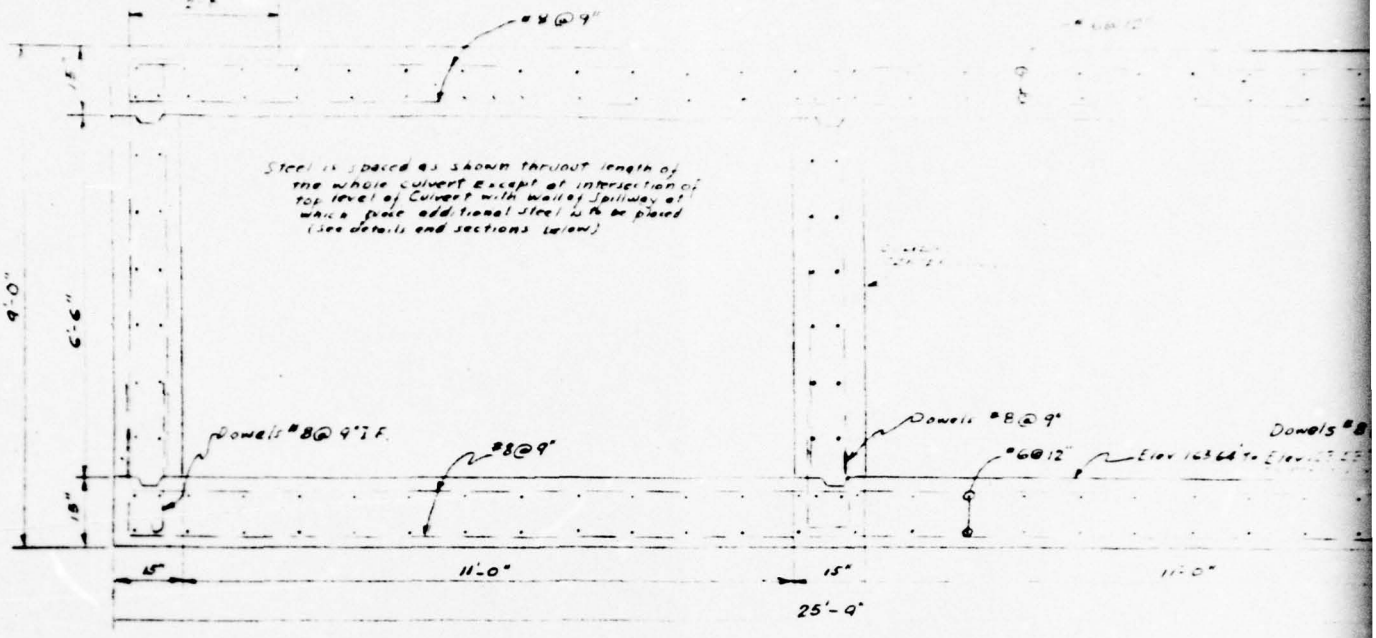

No Name #1

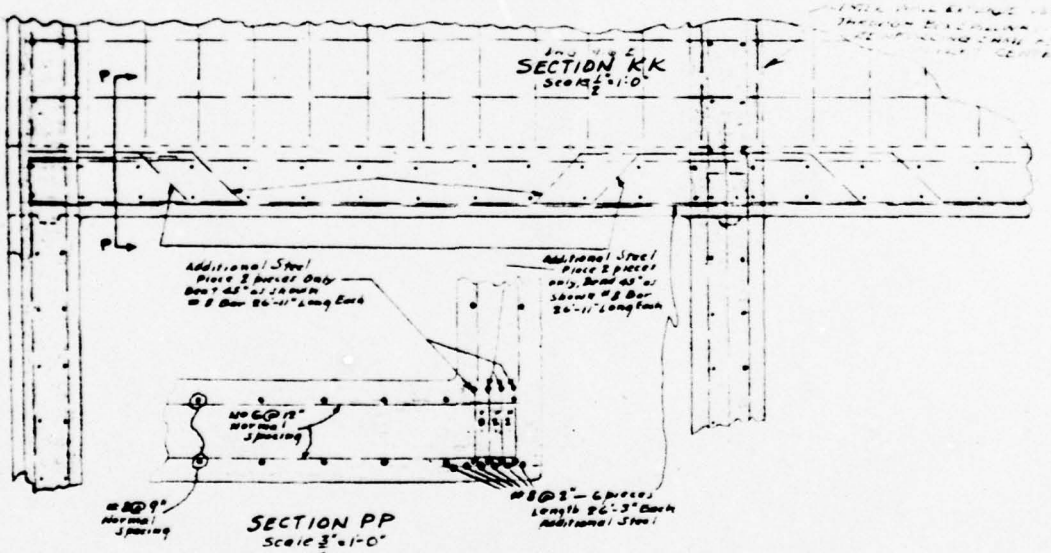
PROPOSED CULVERT and BOX SPILLWAY TO and THRU PROPOSED DAM ON CRAMERS CREEK at SITE OF ROUND VALLEY PUMP STA.

FOR: PAUL C. WIRTZ
IN
CLINTON TOWNSHIP
HUNTERDON COUNTY, N.J.
BY
STUDER AND McELDOWNEY
CIVIL ENGINEERS AND LAND SURVEYORS
CLINTON N.J.

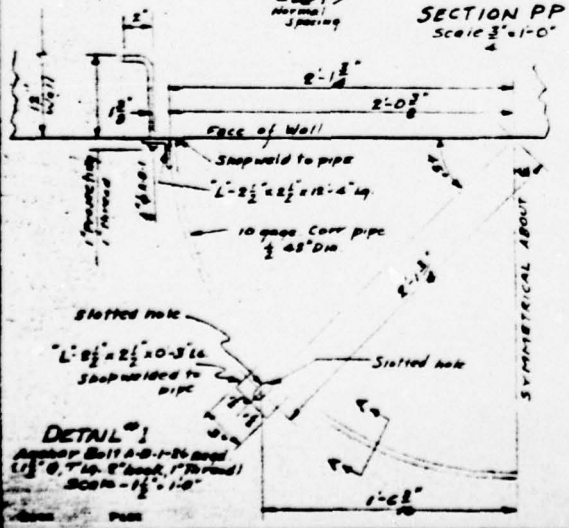
SCALE 1"=10' 1"=50' DWN BY: J.B.S CKD BY:
DATE Oct. 3, 1963 DWG NO: 916-B

PLATE 4
2

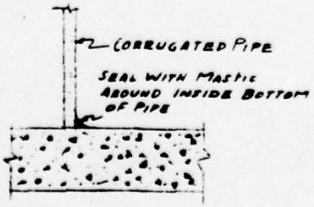


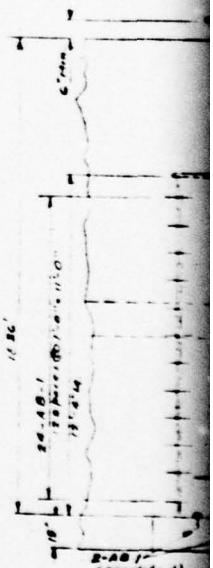

SECTION PP
Scale 3/4"=1'-0"




DETAIL "1"
Anchor Bolt A-0-1-24 and (1) 3/8" Ø, 7" Lg. 5" Bent, 1" Thread)
Scale - 1 1/2"=1'-0"




SECTION AA
Not To Scale

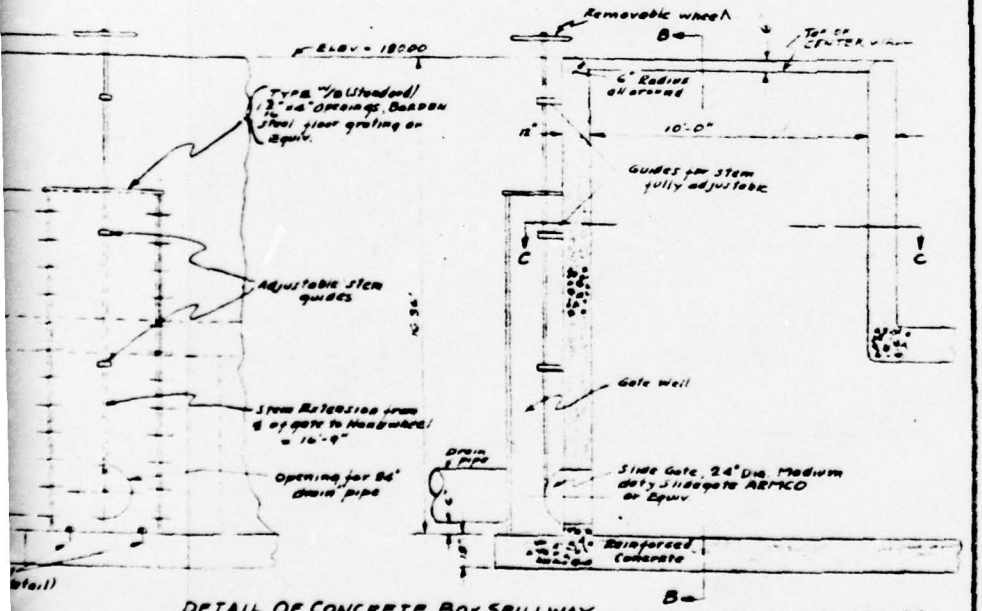



All exposed
unless Otherwise
Min cover
Min Splice
No. Bar - 23"

1




SECTION BB
Scale 1/2" = 12"




DETAIL OF CONCRETE BOX SPILLWAY
Scale 1/2" = 12"

No. NJ-1 37

NOTES

osed edges of concrete to have 3/4" Chamfer
erwise shown
over for steel is 2" unless Otherwise Noted
ings "Overlap of Steel is as follows: No 5 Bar = 19",
33" and No 7 Bar = 27"

FOR GENERAL DATA OF DAM
CULVERT AND SPILLWAY SEE DWG 916-B

DETAILS of CULVERT and BOX SPILLWAY To and THRU PROPOSED DAM ON CRAMERS CREEK at SITE of ROUND VALLEY PUMP STA.

FOR: PAUL C. WIRTZ
IN
CLINTON TOWNSHIP
HUNTERDON COUNTY, N.J

BY

STUDER AND McELDOWNEY
CIVIL ENGINEERS AND LAND SURVEYORS
CLINTON, N.J.

SCALE As Noted DWN BY J.R.S CKD BY

DATE Oct 14, 1963 DWG NO. 917-B

PLATE 5

# APPENDIX A

CHECK LIST - VISUAL OBSERVATIONS

CHECK LIST - ENGINEERING, CONSTRUCTION, MAINTENANCE DATA

CHECK LIST
VISUAL INSPECTION

PHASE I

Name of Dam N. J. No Name No. 31 County Hunterdon State New Jersey Coordinators NJDEP

Date(s) Inspection May 2, 1979 / May 24, 1979 Weather Sunny Temperature 70°F

Pool elevation at Time of Inspection N/A (no pool) M.S.L. Tailwater at time of Inspection 164' M.S.L.

