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METEDECONK RIVER BASIN

SOUTH BRANCH METEDECONK RIVER, OCEAN COUNTY

NEW JERSEY

BENNETTS MILLS DAM

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

NJ00088

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

JULY 1978

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

IN REPLY REFER TO
NAPEN-D

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

29 AUG 1978

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Bennett's Mills Dam in Ocean 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 on the first three pages of the report.

Based on visual inspection, available records, calculations and past operational performance, Bennett's Mills Dam is judged to be in fair overall condition. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. Engineering investigations and studies should be made, by a qualified professional consultant engaged by the owner, to more accurately determine the dam's stability, especially with regard to seepage, phreatic levels and soil properties, within twelve months from the date of approval of this report. Any remedial actions found necessary as a result of these investigations and studies should be initiated in calendar year 1979.

b. While the spillway appears adequate for a "Low Hazard Potential" dam using Corps of Engineers screening criteria for the initial study, the actual capacity of the spillway should be determined using more precise and sophisticated methods and procedures. This hydraulic and hydrologic study should be completed within twelve months from the date of approval of this report. In the event the further spillway capacity study indicates the need for increased hydraulic capacity, such remedial work should be initiated in calendar year 1979.

c. The following remedial actions should be completed within six months from the date of approval of this report.

NAPEN-D
Honorable Brendan T. Byrne

(1) Restore the low level outlet gate to operating condition.

(2) Clear the downstream slope and the toe area of all vegetative growth and replace this growth with grass or other suitable ground cover. Also, the vegetative growth on the upstream slope should be controlled to prevent erosion.

(3) Regrade the downstream toe area of the embankment to provide positive drainage.

(4) Repair and stabilize the eroded downstream embankment areas in the vicinity of the highway bridge.

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 Edwin B. Forsythe of the Sixth District. Under the provisions of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, thirty days after the date of this letter.

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

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 yours,

James G. Ton

1 Incl
As stated

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

Cy furn:
Mr. Dirk C. Hofman, P.E.
Department of Environmental Protection

.CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

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APPROVED: James G. Ton
JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 29 Aug 78

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Bennett's Mills Dam, I.D. NJ 00088
State Located:	New Jersey
County Located:	Ocean
Stream:	South Branch, Metedeconk River
Date of Inspection:	May 8, 1978

Assessment of General Condition of Dam with respect to Safety and Recommended Action with Degree of Urgency

Bennett's Mills Dam has a seriously inadequate spillway capacity for its present "High Hazard Potential" classification. It would have an adequate capacity if the classification were revised to "Low Hazard Potential". Based upon the findings listed in Section 1.2.d., it is recommended that this dam be reclassified from "High Hazard Potential" to "Low Hazard Potential"

The spillway capacity was determined by the Corps of Engineers screening criteria. The actual capacity of the spillway should be determined by the owner using more precise and sophisticated methods and procedures. The stability of the spillway structure is questionable until further data can be acquired to make a definitive assessment. A time frame of 12 months for such data acquisition is recommended. The stability of the embankment section is also in question, since it currently exhibits seepage and high phreatic water levels. A program of data acquisition within 12 months is recommended to resolve uncertainties.

Among actions that can be taken within 6 months to improve the safety of the dam are:

1. Restoration of the operation of the low level outlet gate from dry land during storm events.

2. Control of vegetation on and adjacent to the embankment slopes.

3. Repair of eroded embankment areas at the downstream bridge abutments.

4. Regarding of the area at the downstream toe of the embankment to provide positive drainage to the river channels.

5. Regrading and recompaction of downstream face of embankment, addition of materials to widen embankment sufficiently to keep phreatic surface from intersecting downstream face.

Robert Gershowitz, P.E.

Robert Gershowitz, P.E.

May 1978

B E N N E T T ' S M I L L S D A M

SPILLWAY STRUCTURE UPSTREAM OF BENNETT'S MILLS ROAD EMBANKMENT

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ASSESSMENT OF GENERAL CONDITION OF DAM WITH RESPECT TO SAFETY AND RECOMMENDED ACTION WITH DEGREE OF URGENCY

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PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

BENNETT'S MILLS DAM, I.D. NJ 00088

SECTION 1

1. PROJECT INFORMATION

1.1 General

a. Authority

The Dam Inspection Act, Public Law 92-367 of August 1972 authorizes the Secretary of the Army, through the Corps of Engineers to initiate a program of safety inspections. The inspection of Bennett's Mills Dam was carried out under Contract DACW61-78-C-0100 to the Department of the Army, Philadelphia District, Corps of Engineers by the engineering firm of Harris-ECI Associates of Woodbridge, New Jersey.

b. Purpose of Inspection

The purpose of the inspection and evaluation is to identify conditions which threaten the public safety and thus permit the correction of the conditions in a timely manner by the owner. The National Inventory of Dams will be updated by the data acquired during the inspection.

1.2 Description of Project

a. Description of Dam and Appurtenances

Bennett's Mills Dam consists of a semi-circular concrete spillway and outlet channel structure built in back of an existing Ocean County roadway embankment crossing the South Branch of the Metedeconk River. The spillway structure is constructed of reinforced concrete and is of cantilever design with a rounded crest. The spillway is founded on a

concrete footing and floor mat, which in turn is supported on vertical and battered timber piles. The subgrade consists of sandy soils underlain by hardpan, clay, and gravel. A short rectangular concrete outlet channel connects the spillway weir section to the upstream face of the roadway embankment and timber bridge passing over the river channel. The outlet channel is crossbraced at its top by two reinforced concrete struts to resist hydraulic and earth lateral pressures. The outlet channel walls are also supported on concrete footings and vertical and battered timber piles. The reservoir cutoff consists of steel sheet piling driven down to elevation 47.0 MSL, and follows the spillway and outlet channel wall perimeter, connecting into the upstream face of the embankment. A short timber wall section connects the downstream face of the concrete spillway outlet channel to the timber abutment of the Bennett's Mills Road bridge crossing the river.

The bridge abutments are constructed using vertical timber piles backed by wood sheeting. The center pier bent is of timber pile construction. The superstructure beams are steel. The downstream wingwalls of the bridge are also of vertical timber pile construction and are wood sheeted to retain the roadway fill.

The dam embankment is the Bennett's Mills roadway embankment crossing the stream at this location. The two-lane roadway has a black top surfacing and narrow shoulders. The left abutment embankment meets high ground a short distance to the left of the bridge, but the right abutment is considerably longer. The embankment is generally unprotected except at the downstream timber bridge wingwalls where the area is topped by bituminous paving in deteriorated condition. The upstream embankment has a considerable growth of brush between the roadway and pond surfaces. The downstream areas of the embankment are heavily vegetated and poorly graded for drainage.

The impounded pond is shallow and covers approximately 32 acres. Its banks are moderately sloping to flat and adjoined by lake side properties. The downstream river channel is meandering and heavily lined with vegetation. There are no residential developments in the immediate downstream reach, but a subdivision has been built on higher ground of the left bank, some 2,500 feet downstream of the dam axis. The downstream area has been increasingly developed over the last 10 years.

b. Location

Bennett's Mills Dam is located on the South Branch of the Metedeconk River at Bennett's Mills in Jackson Township, Ocean County, New Jersey. The Metedeconk River Basin is a small independent river basin draining into Barnegat Bay.

c. Size Classification

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

d. Hazard Classification

In the National Inventory of Dams, Bennett's Mills Dam has been classified as having "High Hazard Potential" on the basis that in the event of failure of the dam and its appurtenances, excessive damage could occur to downstream property together with the possibility of the loss of more than a few lives. Visual inspection of the dam leads to the conclusion that this dam should be classified as having "Low Hazard Potential" on the basis that there is no development for a half mile downstream of the dam axis, the impounded volume of water is very low, and the dam height also is low. In the event of a complete

dam failure, the resultant surge of water would be significantly reduced in the low wooded overbank area of the meandering river channel and would not be a threat to property or lives.

e. Ownership

Bennett's Mills Dam is owned by Mr. Edward Enno, residing at Bennett's Mills Road, Jackson, New Jersey, adjacent to the dam. Mr. Enno's ownership, as we understand it, extends only to the spillway and outlet channel upstream of the roadway embankment. The Bennett's Mills Road embankment and timber bridge crossing the South Branch of the Metedeconk are owned by Ocean County. According to Mr. Enno, he intends to turn over the spillway facility to Ocean County by the process of non-payment of taxes, but this action has not taken place as yet. Although Mr. Enno was the owner of record at the time of inspection, he was not present at the inspection.

f. Purpose of Dam

The dam is operated as a recreation facility in connection with lake side real estate development. Due to pollution of the waters, the pond is not currently in use.

g. Design and Construction History

The spillway and outlet channel structure were designed in 1948 by Bruce Larrabee, P.E. of Toms River, New Jersey, and was constructed in the same year, according to records available from the New Jersey Department of Environmental Protection (NJ-DEP) files. A small dam had existed downstream of the site dating to 1928. No data was recovered in regard to the roadway embankment except that it existed at the time the spillway was built and has no special features to retain water. The timber bridge now existing at the site was rebuilt in connection with the spillway structure and is very similar in appearance to the previous bridge shown on a photograph in the NJ-DEP files taken in 1932.

The spillway and outlet channel were designed to be independently stable and no thrust from these structures is transferred to the bridge abutments or embankment. The timber piles were driven to refusal in the hardpan stratum to a depth of 12 feet below pile cutoff. The steel sheet piling was driven to a 9-foot depth with the aid of a 1,000-ft.-pound steam hammer. The organic materials at the structure were removed down to non-organic material and was replaced with clean washed sand. The construction phase was under the supervision of the NJ-DEP's predecessor agency of the time.

After completion of the spillway, the resulting lake depth was too shallow for the owner's intended purposes and he applied to the NJ-DEP in 1949 to have the dam crest raised by one foot, to elevation 66. This request was granted and the work was accomplished in that year.

h. Normal Operating Procedures

The normal operating procedure is to allow the stream water to flow over the weir, keeping the low level outlet closed. The low level outlet is practically inaccessible and is not opened during rain storms. The low level outlet could be used to draw-down the water level in the reservoir for reservoir dredging purposes or inspection, and has been used that way in the past year.