Inspection Personnel:

May 2, 1979

Eugene Koo
Henry King
Chuck Chin

Owner/Representative

Paul Wirtz
Abe Shaika
Mr. Chase

May 24, 1979

William Flynn

Owner Representative

Paul Wirtz

## EMBANKMENT

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS AND RECOMMENDATIONS |
|---|---|---|
| SURFACE CRACKS | A roadway embankment forms the dam. No cracks were visible in the road pavement nor in the embankment slopes. | |
| UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE | No visible movement or cracking at the toe was observed. | |
| SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES | The embankment has upstream and downstream slopes of 2 horizontal to 1 vertical. No apparent sloughing or erosion. The upstream slope of the embankment is protected with rip rap and is in good condition. The downstream slope is covered with grass and with light brush and is in good condition. | |
| VERTICAL & HORIZONTAL ALIGNMENT OF THE CREST | No obvious misalignment or settlement was visible. | |
| RIPRAP FAILURES | Rip rap was in good condition. | |

## EMBANKMENT

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS AND RECOMMENDATIONS |
|---|---|---|
| VEGETATION | Upstream and downstream slopes are mostly grassy with some brush. Upstream slope is protected with broken stone rip rap. | |
| JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM | Good condition. | |
| ANY NOTICEABLE SEEPAGE | No water was in the reservoir during the inspection. Seepage was observed at the top of the left culvert wingwall downstream. Another wet spot was observed approximately 20 feet to the right of the culvert wingwall, at the toe of the embankment. | Since the reservoir was empty, the water must have been draining from the embankment soil; probably from a previous rainfall. |
| STAFF GAGE AND RECORDER | None. | |
| DRAINS | None. | |

## UNGATED SPILLWAY

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS AND RECOMMENDATIONS |
|---|---|---|
| CONCRETE WEIR | Reinforced concrete box spillway (located in the reservoir above upstream toe) is in good condition. | |
| APPROACH CHANNEL | None. Spillway is in reservoir. | |
| DISCHARGE CHANNEL | Spillway discharge flows through embankment in two reinforced concrete culverts, which terminate at the downstream toe of slope, in the natural stream bed. Right half of the channel and the right discharge culvert is partially blocked with sediment on which grass has grown. | Remove sediment blocking right culvert and downstream channel. |
| BRIDGE AND PIERS | None. | |
| FOUNDATION | According to the U.S.G.S., the dam is located on Stockton Formation Gray feldspathic sandstone (Karkose), Conglomerate and red shale. Soil borings taken on the site (1955) found shale and clay. | |

## OUTLET WORKS

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS AND RECOMMENDATIONS |
|---|---|---|
| CRACKING & SPALLING OF CONCRETE SURFACES IN STILLING BASIN | No cracking noted on floor of culvert below spillway. | |
| INTAKE STRUCTURE (LOW-LEVEL) | A single manually operated 24 inch diameter circular sluice gate is located on the upstream face of the box spillway at the invert level of the culvert. At the time of inspection, approximately 75% of the outlet opening was blocked with sand and sediment. No access is provided to gate handwheel. | Periodically remove sediment accumulated at sluice gate and immediately upstream. Provide a bridge and platform at box spillway for operation of gate. |
| OUTLET STRUCTURE (LOW-LEVEL) | Water flows through the 24 inch diameter sluice gate into the left discharge culvert, to the downstream channel. The sluice gate was in the open position at the time of inspection. | |
| OUTLET FACILITIES | No auxillary outlet facilities. | |
| EMERGENCY GATE | None. | |

## INSTRUMENTATION

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS AND RECOMMENDATIONS |
|---|---|---|
| MONUMENTATION/SURVEYS | Two state monuments are indicated on drawings of the dam, but were not found at the inspection. | |
| OBSERVATION WELLS | None. | |
| WEIRS | None. | |
| PIEZOMETERS | None. | |
| OTHERS | None. | Install head-water and tailwater gages. |

## RESERVOIR

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS AND RECOMMENDATIONS |
|---|---|---|
| **SLOPES** | The land surrounding the reservoir is moderately to steeply sloped. The left side is densely covered with medium size trees and brush. Part of the right side is covered with grass only, and the remainder is wooded. | |
| **SEDIMENTATION** | The reservoir is normally empty. The only sedimentation occurs at the low level-outlet sluice gate, which was partially blocked. Because of this blockage, the reservoir occasionally fills (after heavy rainfall) then slowly drains through the blocked sluice gate. | Periodically clear sediment from the low-level outlet and the spillway discharge culvert. |
| **USE** | Intended for recreation but never filled. | |
| | | |
| | | |

## DOWNSTREAM CHANNEL

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS AND RECOMMENDATIONS |
|---|---|---|
| CONDITION (OBSTRUCTIONS, DEBRIS, ETC.) | Some sedimentation has occurred in the downstream channel for a distance of 100 feet from the culvert outlet. Further downstream a fence crosses the channel, before channel enters the wooded section of the valley. | |
| SLOPES | Mild. Vegetation varies from wooded to grassy. | |
| APPROXIMATE NUMBER OF HOMES AND POPULATION | More than 10 houses and Route 513 within 700 feet downstream. | |
| | | |
| | | |

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

| ITEM | REMARKS |
|---|---|
| PLAN OF DAM | Available on microfilm at NJDEP. |
| REGIONAL VICINITY MAP | Available - County Map<br>U.S.G.S. Quadrangle sheet for Pittstown, NJ. |
| CONSTRUCTION HISTORY | Soil borings, stream encroachment applications, etc.<br>Available on microfilm. Built 1964. |
| TYPICAL SECTIONS OF DAM | Available on microfilm. |
| HYDROLOGIC/HYDRAULIC DATA | Spillway capacity calculations for 15-year storm on microfilm. |
| OUTLETS - PLAN | Available on drawings (NJDEP). |
| - DETAILS | Available on drawings (NJDEP). |
| - CONSTRAINTS | None. |
| - DISCHARGE RATINGS | Available on drawings (NJDEP). |
| RAINFALL/RESERVOIR RECORDS | None known to exist. |

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

| ITEM | REMARKS |
|---|---|
| DESIGN REPORTS | Havens & Emerson, Consulting Engineers, Saddle Brook, NJ<br>ATT: Mr. Abplanalp - (201) 845-0470 (Contract PS-1). |
| GEOLOGY REPORTS | U.S.G.S. Quadrangle Geological Overlay<br>Rutgers Report for Hunterdon Co. |
| DESIGN COMPUTATIONS | None. |
| HYDROLOGY & HYDRAULICS | Spillway capacity calculation on microfilm. |
| DAM STABILITY | None. |
| SEEPAGE STUDIES | None. |
| MATERIALS INVESTIGATIONS | None. |
| BORING RECORDS | Available on microfilm. Hard shale found about 6 feet below surface of original ground. |
| LABORATORY | None. |
| FIELD | None. |
| POST-CONSTRUCTION SURVEYS OF DAM | None. |
| BORROW SOURCES | Excavation for state pumping station. |
| SPILLWAY PLAN - SECTIONS | Available on microfilm. |
| - DETAILS | Available on microfilm. |

# APPENDIX B

PHOTOGRAPHS

(Taken May 2, 1979)

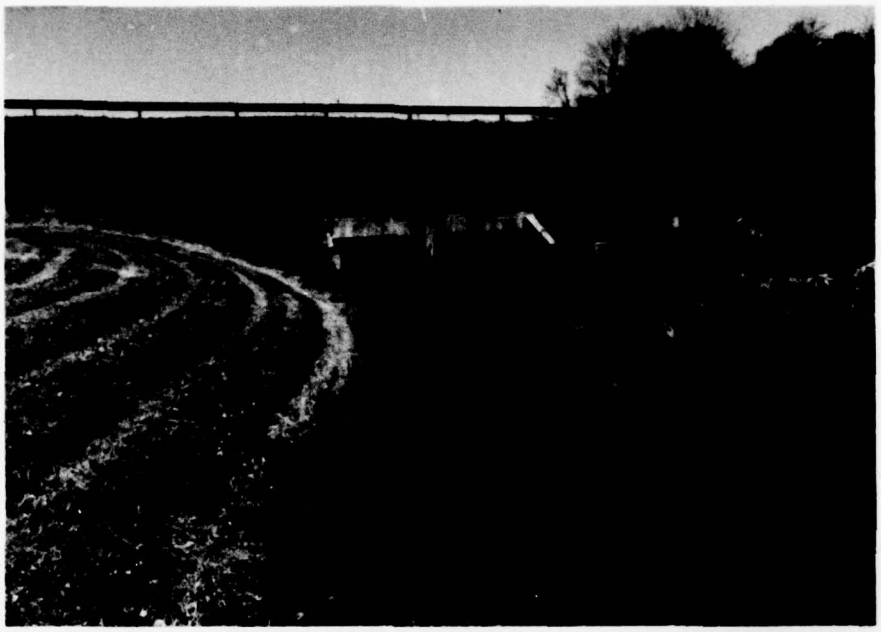


Photo No. 1 - General view of embankment, spillway discharge culvert, and downstream channel. Note sedimentation and growth blocking right culvert.



Photo No. 2 - View of road over embankment from right side. Note rip-rap on upstream face and box spillway (left of picture).

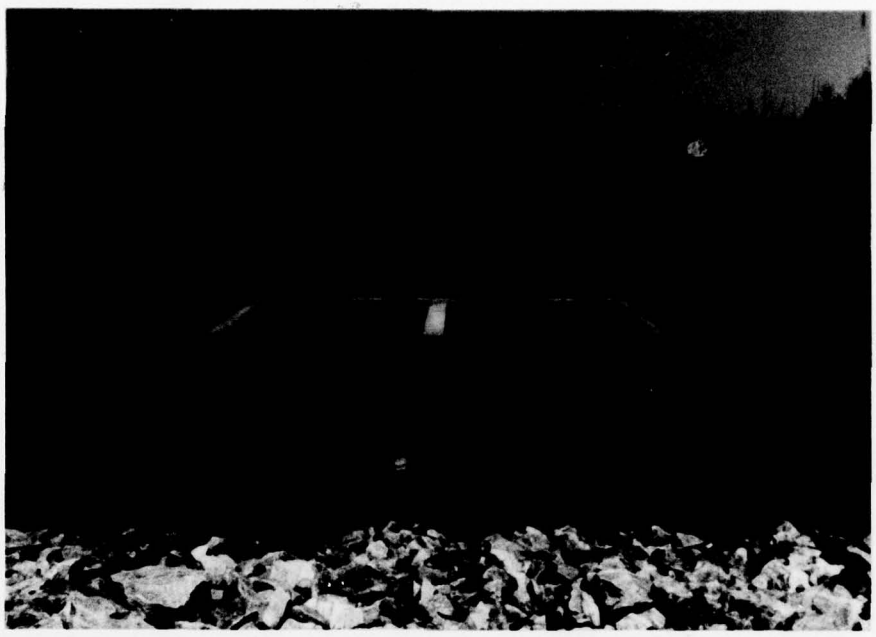


Photo No. 3 - View of box spillway and reservoir basin from top of embankment. Reservoir is normally empty. Note outlet gate handwheel, also debris on spillway crest indicating past over-flow.