1.3 Pertinent Data

a. Drainage Areas

At dam axis, drainage area is 18.4 square miles.

b. Discharge at Dam Site

Maximum known flood at dam site:	No information available or uncovered
Warm water outlet at pool elevation:	NA
Diversion tunnel low pool outlet at pool elevation:	NA
Diversion tunnel outlet at pool elevation:	NA
Gated spillway capacity at pool elevation:	NA
Gated spillway capacity at maximum pool elevation:	NA
Ungated spillway capacity at maximum pool elevation:	1,030 cfs
Total spillway capacity at maximum pool elevation	1,030 cfs

c. Elevation (feet above MSL)

Top dam:	70.3
Maximum pool design surcharge:	3 feet
Full flood control pool:	NA
Recreation pool:	66.0
Spillway crest:	66.0
Upstream portal invert diversion tunnel:	NA
Downstream portal invert diversion tunnel:	NA
Streambed at centerline of dam:	54.5
Maximum tailwater:	No information available

d. Reservoir

Length of maximum pool:	6,200 feet
Length of recreation pool:	3,600 feet
Length of flood control pool:	NA

e. Storage (acre-feet)

Recreation pool:	60
Flood control pool:	NA
Design surcharge:	170
Top of dam:	240

f. Reservoir Surface (acres)

Top dam:	61
Maximum pool:	59
Flood-control pool:	NA
Recreation pool:	32
Spillway crest:	32

g. Dam

Type:	Earth roadway embankment, with concrete spillway
Length:	350 feet
Height:	15.8 feet
Top width:	30 feet
Side slopes - Upstream:	Estimated at 1V on 2H
- Downstream:	" 1V on 2H
Zoning:	Unknown
Impervious core:	Unknown
Cutoff:	Unknown (believe none)
Grout curtain:	None

h. Diversion and Regulating Tunnel

Type:	NA
Length:	NA
Closure:	NA
Access:	NA
Regulating facilities	NA

i. Spillway

Type:	Circular concrete weir on timber piles
Length:	60.3 feet
Crest elevation:	66.0
Gates:	None
U/S Channel:	None
D/S Channel:	Rectangular with concrete invert and side walls connecting spillway to upstream face of roadway embankment

j. Regulating Outlets

Low level outlet:	42-inch pipe passing through spillway weir wall
Controls:	42-inch slide gate valve face mounted on reservoir side of spillway weir wall
Emergency gate:	None
Outlet:	42-inch diameter pipe ending in the area within the semi-circular crest

SECTION 2

2. ENGINEERING DATA

2.1 Design

A full set of contract drawing were available in the files of the New Jersey Department of Environmental Protection (NJ-DEP) relating to the spillway and downstream outlet channel located upstream of the roadway embankment and bridge. The drawings are detailed as far as the original spillway crest height is concerned and are marked up to show the subsequent raising of the crest by one foot. The boring logs of the test borings made at the site are shown on one of the contract drawings together with the details of the steel sheet piling cutoff and timber piles.

No drawings were uncovered in regard to the roadway embankment being used for water impounding purposes or the timber spillway bridge. The spillway structure was approved by the NJ-DEP to pass 1,000 cfs based on a drainage area of 18.4 square mile and unit spillway design inflow of 54.3 cubic feet per square mile (South New Jersey curves).

The spillway is rated at 1,030 cfs at a head of 3 feet leaving a freeboard of 1.3 feet to the top of the roadway embankment at the dam. This freeboard may vary and become less since the roadway is on a descending grade atthe river crossing.

No data on stability computations were uncovered except for a statement that the spillway and outlet channel structure were designed to be independently stable and not transfer any loads to the roadway embankment or the bridge. No data has been uncovered on the roadway embankment or the timber bridge crossing the river.

2.2 Construction

Data pertaining to construction was found in the inspection reports of the NJ-DEP. The dam foundation area was cleaned of overlying organic materials and replaced by clean sand to the underside of the spillway footings. The timber pile foundations were driven to refusal into the hardpan layer at the dam site. Pile penetration was recorded at 12 feet. The steel sheet pile cutoff was driven to a depth of 9 feet. No data on the roadway embankment was available.

2.3 Operation

The dam has been operated as a simple overflow facility. No regulation of the pond surface is attempted by use of the low level outlet.

2.4 Evaluation

a. Availability

Insufficient data is available in regard to the spillway and outlet channel structure to determine its safety. No data has been acquired on which to base an assessment of safety in regard to the embankment.

b. Adequacy

The data available on the spillway structure is considered inadequate. The data relating to the roadway embankment is considered inadequate. Additional information required includes:

1. Detailed plans of the bridge and downstream channel to allow the establishment of a tail-water rating curve.

2. Detailed as-built survey of the embankment including a roadway profile and cross sections at the spillway and at 100-foot intervals.

3. Borings of the embankment to determine its engineering properties.

4. Topographic information on the downstream side of the dam relating to achieving proper surface drainage of this area.

c. Validity

The validity of data acquired on the spillway structure is not challenged. The spillway structure as seen on the site corresponds to the plans available.

SECTION 3

3. VISUAL INSPECTION

3.1 Findings

a. General

The physical condition of Bennet's Mills Dam is fair. The concrete spillway is in good alignment and has not settled. The embankment is poorly maintained, seeps in places and is locally eroded. The downstream embankment toe area is overgrown by vegetation in the wild state and is poorly graded for drainage.

b. Dam

Bennett's Mills Dam is an earth embankment built as a roadway fill, and not specifically for water retention purposes. The crest of the dam is an asphalt paved two-lane road. Both upstream and downstream slopes are very irregular. Based on construction drawings made available for the spillway, the foundation appears to be sand and gravel overlaying a gravelly clay. Based on observations, it is assumed that the embankment is homogeneous consisting of sand and gravel.

Seepage was observed along an area 5 to 6 feet in length at the toe of the downstream slope approximately 150 feet to the right of the discharge channel. Soft material was observed to a depth of one foot in the zone of seepage. The seepage quantity was estimated to be one to 3 gpm at the time of the inspection and was flowing clean.

Seepage was also observed along the downstream toe of the embankment and the toe of the left abutment. The combined length of the seepage zone along both the embankment and abutment was approximately 100 feet. The discharge appeared to be quite small and clear. It is believed that this seepage is a combination of seepage from the reservoir and ground water from the hillside immediately above the abutment.

Standing water was observed in several location along the downstream toe of the embankment. The ground in this area is very flat and the water table appears to be naturally high. A brook, unrelated to the reservoir, runs into the discharge channel from the right side a short distance from the dam.

A one-foot diameter corrugated metal pipe storm drain extends from the downstream side of the road to about the middle of the downstream slope in the embankment left of the discharge channel. Some minor erosion was observed in this area.

Considerable erosion was observed behind the downstream side of the right bridge abutment wingwall and to a lesser extent behind the left bridge abutment wingwall. No riprap erosion protection was observed in these areas. Asphalt erosion protection did not appear adequate.

Both the upstream and downstream slopes, as well as the ground immediately downstream of the dam, are covered with heavy growth of trees and brush. This appears to be the only erosion protection on the upstream slope.

c. Appurtenent Structures

The concrete spillway and outlet channel structures are in good condition. The concrete surfaces are in good condition, and no significant cracking was seen. The alignment of the crest is good and apparently level without observable settlements. No construction joint or monolith joint spalling or, misalignment, or offsets were in evidence. The steel sheet piling cutoff could be observed at both ends of spillway structure at its connection to the embankment. Visible parts of this sheet piling are in acceptable condition. The juncture of the spillway structure and the embankment and bridge is by a creosoted timber retaining wall connection in good condition, effectively retaining the embankment.

A sluice gate is located on the upstream face of the spillway, just above the elevation of the downstream channel bottom. The gate normally would be used for bypass and for reservoir draw-down.

At present, the gate is considered inoperable during a storm emergency. The valve stand has been removed and all that remains of the stem is a projection approximately 5 inches above the crest of the spillway. The back side of the gate was obscured by a 4-inch deep flow over the spillway at the time of inspection.

According to the owner, the gate valve was opened within the last year by the State Police who drained the lake by operating the low level outlet, in a search of the lake bottom for a hidden arms cache.

The creosoted timber bridge superstructure and downstream wingwalls are in good serviceable condition. Although there is erosion behind the wingwalls, the timber structure itself is not a contributing cause of this erosion.

d. Reservoir Area

The reservoir rim is gently sloping upward on the right shoreline and moderately steeply sloping upward on the left shoreline. The right shoreline is developed by several properties and the shoreline vegetation is maintained, in general, in a controlled state. The left pond bank is more heavily vegetated. The reservoir itself is shallow and aquatic growth seems to be substantial in shallower areas. Sedimentation effects are visible at the upper reach of the pond at the inlet of the river.

A fine-grained, micaceous sand interbedded with clay lenses (Cohansey Sand) underlies the embankment, spillway structure, and reservoir. A coarser sand with some gravel and occasional lenses of light-colored clay (Kirkwood Sand) crop out west and east of the dam. It appears that this latter material was used to build the embankment.

e. Downstream Channel

The downstream channel of the South Branch of the Metedeconk River is meandering and not too well defined, with low banks overgrown by heavy brush and trees. No residences were observed within the first 300 yards of the dam axis.

The visual inspection check list is included in Appendix A.

Photographs taken during the site inspection are included in Appendix B.

3.2 Evaluation

1. Embankment Seepage:
   The seepage of the right abutment can lead to embankment erosion and consequently instability if left unchecked.

2. Embankment Slopes
   The downstream embankment slope is highly irregular and eroded. Both slopes have excessive growths of vegetation including root systems.

3. Downstream Area:
   The existing embankment toe and the area sloping away downstream are poorly graded, impeding drainage away from the toe. Trees and vegetation cover the downstream areas.

4. Low Level Outlet:
   The low level outlet cannot be conveniently operated since access is only by boat. The discharge capacity of this outlet would become valuable in time of severe floods and could help prevent overtopping of the dam, if it were conveniently operable from the roadway surface.

SECTION 4

4. OPERATIONAL PROCEDURES

4.1 Procedures

As far as can be determined, the pond is operated simply on a run-of-the river basis with all discharges passing over the spillway crest. The low level outlet is not normally operable from the land side, requiring a small boat for access. The reservoir has been dewatered in the past by the use of this gate.

4.2 Maintenance of the Dam

The dam embankment is maintained by Ocean County as part of the County's roadway system. Maintenance is on an as-needed basis. The spillway structure is maintained on an as-needed basis.

4.3 Maintenance of Operating Facilities

The low level outlet gate is in operational condition, according to the owner, but apparently is not maintained. It cannot be safely operated during a high water emergency.

4.4 Description of any Warning System in Effect

There is no formal system of warning downstream residents in case of dam misoperation or possible failure or high water inflows and outflows in the pond.

4.5 Evaluation

Maintenance and operation procedures should be improved by the owners. An annual inspection site visit is recommended utilizing a check list similar to the one used in this report and appended, Appendix A. Inspection reports should be filed for review. A staff gage should be installed at the spillway, correlated to the crest elevation of the spillway. The gage should be read at site visits for inspection and maintenance and during heavy rainfalls. Site visits should be logged in a permanent record.

A downstream warning system is not considered necessary at this stage of basin development since the area is sparsely populated and the likelyhood of damage due to dam misoperation and possible failure is considered remote. This current assessment should be updated every five years in the light of possible development downstream.

SECTION 5

5. HYDRAULIC / HYDROLOGIC

5.1 Evaluation of Features

a. The drainage area above the dam axis is oblong, approximately 7-mile long by 3-mile wide. The stream length above the dam 8.7 miles and the head waters reach elevation 200 MSL. The drainage area is very sparsely developed and is characterized by high infiltration rates into the sandy surface soils, and low surface drainage runoffs in the watercourses.

The evaluation of the hydraulic and hydrologic features of the Bennett's Mills Dam was based on criteria set forth in the Corps' Guidelines, Section 4.3 and additional guidance provided by the Philadelphia District Corps of Engineers.

Based upon a reclassification of the dam's Hazard Potential to "Low", the appropriate Spillway Design Flood would fall in the range of a 50-year to 100-year discharge. The 100-year discharge for the South Branch of the Metedeconk River has been computed at the Jackson/Lakewood Townships boundary downstream of Bennett's Mills Dam (D.A. 23 square miles) as 1,100 cfs in the Flood Insurance Study for Lakewood Township. Transposed to the Bennett's Mills Dam axis by the relationship $\left(\frac{A^1}{A^2}\right)^{0.6}$ the 100-year reservoir invlow is computed at 965 cfs. The 100-year flow of 965 cfs is close to the rated capacity of the spillway (1,030 cfs at 3.0-ft. freeboard).

Stream flows for Flood Insurance Reports are calculated on the basis of New Jersey Department of Environmental Protection Special Report No. 38.

The 100-year stream flow at the dam was also checked using the Regional Frequency Relationships of the Upper Delaware River Basin (Zone B) and found to be 980 cfs, giving good agreement with the Flood Insurance Report discharge figure. The spillway rating curve and the reservoir capacity curves are presented in Plates 2 and 3 of Appendix D respectively.

b. Experience Data

According to the owner, the highest pond level he remembers rose to 8 inches above the crest level (Equivalent to a flow of approximately 110 cubic feet per second). The maximum flood of record for the South Branch of the Metedeconk River at the discontinued gage at Lakewood, New Jersey (Drainage area 26.0 square miles) was 568 cfs on December 17, 1974. The gage record covers only the years 1973-1976.

c. Visual Observation

The overtopping of the roadway embankment is predicated on a minimum embankment elevation of 4.3 feet above Spillway Crest level, as shown on the available contract drawings. There are no roadway profiles of the top of roadway embankment available to verify the freeboard height. Visual observations show that the roadway is on a slight grade and that the minimum freeboard should be verified by field survey.

d. Overtopping Potential

If the dam is classified as having "Low Hazard Potential", for the reasons stated in Section 1.2.d., then the Spillway Design Flood is the 100-year flood and the spillway capacity is adequate. The dam will not be overtopped in this case. This interpretation is recommended, subject to a review every five years to account for changes in drainage area development upstream and downstream of the dam site.

e. Reservoir Drawdown

The reservoir drawdown below the spillway crest elevation 66.0 is accomplished by permitting discharge through the 42 inch outlet pipe with invert elevation 55.17. Assuming drawdown to the centerline of the pipe, elevation 56.92 results in a maximum head differential of 9.08 feet. Assuming a constant inflow of 36.8 cfs (2 cfs/square mile), the drawdown can be accomplished in 16 hours. Assuming no inflow into the reservoir, the drawdown time is reduced to 13 hours.

SECTION 6

6. STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observation

1. Spillway and Outlet Channel Structure:
This structure shows no visual signs of leakage, cracking or settlements or differential movements that would suggest instability.

The inoperable low level outlet increases the possibility of the dam being overtopped and is a negative factor in assessing the overall safety of the dam.

2. Embankment:
The roadway embankment was not constructed with water impoundment in mind and, in all probability has no design features to act as a water barrier except for a relatively wide width in relation to the differential head. The signs of seepage on both embankments are phenomena that raise questions as to the existing phreatic levels and the continuing stability of the embankment. Excessive erosion behind the downstream bridge wingwalls could adversely affect the stability if left uncorrected. The upstream slope has no slope protection except for uncontrolled growth of brush which also could affect the stability of the slope if left

unattended. Excessive and uncontrolled vegetation on the embankment slopes will affect the stability adversely if left uncorrected.

The poor discharge at the downstream toe area could lead to slope erosion and slumping if left uncorrected.

b. Design and Construction Data

1. Spillway and Outlet Channel Structure:
Drawings relating to the timber pile foundation do not show any stability analysis results. No computations relating to stability were uncovered for checking. No data relating to the capacity of vertical and battered timber piles to resist lateral water loadings without transferring loads to the embankment or bridge superstructure can be deduced on the basis of available data. A preliminary analysis of lateral loading on the timber piles shows that they exceed the allowable limits at the maximum design pool levels. Further data acquisition relating to the in-situ engineering properties of the subgrade materials and tailwater design levels is required to verify stability safety factors.

2. Embankment:
No cross sections or foundation data is available on which to base a definitive stability analysis.

The presence of pervious strata in the spillway area as shown on the borings, could be the cause cause of the observed seepage.

c. Operating Data

No operating data has been acquired which bears on the stability of the embankment and its spillway.

d. Post Construction Changes

The raising of the spillway crest by one-foot shortly after completion of the dam affects the stability negatively by increasing water levels and decreasing the freeboard, thus increasing the possibility of overtopping the dam during a severe rainstorm.

e. Seismic Stability

In general, projects located in Seismic Zone 0, 1 and 2 may be assumed to present no hazard from earthquake, provided that static stability conditions are satisfactory and conventional safety margins exist.

SECTION 7

7. ASSESSMENT / REMEDIAL MEASURES

7.1 Dam Assessment

a. Safety

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

- The Bennett's Mills Dam spillway can safely pass the 50-year and 100-year reservoir inflows and therefore is acceptable for the dam classification of "Low Hazard Potential".

- The ability of the spillway structure to independently resist lateral loads at maximum surcharge pool levels is questionable until further data relating to the subgrade material properties and tailwater rating have been acquired.

- The low level outlet is of questionable operability at present and should be upgraded to be safely operable from the roadway during rainstorms to provide valuable extra discharge capacity during storm events.

- The embankment safety is questionable in that seepage sources have been observed on the downstream face of the embankment indicating high phreatic levels.

- The upstream slope stability is in question until additional data can be acquired to assess its safety.

- The downstream area is poorly graded for drainage and overgrown tending to destabilize the embankment toe.

b. Adequacy of Information

Available data is not sufficient to fully evaluate the safety of the dam. Needed information includes:

1. In order to perform a definitive stability analysis of the spillway structure, the engineering properties of soils at the spillway structure foundation are required.

2. A profile and cross section survey of the roadway embankment together with determination of engineering properties of the embankment and foundation soil.

3. A piezometric survey of the embankment at and adjacent to seepage points. Channelization of embankment seepage and estimation of flow volume at monthly intervals. This information is needed to assess the stability of the dam and to determine the actual freeboard and the location of the overtopping in case of large reservoir inflows.

c. Urgency

The needed data described in Section 7.1.b. should be acquired within a 12-month period.

1. Clean up of the downstream slope and toe area of all vegetation, within 30 feet of the embankment slope and control of vegetation on the upstream slope, should be completed within 6 months.

2. Regrading of the downstream toe area for more positive surface drainage, channelization monitoring of seepage should be completed within 6 months.

3. Protection of the embankment against erosion in the vicinity of the downstream wingwalls should be completed within 6 months.

4. Studies to augment the spillway capacity should be completed within 12 months.

d. Necessity for Additional Investigations

Based on the uncertainties in regard to dam safety uncovered during this phase of the investigation, it is recommended that the investigation be continued.

7.2 Remedial Measures

a. Alternatives

If the spillway capacity is to be increased any significant amount, it is suggested that the following alternatives be investigated:

1. Raising of the embankment to provide a greater head on the existing spillway.

2. Creation of an ungated auxiliary spillway at a point along the right embankment section.

3. Creation of a new service spillway, possibly gated and use of the present spillway as an auxiliary facility.

4. A combination of the above alternatives.

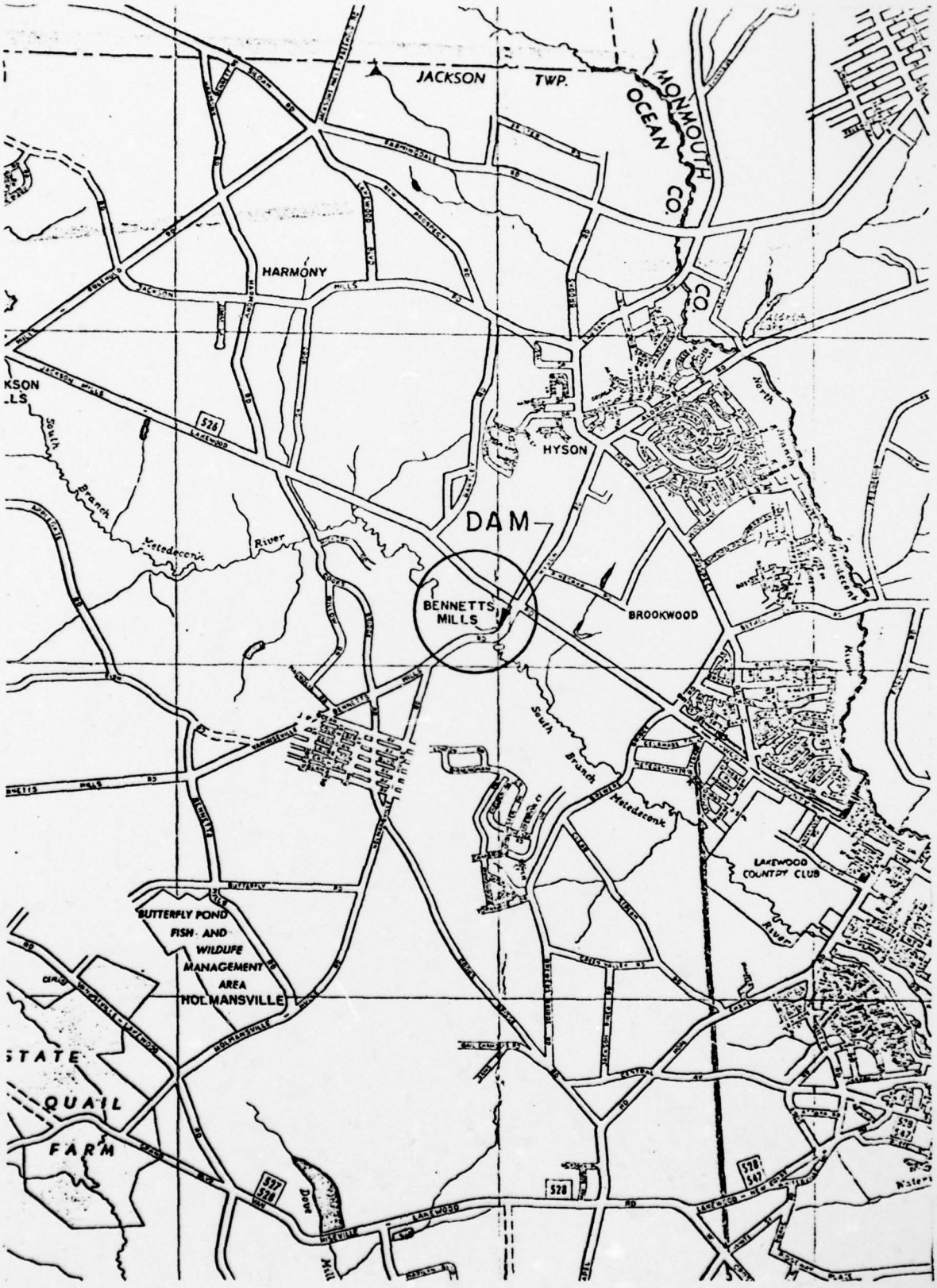
Remedial measure relating to the rehabilitation of the low level outlet gate, clean up of the vegetation on and adjacent to the embankment, re-grading of the downstream area for proper drainage, and protection of the embankment at the downstream wingwalls should be implemented within the time frames stated in Section 7.1 - c.