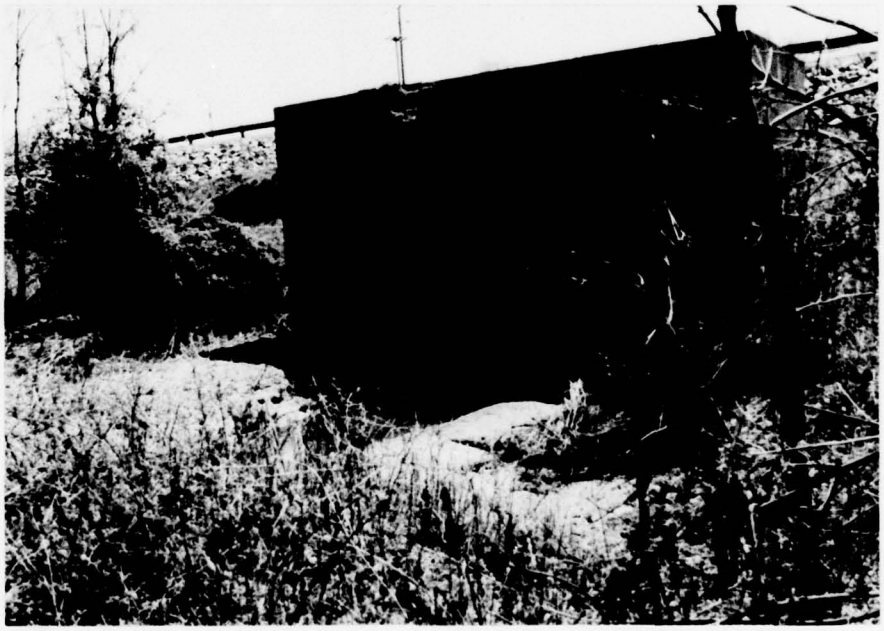


Photo No. 4 - Upstream face of box spillway. Note debris on top of corrugated gate well.



Photo No. 5 - Detail of low level outlet. Note sediment has almost blocked 24" diameter opening in corrugated gate well.



Photo No. 6 - Detail of left wingwall at end of spillway discharge culvert. Seepage is from water retained in the embankment.



Photo No. 7 - View from embankment looking upstream. Note the creek flowing through the empty reservoir basin and the artificial island in the background.



Photo No. 8 - View of downstream channel.

# APPENDIX C

## SUMMARY OF ENGINEERING DATA

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

Name of Dam: New Jersey No Name No. 31

Drainage Area Characteristics: Rural, wooded, few residences.

Elevation Top Normal Pool (Storage Capacity): 180' MSL (40 acre-feet)

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

Elevation Maximum Design Pool: (15 year flood) 183' MSL (73 acre-feet)

Elevation Top Dam: 186' MSL (132 acre-feet)

SPILLWAY CREST

a. Elevation 180' MSL

b. Type Unregulated concrete box spillway.

c. Width 12"

d. Length 70.5 feet.

e. Location Spillover Full length.

f. No. and Type of Gates None.

OUTLET WORK

a. Type Double rectangular box culvert.

b. Location D/S of spillway, under dam. Located Centrally.

c. Entrance Inverts 163.6' MSL

d. Exit Inverts 162.9' MSL

e. Low-level Draindown Facilities 24" ø sluice gate

HYDROMETEOROLOGICAL GAGES

a. Type N/A

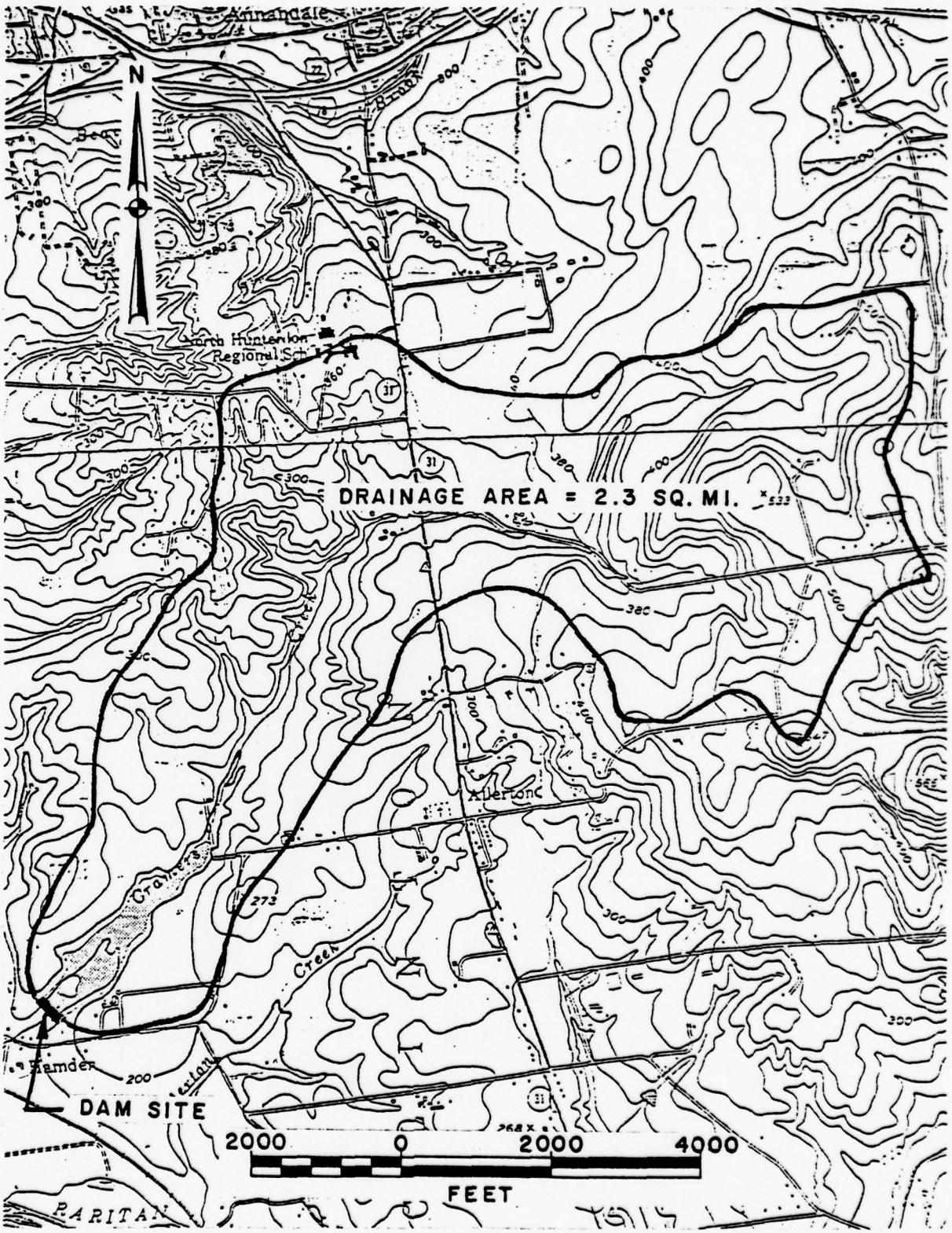
b. Location N/A

c. Records N/A

MAXIMUM NON-DAMAGING DISCHARGE 3127 cfs

# APPENDIX D

## HYDROLOGIC COMPUTATIONS




N.J. NO NAME No. 31 DAM
DRAINAGE BASIN

## Size and Hazard Classification

Surface area of Lake = 27.55 Ac
at elevation 180'

Hight of the Dam = 23 Ft:

Small Dam, High Hazard

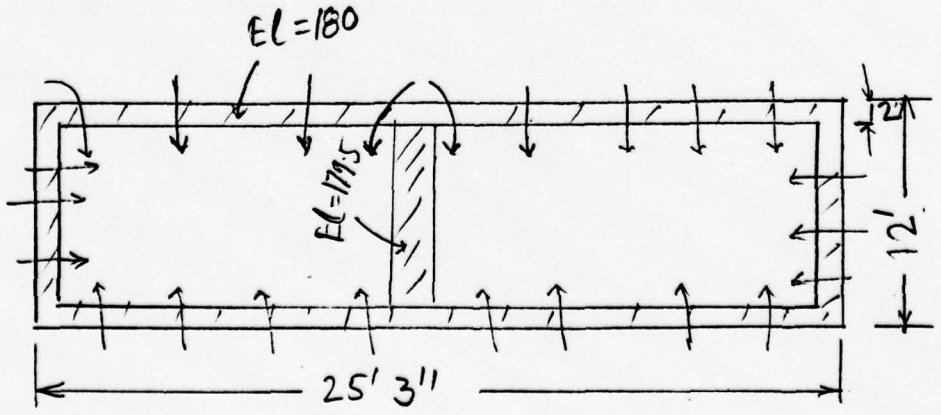
SDF = $\frac{1}{2}$ PMF (Low end of range)

## Hydrologic Analysis.

D.A = 2.31 Sq mi

Inflow Hydrograph at Dam was determined using HEC 1 DB program. The inflow routed through reservoir

## Spillway



Effective length of spillway (EL = 180

$(25'3" + 10'0") \times 2 = 70.5$ Ft

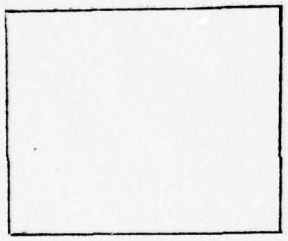
Effective length of Road (EL 186

= 550' (scaled)

Box culvert

One box

$$R = \frac{\text{Area}}{\text{Perimeter}} = \frac{11 \times 6.5}{17.5 \times 2} \approx 2$$




Tailwater depth assumed

$\frac{8}{3} \times R = \frac{16}{3} = 5.33$ ft

above the invert

Invert at D/s end = 162.86

Tail water elevation = 162.86 + 5.33 = 168.19 Ft

When the culvert flow in pressure

$$Q = A \cdot Cd \sqrt{2g \Delta hc}$$

$$Q^2 = (2 \times 11.0 \times 6.5) \times .80 \times 8 \sqrt{\Delta h - hf}$$

$$Q^2 = 837,591 (\Delta h - hf)$$

$\Delta hc$ = head of the culvert.

= Difference of elevation

$hf$ = Friction loss.

Friction loss through the pipe.

$$\frac{29.2\ V^2\ n^2 \times L}{29\ R^{4/3}} = .0001\ \frac{V^2 L}{R^{4/3}}$$

assuming $n = .015$

$R = 2$ Ft

$L = 91$ ft

$$h_L = \frac{.0001 \times 91}{2^{4/3}} \cdot \frac{Q^2}{(11 \times 6.5)^2}$$

$$= 0.71 \times 10^{-6}\ Q^2$$

$$Q^2 = 837,591\ (\Delta h - 0.71 \times 10^{-6}\ Q^2)$$

$$Q^2 + .594\ Q^2 = 837,591\ \Delta h$$

$$Q^2 = 525,375\ \Delta h$$

$$Q = 724\sqrt{\Delta h}$$

Flow through the Spillway

$Q = C L H^{1.5}$ (end contraction neglected for simplicity)

$= 3.75 \times 70 \times H^{1.5}$

$= 262.5\ H^{1.5}$

| Water S.EL | Tail water EL | Head of Culvert flow | $Q_c$ $724\sqrt{\Delta h}$ | Head on Spillway | $Q_s$ $262.5\ H^{1.5}$ |
|---|---|---|---|---|---|
| 180 | 168.2 | 11.8 | 2487 | 0 | 0 |
| 182 | | 13.8 | 2690 | 2 | 742 |
| 184 | | 15.8 | 2878 | 4 | 2100 |
| 186 | | 17.8 | 3054 | 6 | 3857 |
| 188 | | 19.8 | 3221 | 8 | 5939 |
| 190 | | 21.8 | 3380 | 10 | 8300 |
| 195 | | 26.8 | 3748 | 15 | |
| 200 | | 31.8 | 4083 | 20 | |

## Flow through the low level Outlet

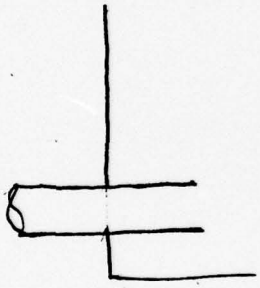
6' length of corrugated Metal pipe 24" in dia.