b. O & M Procedures

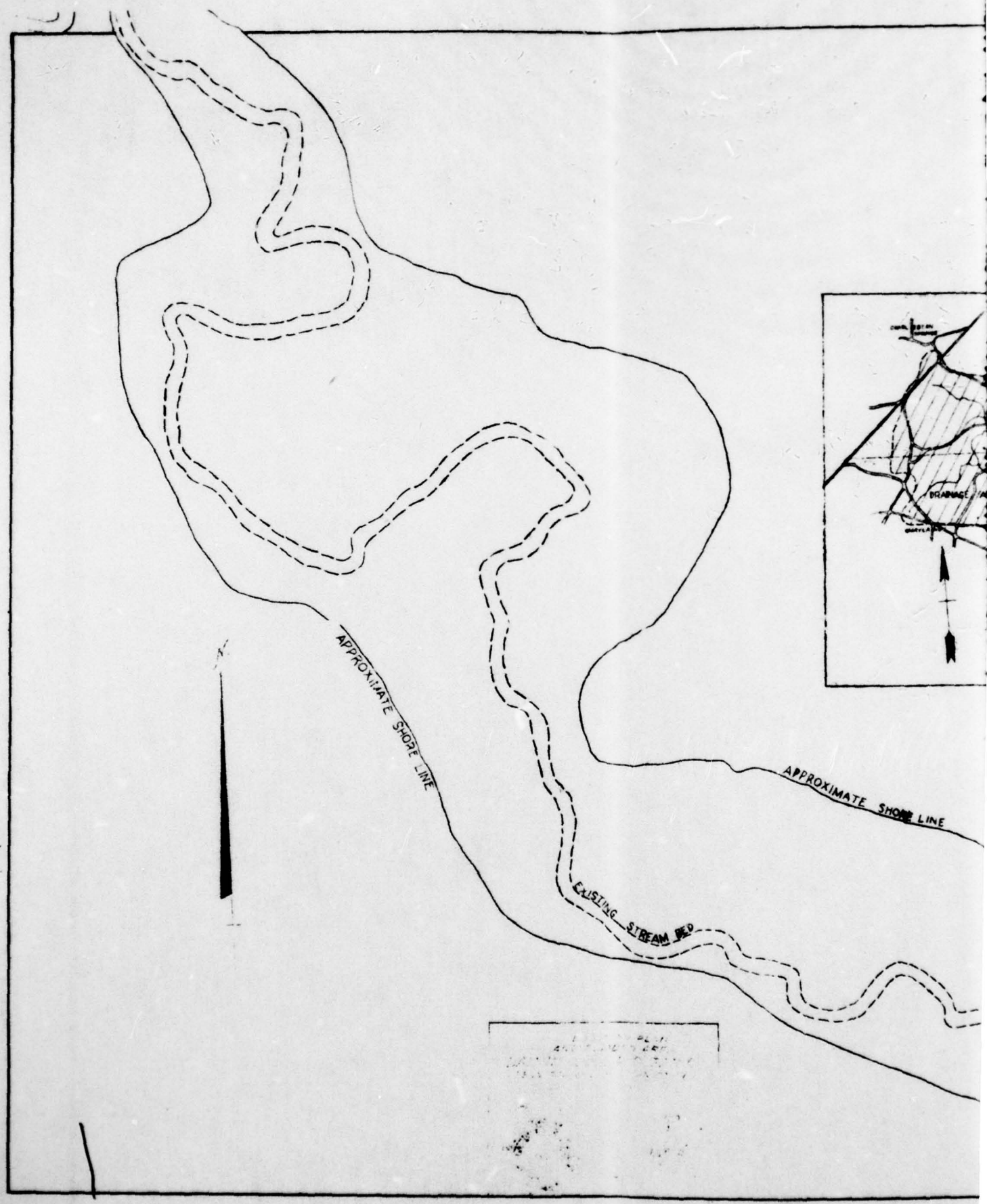
The owners should upgrade the operating and maintenance procedures by issuing a manual and check list for recommended procedures. Inspection and maintenance visits should be logged. Records of pond levels should be kept during routine visits and during severe storms. An annual site inspection should be conducted using a visual inspection check list similar to the one used in this report. Vegetative growth should be controlled at and adjacent to the embankment.

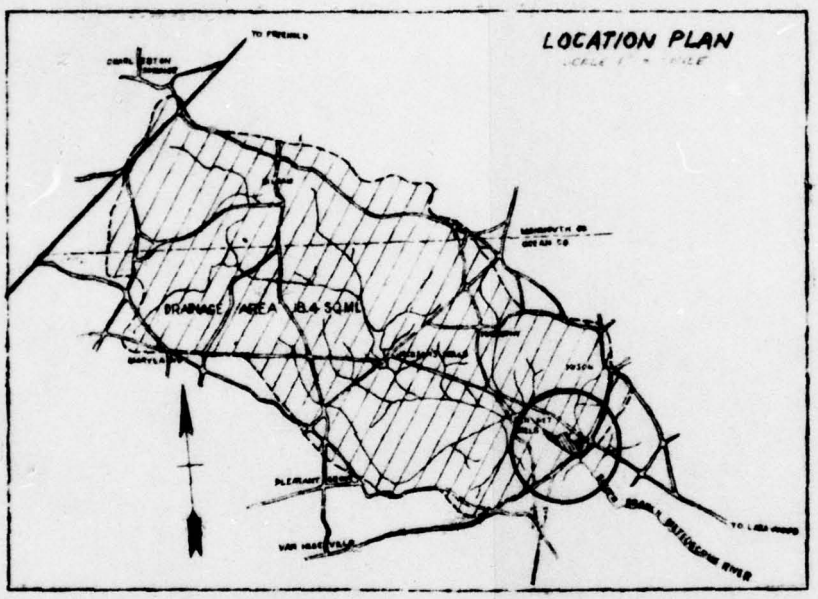
PLATES

DWG NO. 1



VICINITY MAP


APPROXIMATE SHORE LINE
APPROXIMATE SHORE LINE
EXISTING STREAM BED



APPROXIMATE SHORE LINE

EXISTING STREAM BED

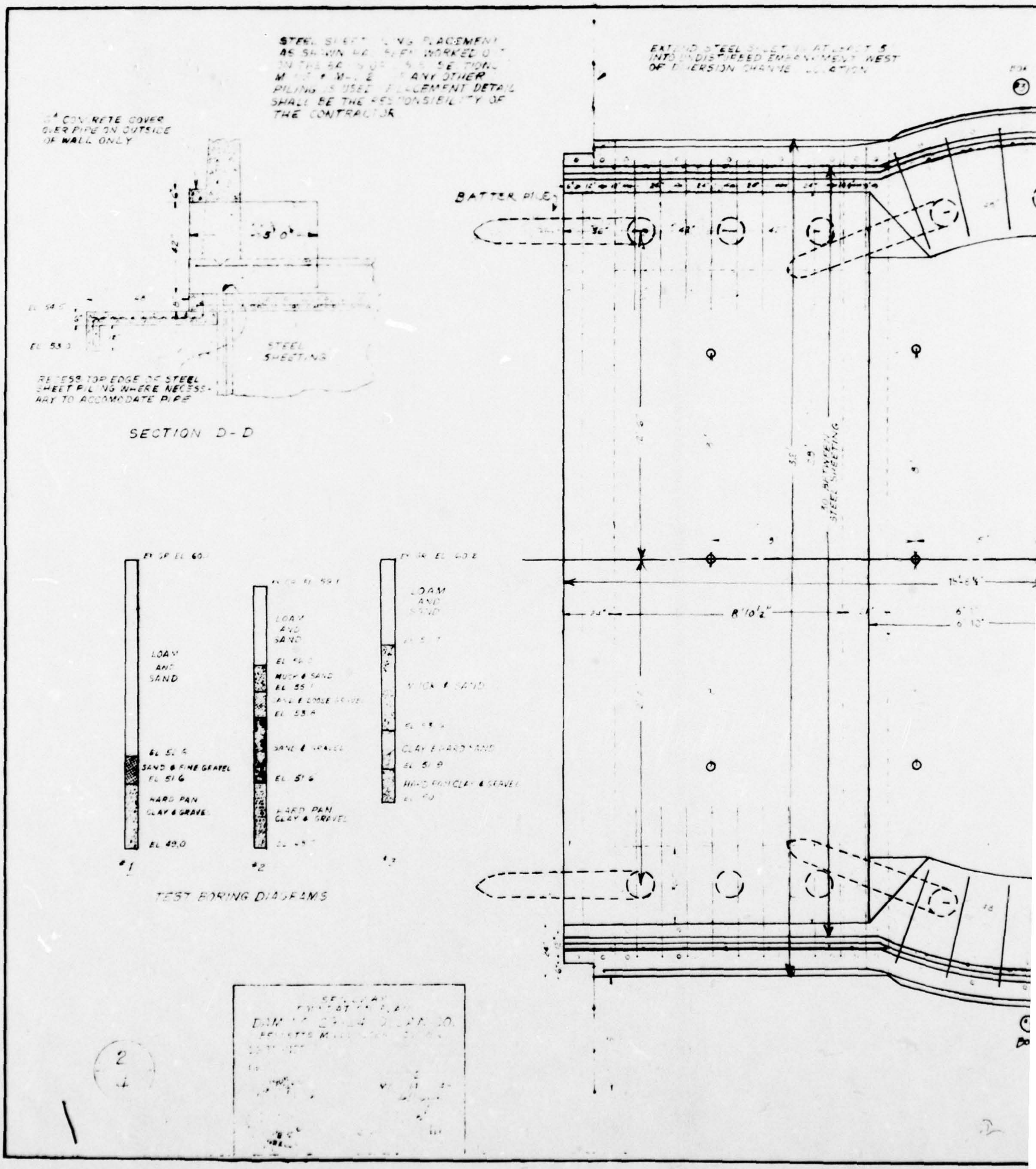
BENNETTS MILLS

DWG. NO. 2

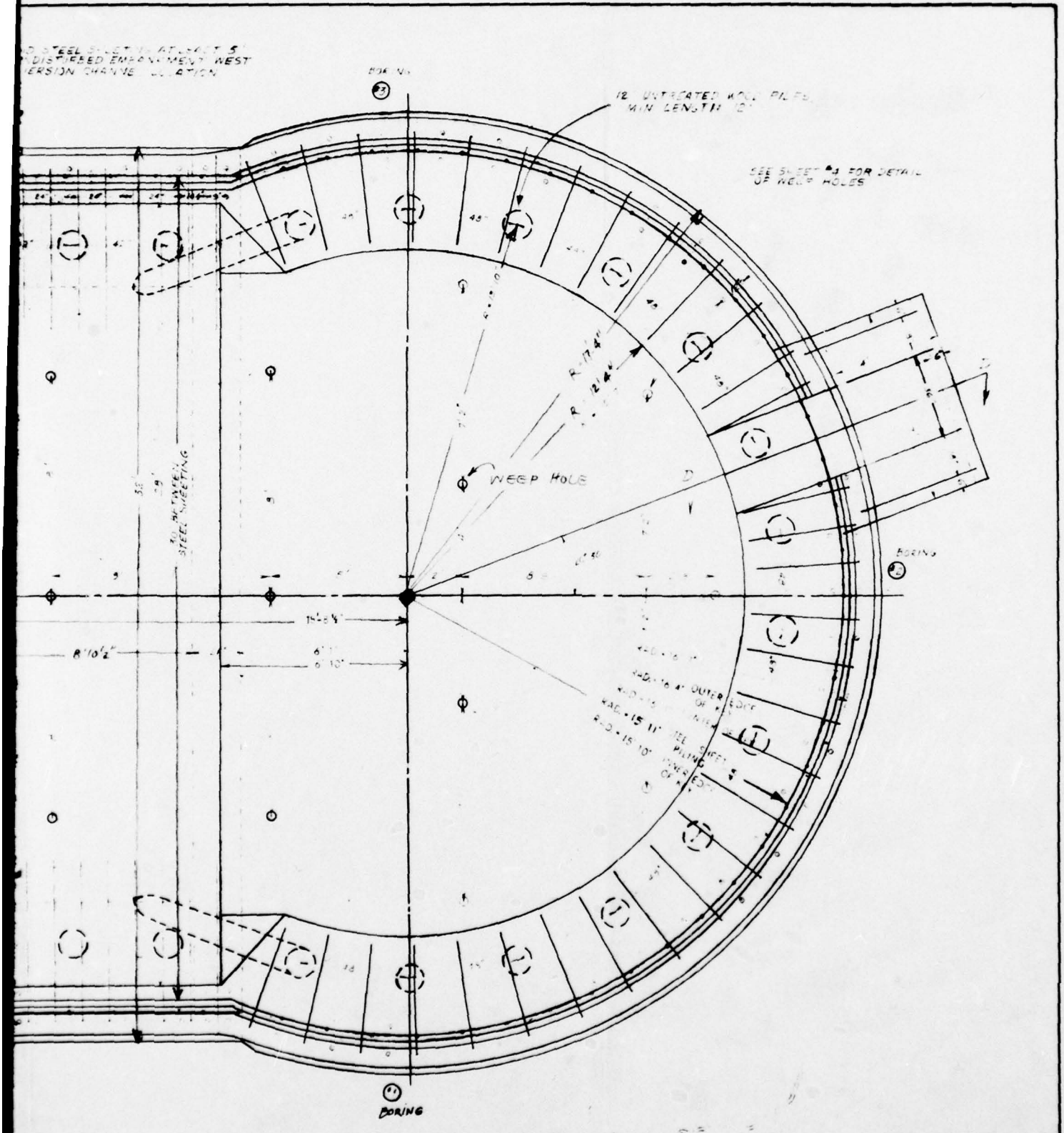
AREA EL. 650 = 43.4 Ac

Spillway

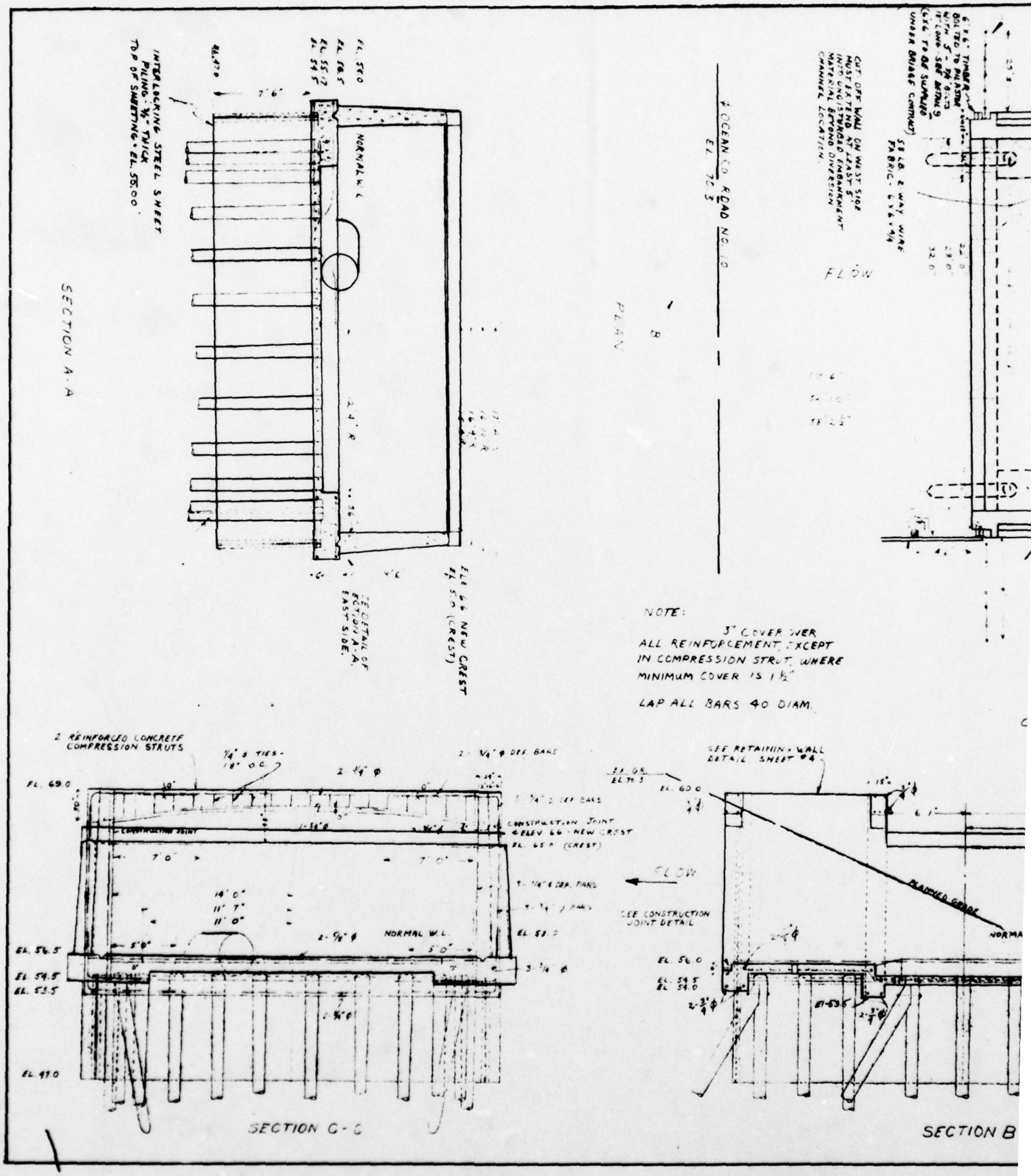
2

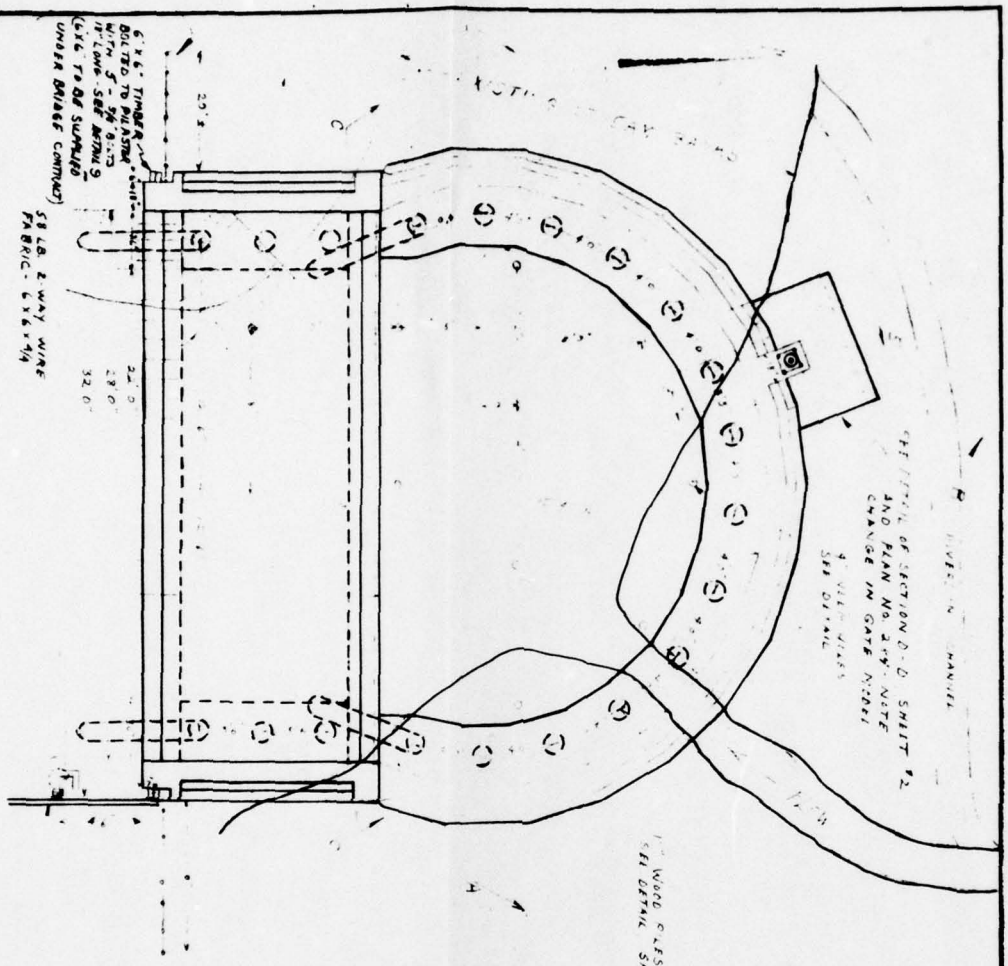


BATTER PILE
5'-0"
42"
EL 54.5
EL 53.0
STEEL SHEETING
RECESS TOP EDGE OF STEEL SHEET PILING WHERE NECESSARY TO ACCOMODATE PIPE
SECTION D-D
LOAM AND SAND
EL 51.6
SAND & FINE GRAVEL
EL 51.6
HARD PAN CLAY & GRAVEL
EL 49.0
MUCK & SAND
SAND & GRAVEL
HARD PAN CLAY & GRAVEL
MUCK & SAND
CLAY & HARD SAND
EL 51.9
#1
#2
TEST BORING DIAGRAMS
8'10½"