Pressure flow is considered.

D/S W.S elevation considered

$163.64 + \frac{2}{3} \times 2 = 164.31$ say 164.5

Pipe is considered as reentrant tube such as shown in the figure



$K_e = 1.0$ entrance loss $h_e = 1.0 \frac{V^2}{2g} = \frac{Q^2}{2A^2g} = .00157 Q^2$

$$Q = cd \times A \sqrt{2g \Delta h}$$

$$= .8 \times \frac{\pi}{4} \times 2^2 \times 8 \sqrt{\Delta h - h_e}$$

$$Q^2 = 404 (\Delta h - h_e)$$

$$= 404 (\Delta h - .00157 Q^2)$$

$$Q^2 + .6356 Q^2 = 404 \Delta h$$

$$Q^2 = 247 \Delta h$$

$$Q = 15.7 \sqrt{\Delta h}$$

| W.S.El | Tailwater level | $\Delta h$ in low level outlet | $Q$ $15.7\sqrt{\Delta h}$ |
|---|---|---|---|
| 166 | 164.5 | 1.5 | 19 |
| 168 | | 3.5 | 29 |
| 170 | | 5.5 | 37 |
| 172 | | 7.5 | 43 |
| 174 | | 9.5 | 48 |
| 176 | | 11.5 | 53 |
| 178 | | 13.5 | 58 |
| 180 | | 15.5 | 62 |
| 182 | | 17.5 | 66 |
| 184 | | 19.5 | 69 |
| 186 | | 21.5 | 73 |
| 188 | | 23.5 | 76 |
| 190 | | 25.5 | 79 |
| 195 | | 30.5 | 87 |
| 200 | | 35.5 | 94 |

## Wier Flow Over the Dam

$Q = CL\,H^{3/2}$

Broad Crested Wier $C = 2.75$

$L = 550'$ (effective)

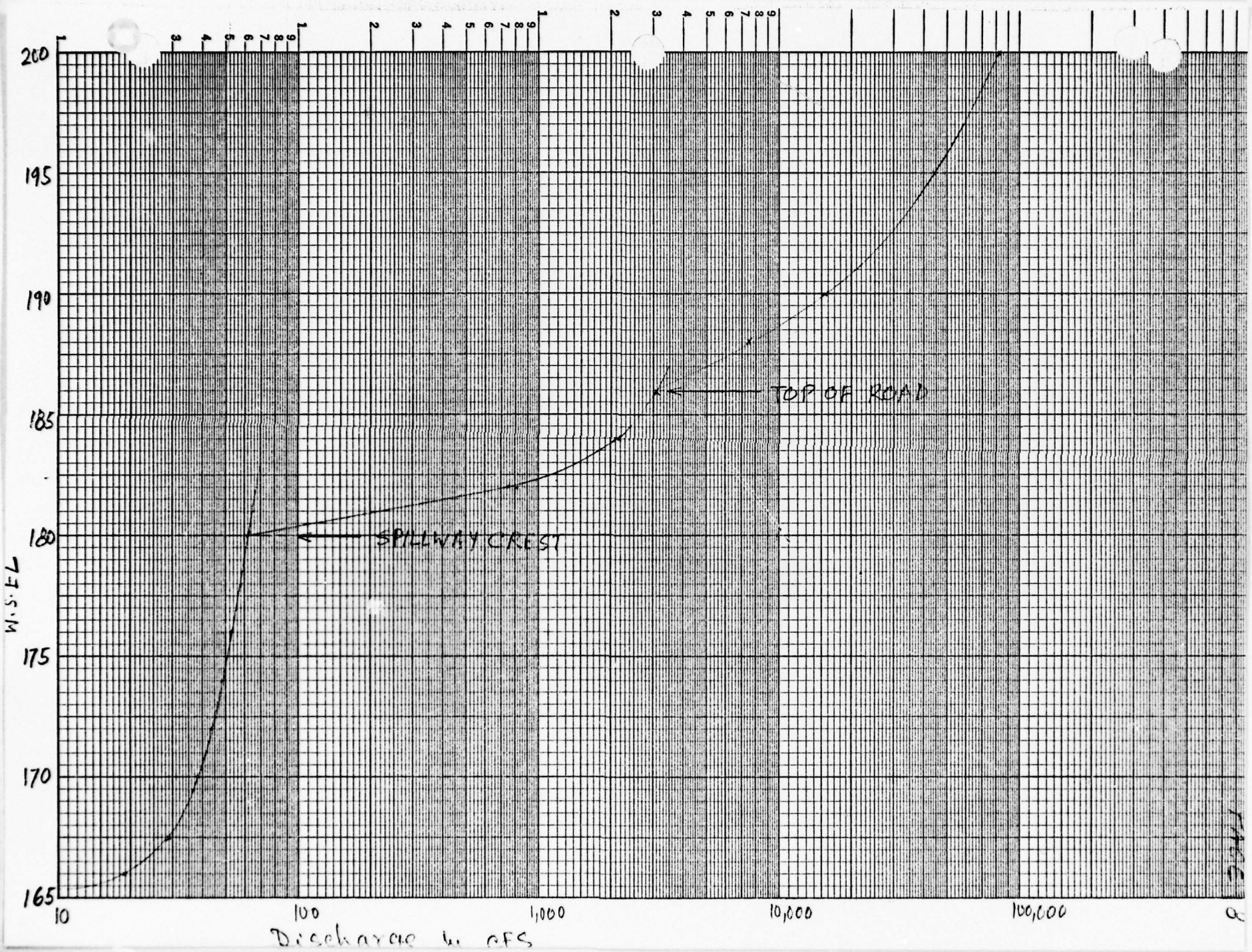
$Q = 2.75 \times 550 \times H^{1.5}$

$= 1513\,H^{1.5}$

| W.S.El | H | Q |
|---|---|---|
| 186 | 0 | 0 |
| 188 | 2 | 4279 |
| 190 | 4 | 12,104 |
| 195 | 9 | 40,851 |
| 200 | 14 | 79,256 |

## Rating curve :

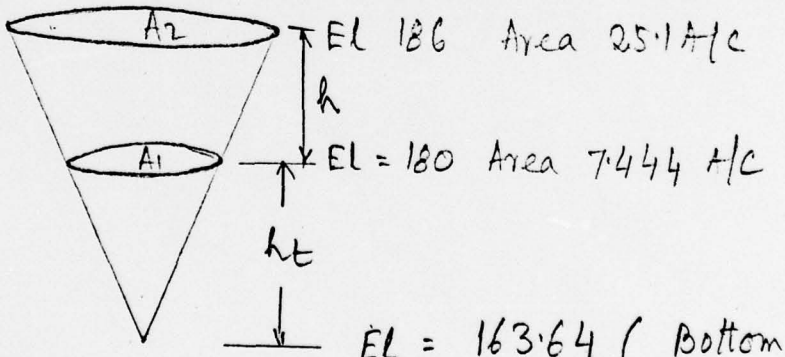
| W.S.E.L. | Discharge: Low level outlet | Discharge: Spillway OR Culvert | Discharge: Road | Total | |
|---|---|---|---|---|---|
| 166 | 19 | | | 19 | |
| 168 | 29 | | | 29 | |
| 170 | 37 | | | 37 | |
| 172 | 43 | | | 43 | |
| 174 | 48 | | | 48 | |
| 176 | 53 | | | 53 | |
| 178 | 58 | | | 58 | |
| 180 | 62 | 0 | | 62 | |
| 182 | 66 | 742 | | 808 | |
| 184 | 69 | 2100 | | 2169 | |
| 186 | 73 | 3,054 | 0 | 3127 | → spillway cap. |
| 188 | 76 | 3,221 | 4,279 | 7576 | |
| 190 | 79 | 3,380 | 12,104 | 15,563 | |
| 195 | 87 | 3,748 | 40,851 | 44,686 | |
| 200 | 94 | 4,083 | 79,256 | 83,433 | |


200
195
190
185
180
175
170
165
M.S.L.
TOP OF ROAD
SPILLWAY CREST
10
100
1,000
10,000
100,000
Q
Discharge in CFS

# Reservoir Stage Area Relations

| Elevation | Area Acres | Sq. Mi |
|---|---|---|
| 164 | 0 | 0 |
| 180 | 7.444 | .0116 |
| 186 | 25.1 | .0392 |
| 200 | 39.7 | .0620 |

(Areas are measured from U.S.G.S. Topographic Map)




$$h_t = h / \left( \sqrt{\frac{A_2}{A_1}} - 1 \right) =$$

$$= 6 / \left( \sqrt{\frac{25.1}{7.44}} - 1 \right) = 7.17$$

$180 - 7.17 \simeq 173$ which is much higher than the bottom of Dam.

So bottom of Dam is considered as zero area

# Determination of PMP

PMS

## PMP

Probable Maximum Precipitation amount from HMS Report 33

= 23" 200 sq miles - 24 hrs
(all season envelope)

Depth area - duration relationship. Percentage to be applied to the above figure.

## ZONE 6

| | |
|---|---|
| 6 hr | - 112 |
| 12 hr | = 123 |
| 24 hr | = 132 |
| 48 hr | = 143 |

## Determination of Tc

1) Estimating Tc from velocity estimate and watercourse length.

| | Slope | Vel. | Remarks |
|---|---|---|---|
| Overland flow | $\frac{600-420}{3500} = 5.14\%$ | 3.0 ft/sec | Postures (upper portion of watershed |
| Reach 1 | $\frac{420-300}{4800} = 2.5\%$ | 3.0 " | Natural channel, not well defined |
| Reach 2 | $\frac{300-180}{10,000} = 1.2\%$ | 1.5 " | Natural channel Neglect flow thro' lake |

$$Tc = \frac{3500+4800}{3 \times 3600} + \frac{10,000}{1.5 \times 3600} = 2.62 \text{ hrs.}$$

2) Esting Tc assuming same vel

$$Tc = \frac{18,300}{2 \times 3600} = 2.54 \text{ hrs.}$$

3) From Nomograph of design of Small Dam (S.C.S Guide) – Same as Kirpich

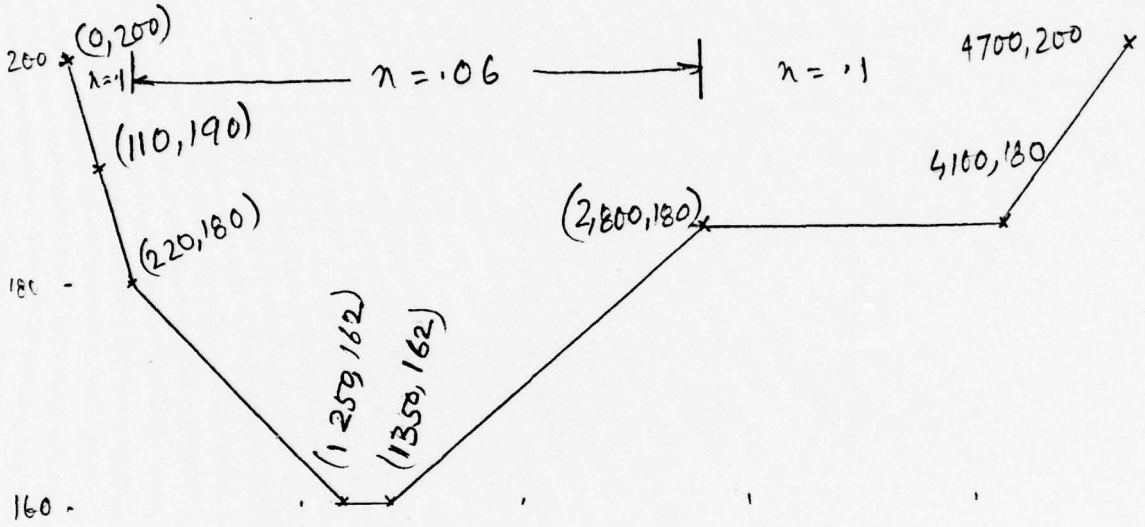
$$Tc = \left(\frac{11.9\ L^3}{H}\right)^{.385}$$

L in miles = 3.466 miles
H in Ft = 420

$= 1.06$ Hrs

Use Tc = 2.5 hrs
Lag = 0.6 Tc = 1.5 hrs.