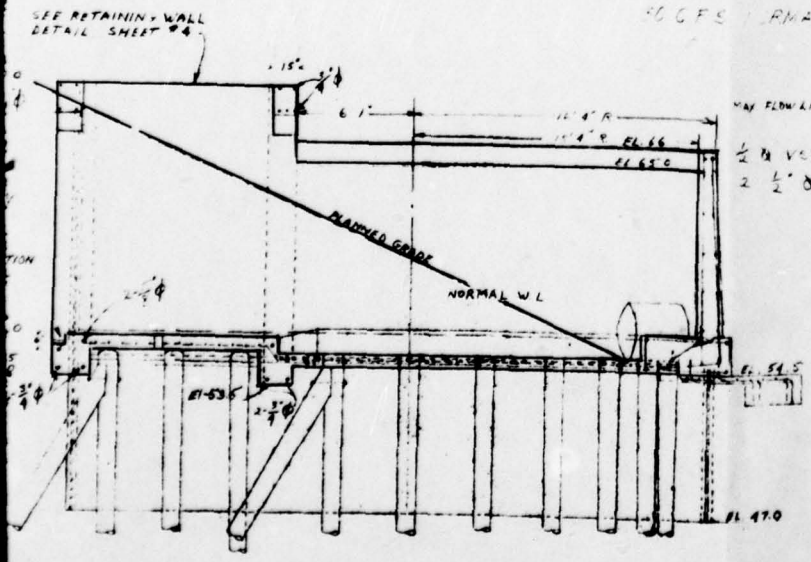
BENNETTS MILLS DWG. NO. 3


SECTION A-A
INTERLOCKING STEEL SHEET PILING - ¼" THICK TO P OF SHEETING - EL. 55.00
EL. 47.0
7'6"
NORMAL W.L.
EL. 56.0
EL. 58.5
EL. 55.12
EL. 54.5
SEE DETAIL OF EXCAVATION EAST SIDE.
EL. 66 NEW CREST EL. 65.0 (CREST)
PLAN
OCEAN CO. ROAD NO. 10
EL. 70.3
CUT OFF WALL ON WEST SIDE MUST EXTEND AT LEAST 5' INTO UNDISTURBED EMBANKMENT MATERIAL BEYOND DIVERSION CHANNEL LOCATION.
FLOW
6" x 6" TIMBER RAIL BOLTED TO PILASTER WITH 5 - ¾" Ø BOLTS 18" LONG - SEE DETAIL 9
(EXC. TO BE SUPPLIED UNDER BRIDGE CONTRACT)
58 LB. 2 WAY WIRE FABRIC - 6"x6" - 4/4
NOTE:
3" COVER OVER ALL REINFORCEMENT EXCEPT IN COMPRESSION STRUT WHERE MINIMUM COVER IS 1½"
LAP ALL BARS 40 DIAM.
2 REINFORCED CONCRETE COMPRESSION STRUTS
¼" Ø TIES - 18" O.C.
2 - ¾" Ø
2 - ¾" Ø DEF. BARS
EL. 69.0
CONSTRUCTION JOINT
1-5/8" Ø
CONSTRUCTION JOINT & ELEV. 66 - NEW CREST
EL. 65.0 (CREST)
7'0"
14'0"
11'7"
11'0"
2-5/8" Ø
NORMAL W.L.
EL. 58.5
5'0"
EL. 56.5
EL. 54.5
EL. 53.5
EL. 47.0
SECTION C-C
SEE CONSTRUCTION JOINT DETAIL
SEE RETAINING WALL DETAIL SHEET #4
EL. GR. EL. 70.3
EL. 60.0
15"
6'1"
PLANTED GRADE
NORMA
EL. 56.0
EL. 59.5
EL. 59.0
2-¾" Ø
EL. 53.5
SECTION B



3" COVER OVER REINFORCEMENT EXCEPT COMPRESSION STRUT WHERE COVER IS 1½"

BARS 40 DIAM.



SECTION B-B

NOTE:
ALL PILING MUST BE DRIVEN. NO JETTING WILL BE PERMITTED.

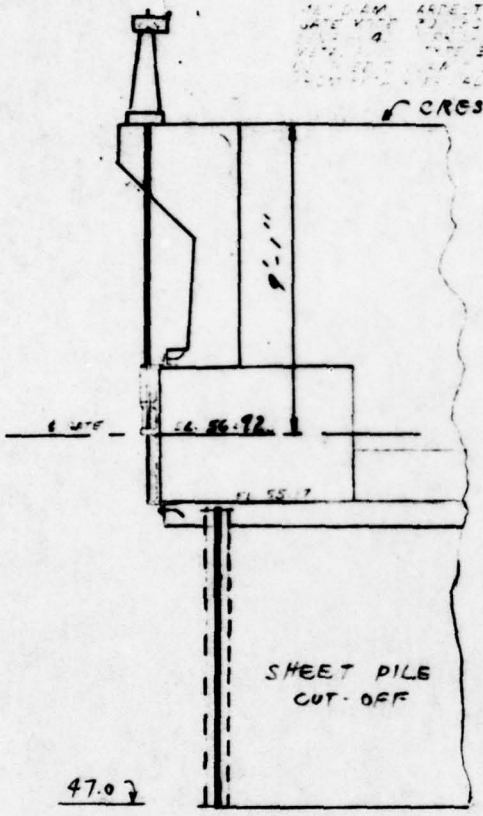
BENNETTS MILLS
DWG. NO. 4

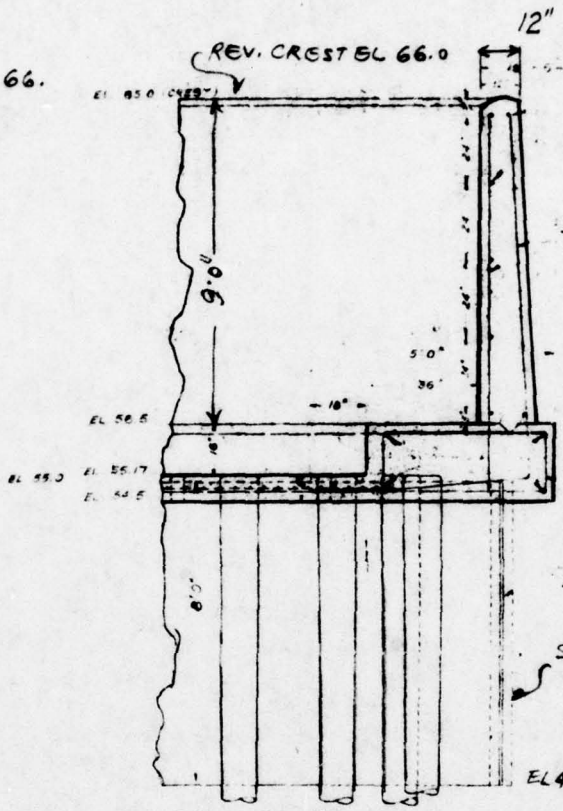
SPILLWAY
PLAN & SECTION VIEWS
LAM NO 29-24, OCEAN CO.
BENNETTS MILLS, OCEAN CO. N.J.

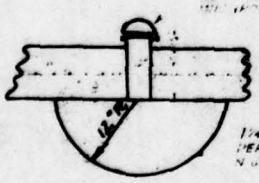
DESIGNED BY BRUCE M. LARRABEE
31 MAIN ST. TOMS RIVER, N.J.
PROFESSIONAL ENGINEER AND LAND SURVEYOR

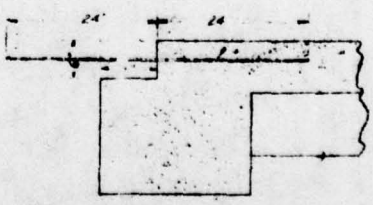
REVISED BY WILBUR ROBERTS
PROFESSIONAL ENGINEER AND LAND SURVEYOR
LICENSE NO. 2681

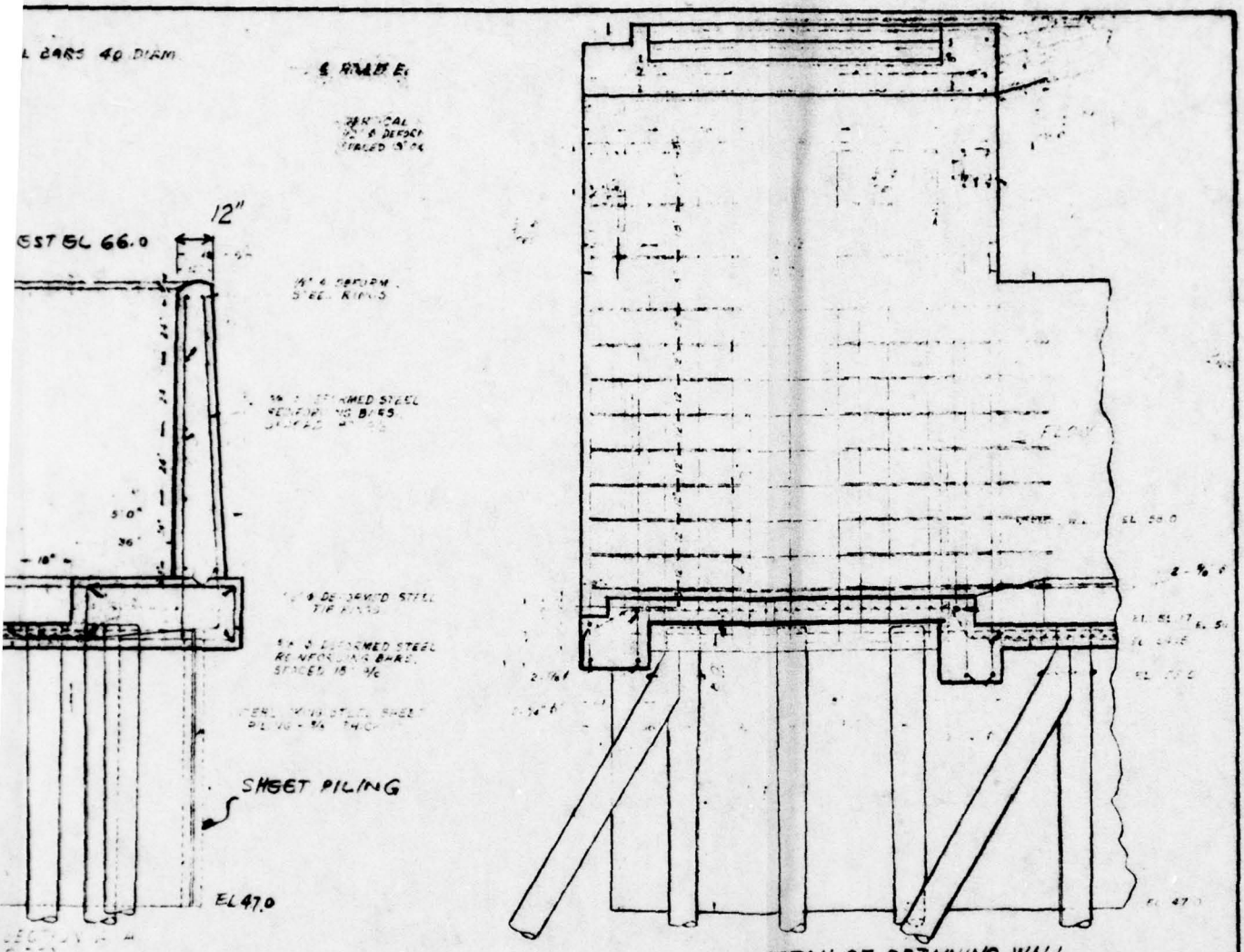
REVISED MARCH 15, 1949 - CREST ELEV.
REVISED AUG 20, 1948
REVISED JUNE 7, 1948