## Cross section at D/s Reach




Reach 1, = 700 Ft

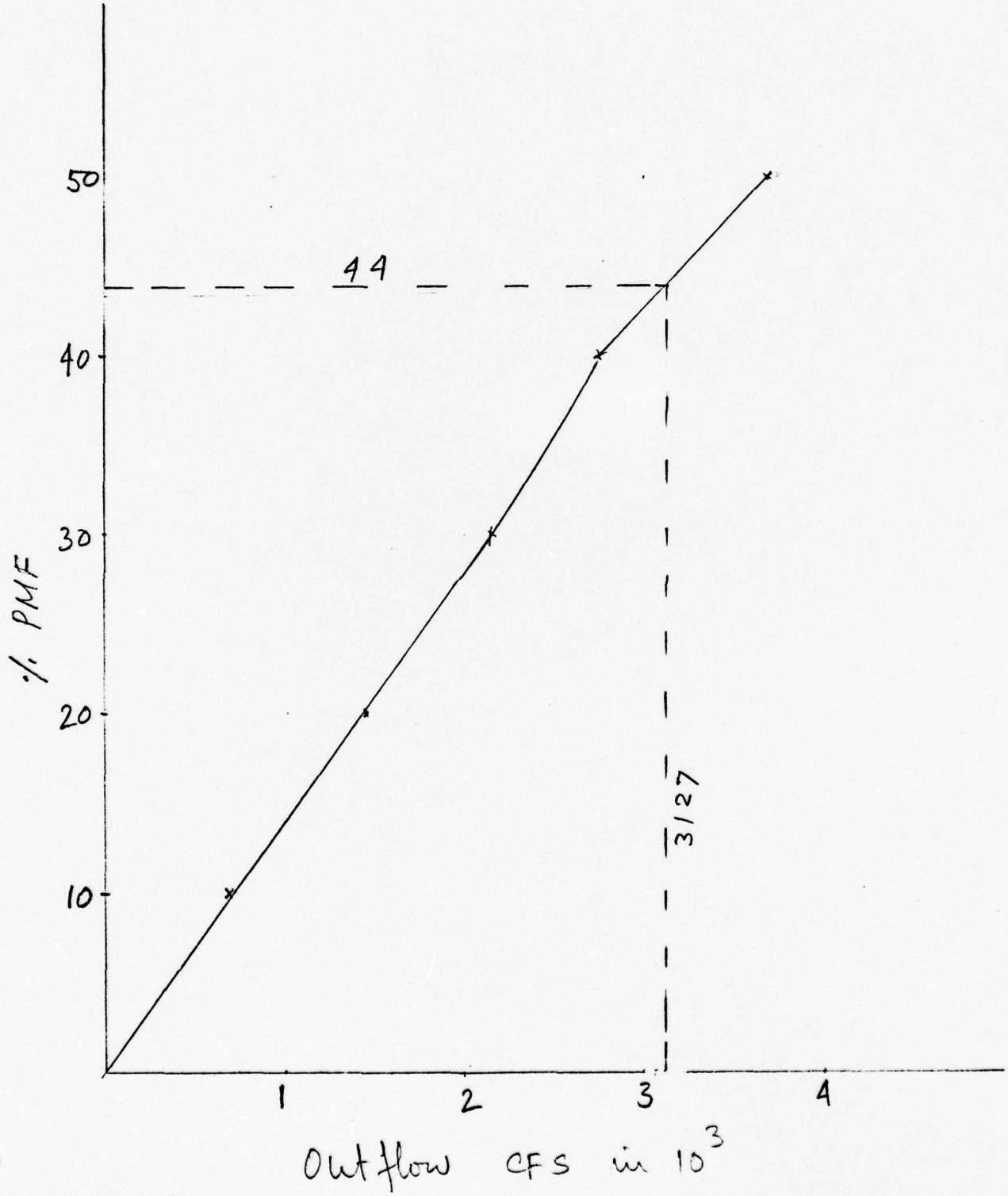
S = .0077

700 Ft D/s of the Dam is considered Hazard point

FREDERIC R. HARRIS, INC.
CONSULTING ENGINEERS

SUBJECT N.J. Dam Inspection — No Name 31
COMPUTED BY S.B. CHECKED BY
SHEET No. 13 OF 17
JOB No. 10-A20-01
DATE July, 1979

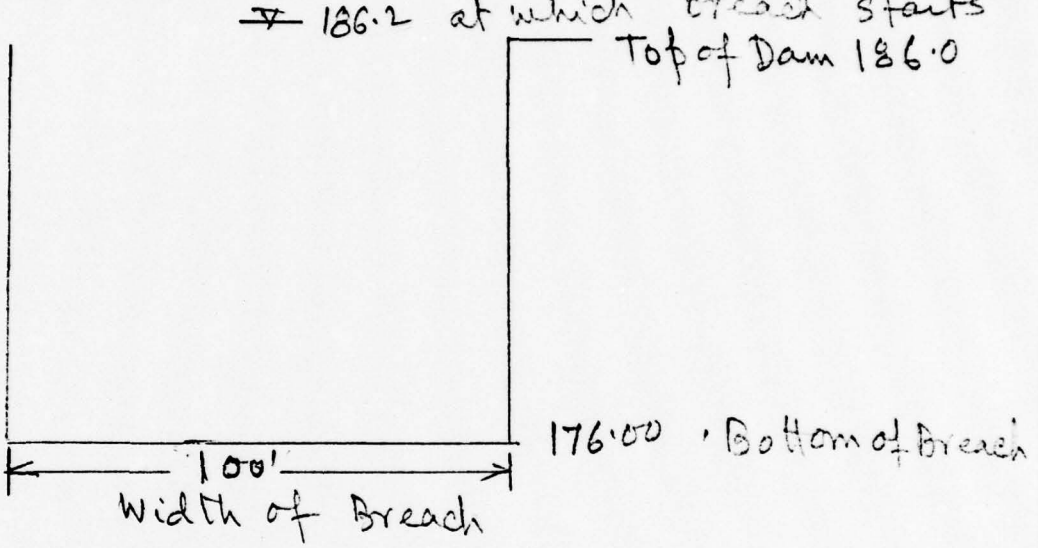
# Overtopping Potential




Overtopping of Dam occurs at El 186.00
Q = 3127 cfs (44 % of PMF)

# Breach Analysis

Assume breach begins to develop when reservoir stage reaches just above the Dam. Assumed El = 186.2 ie, 0.2 ft above the Dam.




Effect of breach was analysised 700 ft D/S of Dam

Maximum stage without Dam break = 165.3
Maximum stage with Dam break = 165.7

There will be no significant increase in stage due to dam break, and thus no significant increase in the potential loss of life.

There are about 10 occupied buildings downstream which are likely to be flooded by a stage of 165.7! "High" hazard rating is retained.

# Reservoir Evaluation

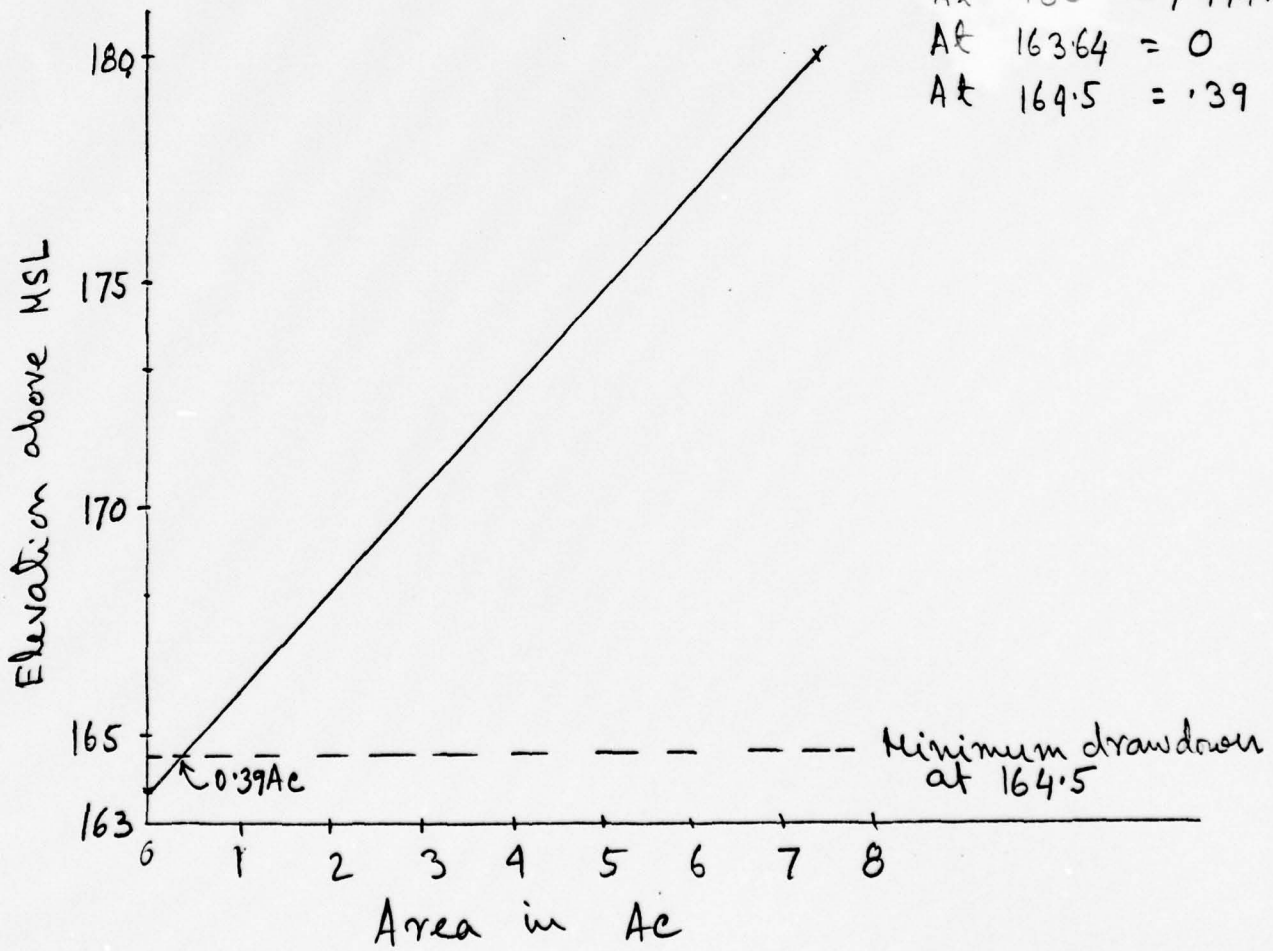
a) Discharge Vs. Head

$Q = 15.7 \sqrt{4h}$ (see page 5 of Computation sheets.)