CREST EL. 66.
SHEET PILE
CUT-OFF
47.0

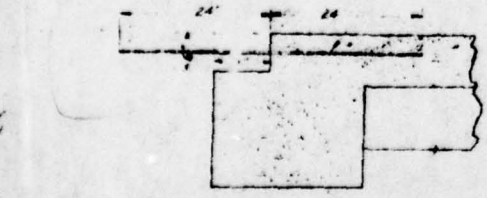

REV. CREST EL 66.0
12"
9.0"
SHEET PILING
EL 47.0

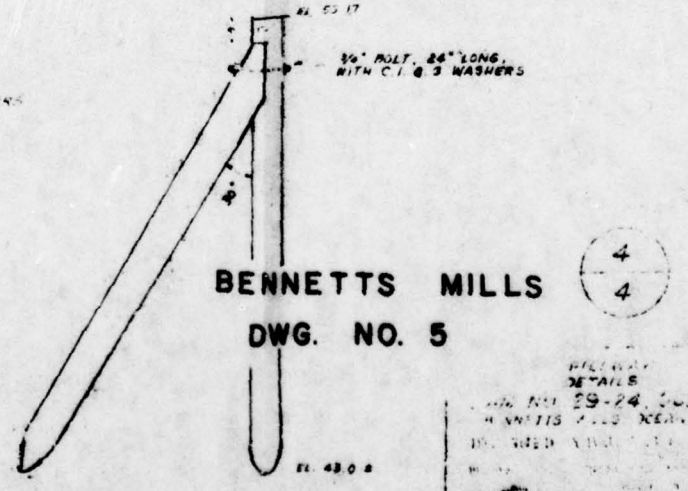



24"
24"



DETAIL OF RETAINING WALL
(WEST SIDE)





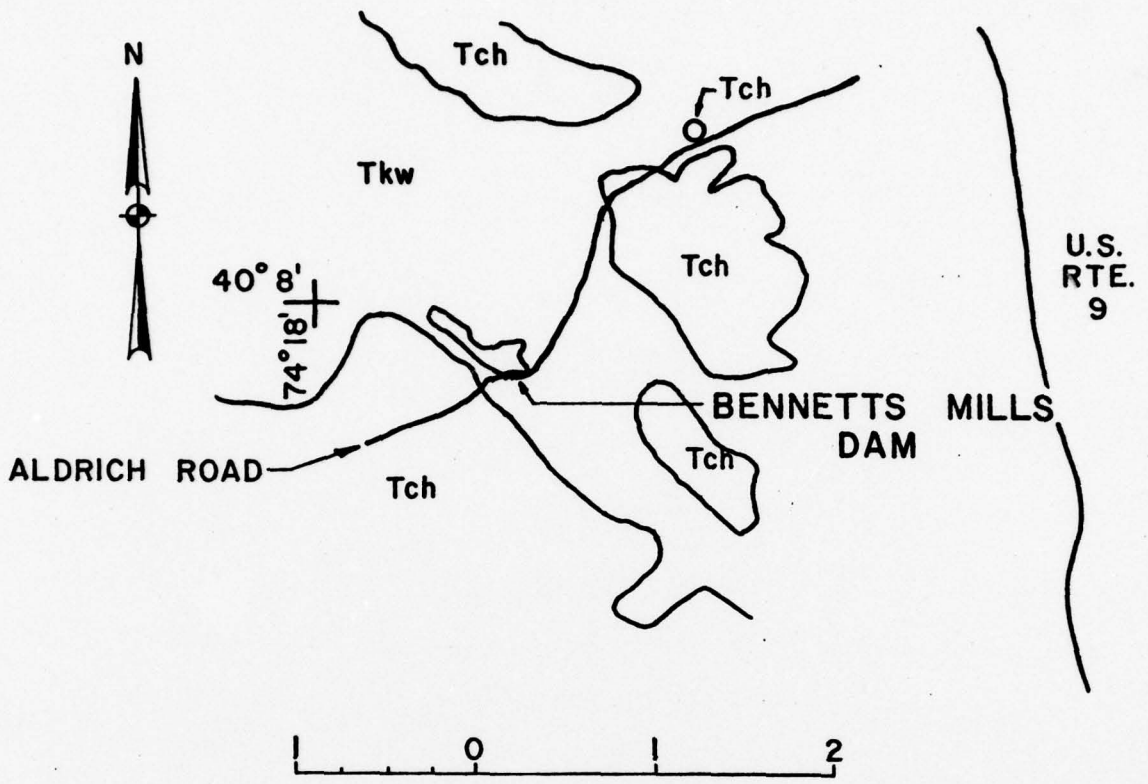
DETAIL OF BATTER PILES

BENNETTS MILLS

DWG. NO. 5

4/4

REVISED JUNE 11, 1946
REVISED JULY 9, 1946



LEGEND

TERTIARY

Tch Cohansey Sand
Coarse, Light-Colored Sand with Occasional Lenses Light-Colored Clay a Few Inches to About Ten Feet Thick

Tkw Kirkwood Sand
Fine, Micaceous Sand Interbedded with Lens-Shaped Clay Beds; Black, Lignitic Clay at Base of Unit

——— Contact:

GEOLOGIC MAP
BENNETTS MILLS

DWG. NO. 6

APPENDIX A

CHECK LIST - VISUAL OBSERVATIONS

CHECK LIST - ENGINEERING, CONSTRUCTION MAINTENANCE DATA

CHECK LIST
VISUAL INSPECTION
PHASE 1

Name Dam BENNETT'S MILLS DAM County Ocean State New Jersey Coordinators

Date(s) Inspection May 8, 1978 Weather Partly Cloudy Temperature 50°F

Pool Elevation at Time of Inspection 66.3 M.S.L. Tailwater at Time of Inspection 55.5 M.S.L.

Inspection Personnel:

Seymour Roth
David Kerkes
William Flynn
Lynn Brown
Lawrence Woscyna, NJ-DEP

Recorder: Seymour M. Roth

The owner of the spillway structure, Mr. Edward Enno, was not at the site for the inspection. He claims he is turning over the dam structure to Ocean County for taxes; however, Ocean County has not acted to take over the dam. Ocean County owns the Bennett's Mills Roadway embankment which impound the lake waters and the timber bridge crossing the South Branch of the Metedeconk River.

CONCRETE/MASONRY DAMS (NA, see Ungated Weir page)

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
SEEPAGE OR LEAKAGE	NA	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	NA	
DRAINS	NA	
WATER PASSAGES	NA	
FOUNDATIONS	NA	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	NA	
STRUCTURAL CRACKING	NA	
VERTICAL & HORIZONTAL ALIGNMENT	NA	
MONOLITH JOINTS	NA	
CONSTRUCTION JOINTS	NA	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
SURFACE CRACKS	A roadway embankment forms the dam. There are no visible surface cracks related to embankment settlement of movement.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	No visible movements. The area at the downstream toe is poorly graded at the extreme left end of the dam. There is standing water, plus seepage from the roadway embankment and from the adjacent left abutment hillside slope. The natural water level is high on the left embankment toe area. There is a small brook running parallel to the embankment toe on the right abutment embankment also keeping the area mucky. Both downstream areas are heavily vegetated.	Regrade right and left embankment toe areas to drain properly into the river; channelize right embankment creek. Remove all brush and trees within 20 ft. of embankment toe of slope.
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	The general downstream embankment slope is irregular and requires reshaping. The downstream embankment slope seems soft and poorly compacted. Highway drainage runs down one or two spots of right embankment creating local erosion damage. On left embankment, a poorly located slope also is causing erosion damage. The upstream embankment slope above the lake's surface is irregular. There is considerable erosion in back of the right downstream bridge wingwall, some erosion behind D/S left wingwall.	Regrade embankment slopes. Protect areas affected by roadway surface drainage with stone, or asphaltic surface.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	The roadway embankment is built on a curve and on an upward slope from right to left, no obvious misalignments or settlements are visible.	Protect areas behind downstream wingwalls with stone or asphalt paving.
RIPRAP FAILURES	Asphaltic abutment protection at downstream bridge abutment slopes has failed and is undercut on right side, serviceable but deteriorating on left side.	Repave with asphalt material or place slope protection.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	A steel sheet pile wall connecting the concrete spillway structure to the roadway embankment is visible on the upstream side of the roadway extending approximately 10 feet into the embankment	
ANY NOTICEABLE SEEPAGE	There is some embankment seepage in the right embankment at the toe of the embankment slope, approximately 150 ft. from the centerline of the river. The wet area is approximately 6-foot wide, the soil is soft to a depth of one foot, and seeps 1-3 gpm. On left embankment, there is some seepage at the extreme end of the embankment and hillside.	Determine source of seepage; channelize seepage and measure volume
STAFF GAGE AND RECORDER	None	
DRAINS	None	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CRACKING & SPALLING OF CONCRETE SURFACES IN STILLING BASIN		
INTAKE STRUCTURE	NA	
OUTLET STRUCTURE	NA	
OUTLET FACILITIES	42-inch gate valve in unknown condition passing through weir. Valve stem barely sticking up above pool level. Gate is inaccessible during high water emergencies.	Install gate stem extension for operation from any land in emergencies
EMERGENCY GATE	None	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CONCRETE	Semi-circular (270 degrees) weir of reinforced concrete with a flat weir crest. The concrete surfaces are in good to fair condition, but part of the spillway weir was obscured by overflowing water and not visible. The spillway crest was fairly level judging from overflowing water.	Lower reservoir level and inspect downstream face of weir.
APPROACH CHANNEL	None	
DISCHARGE CHANNEL	Consists of short 12-foot long section from the spillway weir to the roadway embankment and bridge and is confined by the reinforced concrete floor and walls braced across the top by two struts at the beginning and end of the tion. Concrete surfaces in good condition, no structural cracking or settlement visible.	
BRIDGE AND PIERS	Bridge over the South Branch Metedeconk River is of timber pile substructure type with steel beams. Bridge has a center timber pile bent support and timber pile supported, timber sheeted abutments and wingwalls. All timber is creosoted and in good structural condition. The top of roadway is approximately 5 feet above weir crest.	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CONCRETE SILL	NA	
APPROACH CHANNEL	NA	
DISCHARGE CHANNEL	NA	
BRIDGE AND PIERS	NA	
GATES & OPERATION EQUIPMENT	NA	