b) Area Vs. Head

Assume a straight line relationship from normal water surface Elevation (El 180) to the streambed at ℄ of Dam (Estimated El = 163.64)

At 180 = 7.444 AC
At 163.64 = 0
At 164.5 = .39



c) Drainage area = 2.31 sq miles

Assume constant inflow = 2 cfs/sq mile

= 4.62 cfs

d) Reservoir drawdown study
Discharge vs head

| El (ft) | $\Delta h$ | Discharge $15.7\sqrt{4h}$ |
|---|---|---|
| 164.5 | 0 | 0 |
| 166 | 1.5 | 19 |
| 168 | 3.5 | 29 |
| 170 | 5.5 | 37 |
| 172 | 7.5 | 43 |
| 174 | 9.5 | 48 |
| 176 | 11.5 | 53 |
| 178 | 13.5 | 58 |
| 180 | 15.5 | 62 |

FREDERIC R. HARRIS, INC.
CONSULTING ENGINEERS

SUBJECT N.J. Dam Inspection — NO Name 31
SHEET NO. 17 OF 17
JOB NO. 10-A20-01
COMPUTED BY S.B CHECKED BY
DATE August, 79

## (E) Reservoir drawdown

| El | Area (Ac) | Av Area (Ac) | Vol (AF) * | Head on outlet h (Ft) | Outlet Q $15.7\sqrt{h}$ cfs | Time to draw $\frac{\text{Vol} \times 24}{1.98 \times Q}$ $t_1$ (hrs) | Time to draw 2cfs/SM (4.6 cfs) $\frac{4.61}{Q} \times t_1$ $t_2$ (hrs) | Total time $t_1 + t_2$ (hrs) |
|---|---|---|---|---|---|---|---|---|
| 180 | 7.444 | | | | | | | |
| | | 6.989 | 13.978 | 14.5 | 59.8 | 2.83 | .22 | 3.05 |
| 178 | 6.534 | | | | | | | |
| | | 6.079 | 12.158 | 12.5 | 55.5 | 2.66 | .22 | 2.88 |
| 176 | 5.624 | | | | | | | |
| | | 5.169 | 10.338 | 10.5 | 50.9 | 2.46 | .22 | 2.68 |
| 174 | 4.714 | | | | | | | |
| | | 4.259 | 8.518 | 8.5 | 45.8 | 2.25 | .23 | 2.48 |
| 172 | 3.804 | | | | | | | |
| | | 3.349 | 6.698 | 6.5 | 40.0 | 2.03 | .23 | 2.26 |
| 170 | 2.894 | | | | | | | |
| | | 2.439 | 4.878 | 4.5 | 33.3 | 1.78 | .25 | 2.03 |
| 168 | 1.984 | | | | | | | |
| | | 1.529 | 3.058 | 2.5 | 24.8 | 1.49 | .28 | 1.77 |
| 166 | 1.074 | | | | | | | |
| | | 0.733 | 1.100 | 0.75 | 13.6 | 0.98 | .33 | 1.31 |
| 164.5 | 0.391 | | | | | | | |
| | | | | | | 16.48 | | 18.46 |
| | | | | | | ≈ 16.5 hrs | | ≈ 18.5 hrs. |

Time of Complete drawdown with no inflow = 16.5 hrs.

Time of Complete drawdown with 2 cfs/SM = 18.5 hrs.

* N.B. These volumes were not computed by the conic method, and show variation from the HEC1-DB values. They are conservative by a factor of 50% for drawdown, which is an order of satisfactory.

HEC1-DB

COMPUTER PRINT-OUT

```
**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********************************
    1                 A1       N.J. DAM INSPECTION
    2                 A2       N.J. NO NAME NO 31 (00519)
    3                 A3       MULTIRATIO PMF ROUTING
    4                 H    100       0       15        0        0        0        0        0        0        0
    5                 B1     5
    6                 J      1       5        1
    7                 J1    .5      .4       .3       .2       .1
    8                 K      0    RES.                                      1
    9                 K1       LOCAL INFLOW
   10                 H      1       2     2.31                2.31
   11                 P      0      23      112      123      132
   12                 T                                                  1      .10              .02
   13                 W2            1.5
   14                 X     -1    -0.05        2
   15                 K      1       DAM                                 1
   16                 K1       ROUTING THROUGH DAM
   17                 Y                                1        1
   18                 Y1     1                                        -166       -1
   19                 Y4   166     168      170      172      174      176      178      180      182      184
   20                 Y4   186     188      190      195      200
   21                 Y5    19      29       37       43       48       53       58       62      808     2169
   22                 Y5  3127    7576    15563    44686    83433
   23                 $A     0   7.444     25.1     39.7
   24                 $E   164     180      186      200
   25                 $$   180
   26                 $D   186
   27                 K      1    REACH1                                 1
   28                 K1       CHANNEL ROUTING MOD. PULS. REACH 1
   29                 Y                                1        1
   30                 Y1     1
   31                 Y6    .1      .06       .1      162      180      700    .0077
   32                 Y7     0     200      110      190      220      180     1250      162     1350      162
   33                 Y7  2800     180     4100      180     4700      200
   34                 K     99
```

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT RES.
ROUTE HYDROGRAPH TO DAM
ROUTE HYDROGRAPH TO REACH1
END OF NETWORK

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

RUN  DATE# 79/08/31.
     TIME# 12.58.10.


                    N.J. DAM INSPECTION
                    N.J. NO NAME NO 31 (00519)
                    MULTIRATIO PMF ROUTING

                                JOB SPECIFICATION
          NQ      NHR     NMIN     IDAY     IHR     IMIN    METRC     IPLT     IPRT    NSTAN
         100        0       15        0       0        0        0        0        0        0
                                   JOPER      NWT   LROPT    TRACE
                                       5        0       0        0

                            MULTI-PLAN ANALYSES TO BE PERFORMED
                                NPLAN= 1 NRTIO= 5 LRTIO= 1
                  RTIOS=     .50     .40     .30     .20     .10

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

                            SUB-AREA RUNOFF COMPUTATION

                  LOCAL INFLOW

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

                                HYDROGRAPH DATA
              IHYDG     IUHG    TAREA     SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
                  1        2     2.31     0.00    2.31    0.00   0.000       0       0       0

                                PRECIP DATA
                          SPFE     PMS      R6     R12     R24     R48     R72     R96
                          0.00   23.00  112.00  123.00  132.00    0.00    0.00    0.00
TRSPC COMPUTED BY THE PROGRAM IS  .800

                                LOSS DATA
          LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
              0    0.00    0.00    1.00    0.00    0.00    1.00    1.00     .10    0.00     .02

                            UNIT HYDROGRAPH DATA
                        TC=  0.00    LAG=  1.50

                            RECESSION DATA
                        STRTQ=   -1.00    QRCSN=    -.05    RTIOR= 2.00

     UNIT HYDROGRAPH 32 END OF PERIOD ORDINATES, TC=    0.00 HOURS, LAG=   1.50  VOL= 1.00
    46.     137.     280.     470.     615.     681.     681.     624.     544.     435.
   321.     249.     192.     154.     120.      92.      72.      56.      44.      34.
    26.      20.      16.      13.      10.       8.       6.       5.       4.       3.
     2.       1.
```

| MO.DA | HR.MN | PERIOD | RAIN | EXCS | LOSS | END-OF-PERIOD FLOW COMP Q | MO.DA | HR.MN | PERIOD | RAIN | EXCS | LOSS | COMP Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.01 | .15 | 1 | .03 | .00 | .03 | 2. | 1.01 | 12.45 | 51 | .52 | .49 | .02 | 554. |
| 1.01 | .30 | 2 | .03 | .00 | .03 | 2. | 1.01 | 13.00 | 52 | .52 | .49 | .02 | 757. |
| 1.01 | .45 | 3 | .03 | .00 | .03 | 2. | 1.01 | 13.15 | 53 | .62 | .59 | .02 | 1027. |
| 1.01 | 1.00 | 4 | .03 | .00 | .03 | 2. | 1.01 | 13.30 | 54 | .62 | .59 | .02 | 1335. |
| 1.01 | 1.15 | 5 | .03 | .00 | .03 | 2. | 1.01 | 13.45 | 55 | .62 | .59 | .02 | 1658. |
| 1.01 | 1.30 | 6 | .03 | .00 | .03 | 3. | 1.01 | 14.00 | 56 | .62 | .59 | .02 | 1975. |
| 1.01 | 1.45 | 7 | .03 | .00 | .03 | 3. | 1.01 | 14.15 | 57 | .77 | .75 | .02 | 2281. |
| 1.01 | 2.00 | 8 | .03 | .00 | .03 | 3. | 1.01 | 14.30 | 58 | .77 | .75 | .02 | 2560. |
| 1.01 | 2.15 | 9 | .03 | .00 | .03 | 3. | 1.01 | 14.45 | 59 | .77 | .75 | .02 | 2812. |
| 1.01 | 2.30 | 10 | .03 | .00 | .03 | 4. | 1.01 | 15.00 | 60 | .77 | .75 | .02 | 3056. |
| 1.01 | 2.45 | 11 | .03 | .00 | .03 | 4. | 1.01 | 15.15 | 61 | .78 | .76 | .02 | 3290. |
| 1.01 | 3.00 | 12 | .03 | .00 | .03 | 4. | 1.01 | 15.30 | 62 | 1.57 | 1.54 | .02 | 3544. |
| 1.01 | 3.15 | 13 | .03 | .00 | .03 | 4. | 1.01 | 15.45 | 63 | 4.39 | 4.36 | .02 | 3975. |
| 1.01 | 3.30 | 14 | .03 | .00 | .03 | 4. | 1.01 | 16.00 | 64 | 1.10 | 1.07 | .02 | 4594. |
| 1.01 | 3.45 | 15 | .03 | .00 | .03 | 4. | 1.01 | 16.15 | 65 | .72 | .70 | .02 | 5427. |
| 1.01 | 4.00 | 16 | .03 | .00 | .03 | 4. | 1.01 | 16.30 | 66 | .72 | .70 | .02 | 6374. |
| 1.01 | 4.15 | 17 | .03 | .00 | .03 | 4. | 1.01 | 16.45 | 67 | .72 | .70 | .02 | 7079. |
| 1.01 | 4.30 | 18 | .03 | .00 | .03 | 4. | 1.01 | 17.00 | 68 | .72 | .70 | .02 | 7402. |
| 1.01 | 4.45 | 19 | .03 | .00 | .03 | 4. | 1.01 | 17.15 | 69 | .57 | .54 | .02 | 7386. |
| 1.01 | 5.00 | 20 | .03 | .00 | .03 | 4. | 1.01 | 17.30 | 70 | .57 | .54 | .02 | 7096. |
| 1.01 | 5.15 | 21 | .03 | .00 | .03 | 4. | 1.01 | 17.45 | 71 | .57 | .54 | .02 | 6654. |
| 1.01 | 5.30 | 22 | .03 | .00 | .03 | 4. | 1.01 | 18.00 | 72 | .57 | .54 | .02 | 6062. |
| 1.01 | 5.45 | 23 | .03 | .00 | .03 | 4. | 1.01 | 18.15 | 73 | .04 | .02 | .02 | 5427. |
| 1.01 | 6.00 | 24 | .03 | .00 | .03 | 4. | 1.01 | 18.30 | 74 | .04 | .02 | .02 | 4898. |
| 1.01 | 6.15 | 25 | .08 | .00 | .08 | 4. | 1.01 | 18.45 | 75 | .04 | .02 | .02 | 4382. |
| 1.01 | 6.30 | 26 | .08 | .00 | .08 | 4. | 1.01 | 19.00 | 76 | .04 | .02 | .02 | 3850. |
| 1.01 | 6.45 | 27 | .08 | .00 | .08 | 4. | 1.01 | 19.15 | 77 | .04 | .02 | .02 | 3283. |
| 1.01 | 7.00 | 28 | .08 | .00 | .08 | 5. | 1.01 | 19.30 | 78 | .04 | .02 | .02 | 2728. |
| 1.01 | 7.15 | 29 | .08 | .06 | .02 | 8. | 1.01 | 19.45 | 79 | .04 | .02 | .02 | 2222. |
| 1.01 | 7.30 | 30 | .08 | .06 | .02 | 17. | 1.01 | 20.00 | 80 | .04 | .02 | .02 | 1780. |
| 1.01 | 7.45 | 31 | .08 | .06 | .02 | 34. | 1.01 | 20.15 | 81 | .04 | .02 | .02 | 1405. |
| 1.01 | 8.00 | 32 | .08 | .06 | .02 | 62. | 1.01 | 20.30 | 82 | .04 | .02 | .02 | 1106. |
| 1.01 | 8.15 | 33 | .08 | .06 | .02 | 98. | 1.01 | 20.45 | 83 | .04 | .02 | .02 | 883. |
| 1.01 | 8.30 | 34 | .08 | .06 | .02 | 138. | 1.01 | 21.00 | 84 | .04 | .02 | .02 | 710. |
| 1.01 | 8.45 | 35 | .08 | .06 | .02 | 178. | 1.01 | 21.15 | 85 | .04 | .02 | .02 | 576. |
| 1.01 | 9.00 | 36 | .08 | .06 | .02 | 215. | 1.01 | 21.30 | 86 | .04 | .02 | .02 | 470. |
| 1.01 | 9.15 | 37 | .08 | .06 | .02 | 247. | 1.01 | 21.45 | 87 | .04 | .02 | .02 | 386. |
| 1.01 | 9.30 | 38 | .08 | .06 | .02 | 272. | 1.01 | 22.00 | 88 | .04 | .02 | .02 | 352. |
| 1.01 | 9.45 | 39 | .08 | .06 | .02 | 291. | 1.01 | 22.15 | 89 | .04 | .02 | .02 | 328. |
| 1.01 | 10.00 | 40 | .08 | .06 | .02 | 305. | 1.01 | 22.30 | 90 | .04 | .02 | .02 | 306. |
| 1.01 | 10.15 | 41 | .08 | .06 | .02 | 317. | 1.01 | 22.45 | 91 | .04 | .02 | .02 | 286. |
| 1.01 | 10.30 | 42 | .08 | .06 | .02 | 326. | 1.01 | 23.00 | 92 | .04 | .02 | .02 | 266. |
| 1.01 | 10.45 | 43 | .08 | .06 | .02 | 333. | 1.01 | 23.15 | 93 | .04 | .02 | .02 | 249. |
| 1.01 | 11.00 | 44 | .08 | .06 | .02 | 338. | 1.01 | 23.30 | 94 | .04 | .02 | .02 | 232. |
| 1.01 | 11.15 | 45 | .08 | .06 | .02 | 342. | 1.01 | 23.45 | 95 | .04 | .02 | .02 | 216. |
| 1.01 | 11.30 | 46 | .08 | .06 | .02 | 346. | 1.02 | 0.00 | 96 | .04 | .02 | .02 | 202. |
| 1.01 | 11.45 | 47 | .08 | .06 | .02 | 348. | 1.02 | .15 | 97 | 0.00 | 0.00 | 0.00 | 188. |
| 1.01 | 12.00 | 48 | .08 | .06 | .02 | 350. | 1.02 | .30 | 98 | 0.00 | 0.00 | 0.00 | 176. |
| 1.01 | 12.15 | 49 | .52 | .49 | .02 | 372. | 1.02 | .45 | 99 | 0.00 | 0.00 | 0.00 | 164. |
| 1.01 | 12.30 | 50 | .52 | .49 | .02 | 432. | 1.02 | 1.00 | 100 | 0.00 | 0.00 | 0.00 | 153. |
| | | | | | | | | | SUM | 24.29 | 21.64 | 2.65 | 129590. |
| | | | | | | | | | | ( 617.) | ( 550.) | ( 67.) | ( 3669.58) |

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 7402. | 4511. | 1349. | 1295. | 129507. |
| CMS | 210. | 128. | 38. | 37. | 3667. |
| INCHES | | 18.16 | 21.73 | 21.73 | 21.73 |
| MM | | 461.39 | 551.92 | 551.95 | 551.95 |
| AC-FT | | 2237. | 2676. | 2676. | 2676. |
| THOUS CU M | | 2759. | 3300. | 3301. | 3301. |

HYDROGRAPH AT STA RES. FOR PLAN 1, RTIO 1

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

| OPERATION | STATION | AREA | PLAN | RATIOS APPLIED TO FLOWS RATIO 1 .50 | RATIO 2 .40 | RATIO 3 .30 | RATIO 4 .20 | RATIO 5 .10 |
|---|---|---|---|---|---|---|---|---|
| HYDROGRAPH AT | RES. | 2.31 | 1 | 3701. | 2961. | 2221. | 1480. | 740. |
| | | ( 5.98) | | ( 104.80)( | 83.84)( | 62.88)( | 41.92)( | 20.96)( |
| ROUTED TO | DAM | 2.31 | 1 | 3636. | 2786. | 2160. | 1448. | 713. |
| | | ( 5.98) | | ( 102.97)( | 78.90)( | 61.16)( | 40.99)( | 20.20)( |
| ROUTED TO | REACH1 | 2.31 | 1 | 3681. | 2780. | 2161. | 1450. | 712. |
| | | ( 5.98) | | ( 104.25)( | 78.72)( | 61.21)( | 41.07)( | 20.17)( |

## SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

| | INITIAL VALUE | SPILLWAY CREST | TOP OF DAM |
|---|---|---|---|
| ELEVATION | 166.00 | 180.00 | 186.00 |
| STORAGE | 0. | 40. | 132. |
| OUTFLOW | 19. | 62. | 3127. |

| RATIO OF PMF | MAXIMUM RESERVOIR W.S.ELEV | MAXIMUM DEPTH OVER DAM | MAXIMUM STORAGE AC-FT | MAXIMUM OUTFLOW CFS | DURATION OVER TOP HOURS | TIME OF MAX OUTFLOW HOURS | TIME OF FAILURE HOURS |
|---|---|---|---|---|---|---|---|
| .50 | 186.23 | .23 | 138. | 3636. | 1.00 | 17.25 | 0.00 |
| .40 | 185.29 | 0.00 | 115. | 2786. | 0.00 | 17.50 | 0.00 |
| .30 | 183.99 | 0.00 | 89. | 2160. | 0.00 | 17.50 | 0.00 |
| .20 | 182.94 | 0.00 | 72. | 1448. | 0.00 | 17.50 | 0.00 |
| .10 | 181.75 | 0.00 | 56. | 713. | 0.00 | 17.50 | 0.00 |

PLAN 1 STATION REACH1

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .50 | 3681. | 165.3 | 17.50 |
| .40 | 2780. | 164.9 | 17.75 |
| .30 | 2161. | 164.6 | 17.50 |
| .20 | 1450. | 164.1 | 17.50 |
| .10 | 712. | 163.5 | 17.50 |

**********

HEC-1 FLOOD HYDROGRAPH PACKAGE (HEC-1)
JULY 1978
LAST MODIFICATION 26 FEB 79

DAM BREAK ANALYSIS

```
     1  A1       N.J. DAM INSPECTION
     2  A2       N.J. NO NAME NO 31 (00519)
     3  A3       MULTIRATIO PMF ROUTING
     4  B    100       0      15       0       0       0       0       0       0       0
     5  B1     5
     6  J      1       1       1
     7  J1    .5
     8  K      0   RES.                                                1
     9  K1       LOCAL INFLOW
    10  M      1       2    2.31            2.31
    11  P      0      23     112     123     132
    12  T                                                  1     .10             .02
    13  W2           1.5
    14  X     -1   -0.05       2
    15  K      1     DAM                                           1
    16  K1       ROUTING THROUGH DAM
    17  Y                                  1       1
    18  Y1     1                                           -166      -1
    19  Y4   166     168     170     172     174     176     178     180     182     184
    20  Y4   186     188     190     195     200
    21  Y5    19      29      37      43      48      53      58      62     808    2169
    22  Y5  3127    7576   15563   44686   83433
    23  $A     0   7.444    25.1    39.7
    24  $E   164     180     186     200
    25  $$   180
    26  $D   186
    27  $B   100       0     176       1     166   186.2
    28  K      1  REACH1                                          1
    29  K1       CHANNEL ROUTING MOD. PULS. REACH 1
    30  Y                                  1       1
    31  Y1     1
    32  Y6    .1     .05      .1     162     180     700   .0077
    33  Y7     0     200     110     190     220     180    1250     162    1350     162
    34  Y7  2800     180    4100     180    4700     200
    35  K     99
```

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT RES.
ROUTE HYDROGRAPH TO DAM
ROUTE HYDROGRAPH TO REACH1
END OF NETWORK

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

RUN  DATE= 79/08/31.
     TIME= 13.12.05.


                    N.J. DAM INSPECTION
                    N.J. NO NAME NO 31 (00519)
                    MULTIRATIO PMF ROUTING, DAM BREAK ANALYSIS

                                JOB SPECIFICATION
      NQ      NHR     NMIN     IDAY      IHR     IMIN    METRC     IPLT     IPRT    NSTAN
     100        0       15        0        0        0        0        0        0        0
                                JOPER      NWT   LROPT    TRACE
                                    5        0        0        0


                          MULTI-PLAN ANALYSES TO BE PERFORMED
                              NPLAN= 1 NRTIO= 1 LRTIO= 1
                RTIOS=    .50

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

                          SUB-AREA RUNOFF COMPUTATION

                LOCAL INFLOW

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

                                HYDROGRAPH DATA
          IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
              1       2    2.31    0.00    2.31    0.00   0.000       0       0       0

                                PRECIP DATA
                SPFE     PMS      R6     R12     R24     R48     R72     R96
                0.00   23.00  112.00  123.00  132.00    0.00    0.00    0.00
TRSPC COMPUTED BY THE PROGRAM IS  .800

                                LOSS DATA
      LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
          0    0.00    0.00    1.00    0.00    0.00    1.00    1.00     .10    0.00     .02

                            UNIT HYDROGRAPH DATA
                        TC=  0.00    LAG=  1.50

                            RECESSION DATA
                    STRTQ=   -1.00    QRCSN=    -.05    RTIOR= 2.00

    UNIT HYDROGRAPH 32 END OF PERIOD ORDINATES, TC=    0.00 HOURS, LAG=   1.50  VOL= 1.00
  46.     137.     280.     470.     615.     681.     681.     624.     544.     435.
 321.     249.     192.     154.     120.      92.      72.      56.      44.      34.
  26.      20.      16.      13.      10.       8.       6.       5.       4.       3.
   2.       1.
```

| O MO.DA | HR.MN | PERIOD | RAIN | EXCS | LOSS | END-OF-PERIOD FLOW COMP Q | MO.DA | HR.MN | PERIOD | RAIN | EXCS | LOSS | COMP Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.01 | .15 | 1 | .03 | .00 | .03 | 2. | 1.01 | 12.45 | 51 | .52 | .49 | .02 | 554. |
| 1.01 | .30 | 2 | .03 | .00 | .03 | 2. | 1.01 | 13.00 | 52 | .52 | .49 | .02 | 757. |
| 1.01 | .45 | 3 | .03 | .00 | .03 | 2. | 1.01 | 13.15 | 53 | .62 | .59 | .02 | 1027. |
| 1.01 | 1.00 | 4 | .03 | .00 | .03 | 2. | 1.01 | 13.30 | 54 | .62 | .59 | .02 | 1335. |
| 1.01 | 1.15 | 5 | .03 | .00 | .03 | 2. | 1.01 | 13.45 | 55 | .62 | .59 | .02 | 1658. |
| 1.01 | 1.30 | 6 | .03 | .00 | .03 | 3. | 1.01 | 14.00 | 56 | .62 | .59 | .02 | 1975. |
| 1.01 | 1.45 | 7 | .03 | .00 | .03 | 3. | 1.01 | 14.15 | 57 | .77 | .75 | .02 | 2281. |
| 1.01 | 2.00 | 8 | .03 | .00 | .03 | 3. | 1.01 | 14.30 | 58 | .77 | .75 | .02 | 2560. |
| 1.01 | 2.15 | 9 | .03 | .00 | .03 | 3. | 1.01 | 14.45 | 59 | .77 | .75 | .02 | 2812. |
| 1.01 | 2.30 | 10 | .03 | .00 | .03 | 4. | 1.01 | 15.00 | 60 | .77 | .75 | .02 | 3056. |
| 1.01 | 2.45 | 11 | .03 | .00 | .03 | 4. | 1.01 | 15.15 | 61 | .78 | .76 | .02 | 3290. |
| 1.01 | 3.00 | 12 | .03 | .00 | .03 | 4. | 1.01 | 15.30 | 62 | 1.57 | 1.54 | .02 | 3544. |
| 1.01 | 3.15 | 13 | .03 | .00 | .03 | 4. | 1.01 | 15.45 | 63 | 4.39 | 4.36 | .02 | 3975. |
| 1.01 | 3.30 | 14 | .03 | .00 | .03 | 4. | 1.01 | 16.00 | 64 | 1.10 | 1.07 | .02 | 4594. |
| 1.01 | 3.45 | 15 | .03 | .00 | .03 | 4. | 1.01 | 16.15 | 65 | .72 | .70 | .02 | 5427. |
| 1.01 | 4.00 | 16 | .03 | .00 | .03 | 4. | 1.01 | 16.30 | 66 | .72 | .70 | .02 | 6374. |
| 1.01 | 4.15 | 17 | .03 | .00 | .03 | 4. | 1.01 | 16.45 | 67 | .72 | .70 | .02 | 7079. |
| 1.01 | 4.30 | 18 | .03 | .00 | .03 | 4. | 1.01 | 17.00 | 68 | .72 | .70 | .02 | 7402. |
| 1.01 | 4.45 | 19 | .03 | .00 | .03 | 4. | 1.01 | 17.15 | 69 | .57 | .54 | .02 | 7386. |
| 1.01 | 5.00 | 20 | .03 | .00 | .03 | 4. | 1.01 | 17.30 | 70 | .57 | .54 | .02 | 7096. |
| 1.01 | 5.15 | 21 | .03 | .00 | .03 | 4. | 1.01 | 17.45 | 71 | .57 | .54 | .02 | 6654. |
| 1.01 | 5.30 | 22 | .03 | .00 | .03 | 4. | 1.01 | 18.00 | 72 | .57 | .54 | .02 | 6062. |
| 1.01 | 5.45 | 23 | .03 | .00 | .03 | 4. | 1.01 | 18.15 | 73 | .04 | .02 | .02 | 5427. |
| 1.01 | 6.00 | 24 | .03 | .00 | .03 | 4. | 1.01 | 18.30 | 74 | .04 | .02 | .02 | 4898. |
| 1.01 | 6.15 | 25 | .08 | .00 | .08 | 4. | 1.01 | 18.45 | 75 | .04 | .02 | .02 | 4382. |
| 1.01 | 6.30 | 26 | .08 | .00 | .08 | 4. | 1.01 | 19.00 | 76 | .04 | .02 | .02 | 3850. |
| 1.01 | 6.45 | 27 | .08 | .00 | .08 | 4. | 1.01 | 19.15 | 77 | .04 | .02 | .02 | 3283. |
| 1.01 | 7.00 | 28 | .08 | .00 | .08 | 5. | 1.01 | 19.30 | 78 | .04 | .02 | .02 | 2728. |
| 1.01 | 7.15 | 29 | .08 | .06 | .02 | 8. | 1.01 | 19.45 | 79 | .04 | .02 | .02 | 2222. |
| 1.01 | 7.30 | 30 | .08 | .06 | .02 | 17. | 1.01 | 20.00 | 80 | .04 | .02 | .02 | 1780. |
| 1.01 | 7.45 | 31 | .08 | .06 | .02 | 34. | 1.01 | 20.15 | 81 | .04 | .02 | .02 | 1405. |
| 1.01 | 8.00 | 32 | .08 | .06 | .02 | 62. | 1.01 | 20.30 | 82 | .04 | .02 | .02 | 1106. |
| 1.01 | 8.15 | 33 | .08 | .06 | .02 | 98. | 1.01 | 20.45 | 83 | .04 | .02 | .02 | 883. |
| 1.01 | 8.30 | 34 | .08 | .06 | .02 | 138. | 1.01 | 21.00 | 84 | .04 | .02 | .02 | 710. |
| 1.01 | 8.45 | 35 | .08 | .06 | .02 | 178. | 1.01 | 21.15 | 85 | .04 | .02 | .02 | 576. |
| 1.01 | 9.00 | 36 | .08 | .06 | .02 | 215. | 1.01 | 21.30 | 86 | .04 | .02 | .02 | 470. |
| 1.01 | 9.15 | 37 | .08 | .06 | .02 | 247. | 1.01 | 21.45 | 87 | .04 | .02 | .02 | 386. |
| 1.01 | 9.30 | 38 | .08 | .06 | .02 | 272. | 1.01 | 22.00 | 88 | .04 | .02 | .02 | 352. |
| 1.01 | 9.45 | 39 | .08 | .06 | .02 | 291. | 1.01 | 22.15 | 89 | .04 | .02 | .02 | 328. |
| 1.01 | 10.00 | 40 | .08 | .06 | .02 | 305. | 1.01 | 22.30 | 90 | .04 | .02 | .02 | 306. |
| 1.01 | 10.15 | 41 | .08 | .06 | .02 | 317. | 1.01 | 22.45 | 91 | .04 | .02 | .02 | 286. |
| 1.01 | 10.30 | 42 | .08 | .06 | .02 | 326. | 1.01 | 23.00 | 92 | .04 | .02 | .02 | 266. |
| 1.01 | 10.45 | 43 | .08 | .06 | .02 | 333. | 1.01 | 23.15 | 93 | .04 | .02 | .02 | 249. |
| 1.01 | 11.00 | 44 | .08 | .06 | .02 | 338. | 1.01 | 23.30 | 94 | .04 | .02 | .02 | 232. |
| 1.01 | 11.15 | 45 | .08 | .06 | .02 | 342. | 1.01 | 23.45 | 95 | .04 | .02 | .02 | 216. |
| 1.01 | 11.30 | 46 | .08 | .06 | .02 | 346. | 1.02 | 0.00 | 96 | .04 | .02 | .02 | 202. |
| 1.01 | 11.45 | 47 | .08 | .06 | .02 | 348. | 1.02 | .15 | 97 | 0.00 | 0.00 | 0.00 | 188. |
| 1.01 | 12.00 | 48 | .08 | .06 | .02 | 350. | 1.02 | .30 | 98 | 0.00 | 0.00 | 0.00 | 176. |
| 1.01 | 12.15 | 49 | .52 | .49 | .02 | 372. | 1.02 | .45 | 99 | 0.00 | 0.00 | 0.00 | 164. |
| 1.01 | 12.30 | 50 | .52 | .49 | .02 | 432. | 1.02 | 1.00 | 100 | 0.00 | 0.00 | 0.00 | 153. |
| | | | | | | | | | SUM | 24.29 | 21.64 | 2.65 | 129590. |
| | | | | | | | | | | ( 617.) | ( 550.) | ( 67.) | ( 3669.58) |

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 7402. | 4511. | 1349. | 1295. | 129507. |
| CMS | 210. | 128. | 38. | 37. | 3667. |
| INCHES | | 18.16 | 21.73 | 21.73 | 21.73 |
| MM | | 461.39 | 551.92 | 551.95 | 551.95 |
| AC-FT | | 2237. | 2676. | 2676. | 2676. |
| THOUS CU M | | 2759. | 3300. | 3301. | 3301. |

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

| OPERATION | STATION | AREA | PLAN | RATIO 1 .50 |
|---|---|---|---|---|
| HYDROGRAPH AT | RES. | 2.31 | 1 | 3701. |
| | | ( 5.98) | | ( 104.80)( |
| ROUTED TO | DAM | 2.31 | 1 | 4885. |
| | | ( 5.98) | | ( 138.31)( |
| ROUTED TO | REACH1 | 2.31 | 1 | 4782. |
| | | ( 5.98) | | ( 135.41)( |

RATIOS APPLIED TO FLOWS

## SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

| | INITIAL VALUE | SPILLWAY CREST | TOP OF DAM |
|---|---|---|---|
| ELEVATION | 166.00 | 180.00 | 186.00 |
| STORAGE | 0. | 40. | 132. |
| OUTFLOW | 19. | 62. | 3127. |

| RATIO OF PMF | MAXIMUM RESERVOIR W.S.ELEV | MAXIMUM DEPTH OVER DAM | MAXIMUM STORAGE AC-FT | MAXIMUM OUTFLOW CFS | DURATION OVER TOP HOURS | TIME OF MAX OUTFLOW HOURS | TIME OF FAILURE HOURS |
|---|---|---|---|---|---|---|---|
| .50 | 186.23 | .23 | 138. | 4892. | .46 | 17.79 | 17.25 |

PLAN 1 STATION REACH1

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .50 | 4782. | 165.7 | 17.75 |