INSTRUMENTATION

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

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENTATIONS
SLOPES	Flat to moderately sloping on left shore, heavy vegetative cover. Moderately sloping to steep on right shore, homes on high bank, vegetation controlled.	
SEDIMENTATION	Some visible at upstream and of pond. Aquatic growth visible in shallow areas.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	No obstructions. Channel meanders has low banks, heavy vegetation on both banks.	
SLOPES	Low banks, ill defined at times, adjacent ground is low.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	None visible within 300 yards downstream. Some subdivision on downstream left bank at Lakewood.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Available for spillway structure; not available for embankment or bridge
REGIONAL VICINITY MAP	Available
CONSTRUCTION HISTORY	Partly available in N.J. Department of Environmental Protection.
TYPICAL SECTIONS OF DAM	Only for spillway structure
HYDROLOGIC/HYDRAULIC DATA	Not available; U.S.G. gage data South Branch Metedeconk River at Lakewood, available for years 1973-1976; gage discontinued.
OUTLETS - PLAN	)
- DETAILS	) Available
- CONSTRAINTS	)
- DISCHARGE RATINGS	Not available
RAINFALL / RESERVOIR RECORDS	Not available

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

ITEM	REMARKS
DESIGN REPORTS	None available.
GEOLOGY REPORTS	None available.
DESIGN COMPUTATIONS	None available.
HYDROLOGY & HYDRAULICS	Available.
DAM STABILITY	None available.
SEEPAGE STUDIES	None avaialble.
MATERIALS INVESTIGATIONS	Not available.
BORING RECORDS	Shown on spillway drawings.
LABORATORY	Not available.
FIELD	
POST-CONSTRUCTION SURVEYS OF DAM	Spillway heightening noted on spillway plans
BORROW SOURCES	None known
SPILLWAY PLAN - SECTIONS - DETAILS	) Available

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

ITEM	REMARKS
OPERATING EQUIPMENT PLANS AND DETAILS	Shown on spillway drawings
MONITORING SYSTEMS	None
MODIFICATIONS	Spillway raised one foot in 1949.
HIGH POOL RECORDS	None kept; owner reports 8-inch maximum over spillway.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None
PRIOR ACCIDENTS OF FAILURE OF DAM - DESCRIPTION - REPORTS	None known
MAINTENANCE OPERATION RECORDS	None kept for spillway.

APPENDIX B

PHOTOGRAPHS

PHOTOGRAPHS TAKEN DURING MAY 1978

Photo 1 - View of the concrete spillway structure on the upstream side of the roadway embankment and the bridge crossing the South Branch of the Metedeconk

Photo 2 - View of the braced outflow channel section of the spillway structure upstream of the roadway embankment

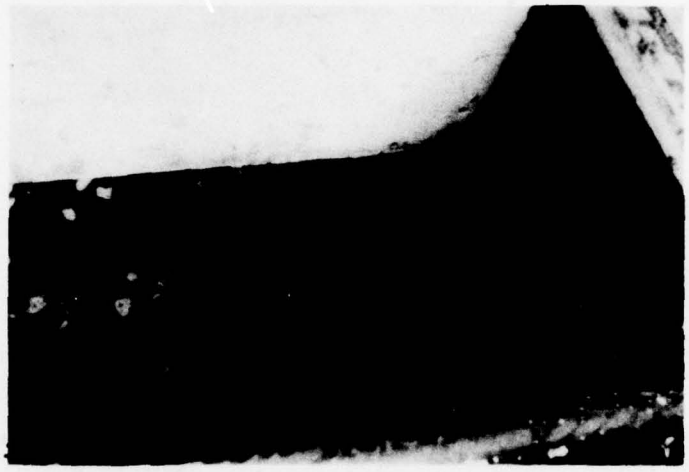


Photo 3 - View of the left downstream face of the concrete spillway and its timber wingwall connection to the bridge; note the steel sheet pile cut-off at the bottom

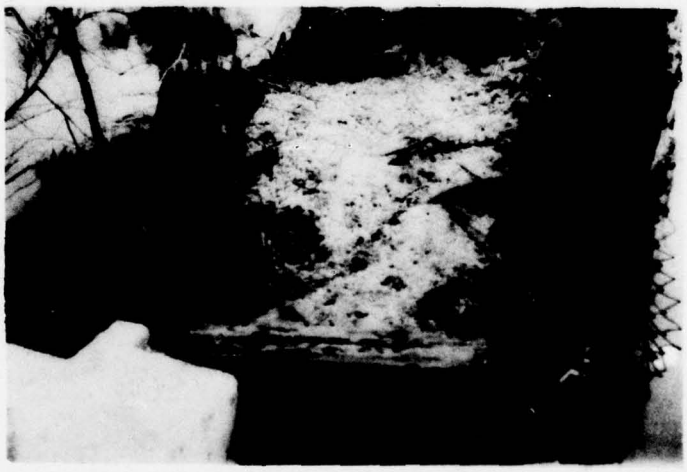


Photo 4 - Left downstream connection between the concrete spillway structure and the timber bridge at the top of the roadway embankment

Photo 5 - Downstream view of the timber substructure of the bridge crossing the South Banch of the Metedeconk River; the spillway structure is in the background

Photeo 6 - View of the right downstream timber bridge wingwall and wingwall extension; the asphalt earth embankment protection has eroded

Photo 7 - View behind the right downstream timber bridge abutment showing erosion

Photo 8 - View of the downstream roadway embankment slope looking toward the right abutment; the water impounding part of the roadway embankment ends approximately at the end of the guardrail

Photo 9 - Downstream face of the roadway embankment at the right abutment

Photo 10 - Downstream face of the left timber bridge wingwall and the roadway embankment slope

Photo 11 - View of the downstream embankment asphaltic protection adjacent to the right timber wingwall

Photo 12 - View of the reservoir, looking upstream from the roadway

APPENDIX C

SUMMARY OF ENGINEERING DATA

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

Name of Dam: BENNETT'S MILLS DAM

Drainage Area Characteristics: Area: 18.4 square miles

Elevation Top Normal Pool (Storage Capacity): 66.0 (17 AF)

Elevation Top Flood Control Pool (Storage Capacity): NA

Elevation Maximum Design Pool: 69.0

Elevation Top Dam: 70.3

SPILLWAY CREST:

a. Elevation 66
b. Type Semi-circular concrete weir
c. Width 18 inches
d. Length 60.3 feet
e. Location Spillover At natural stream channel of South Branch Metedeconk River
f. No. and Type of Gates None

OUTLET WORK:

a. Type 42-inch diameter slide gate
b. Location Upstream face of spillway wall
c. Entrance Inverts 55.17
d. Exit Inverts 55.17
e. Emergency Draindown Facilities None

HYDROMETEOROLOGICAL GAGES:

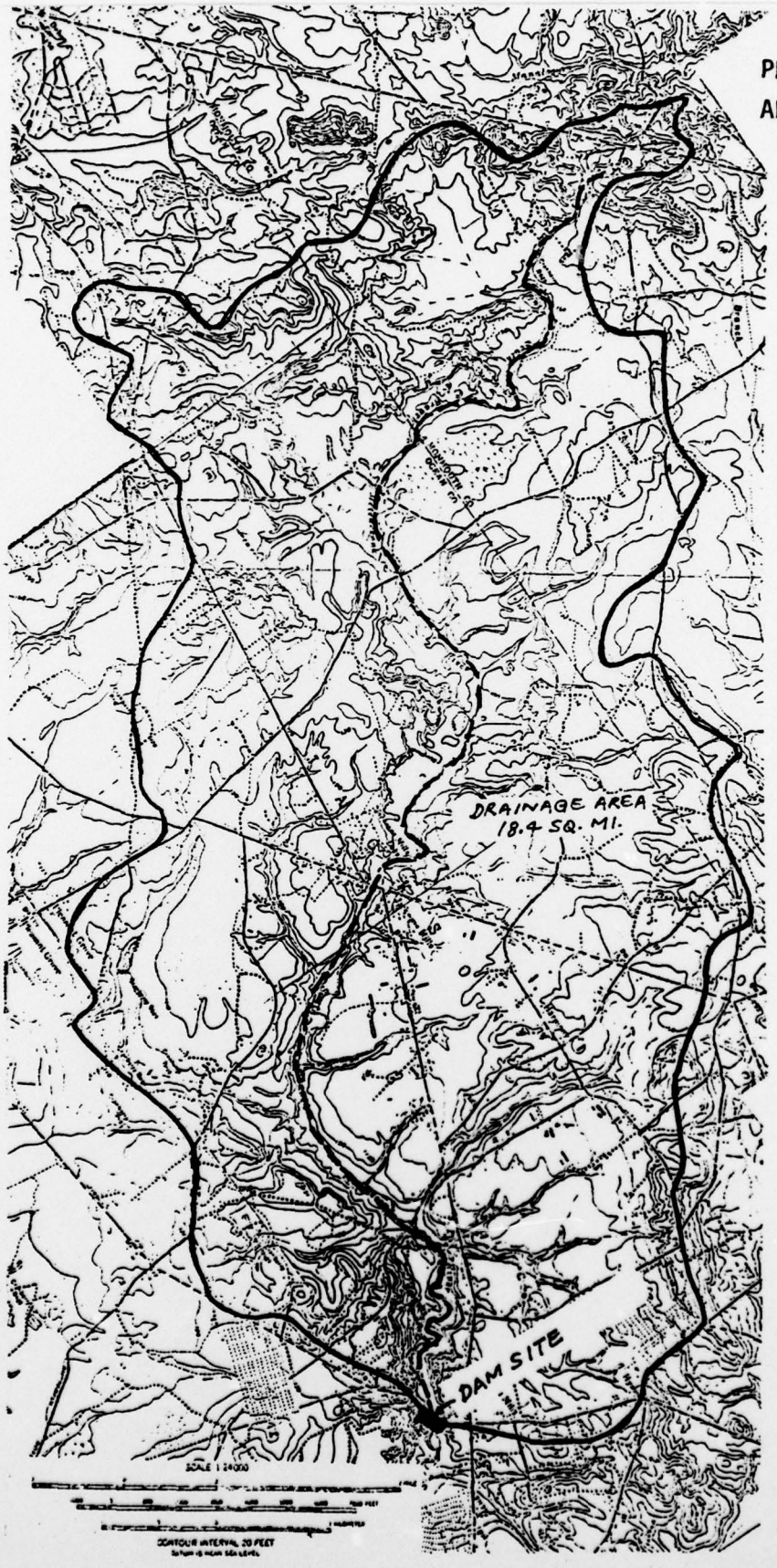
a. Type South Branch Metedeconk River
b. Location Lakewood, N.J. Route 88 Cedar Bridge Avenue
c. Records 1973-1976 (discontinued)

MAXIMUM NON-DAMAGING DISCHARGE Estimated at 1,030 cfs design capacity

APPENDIX D

HYDROLOGIC COMPUTATIONS

PLATE 1 -
APPENDIX D



BENNETT'S MILLS DAM - DRAINAGE BASIN

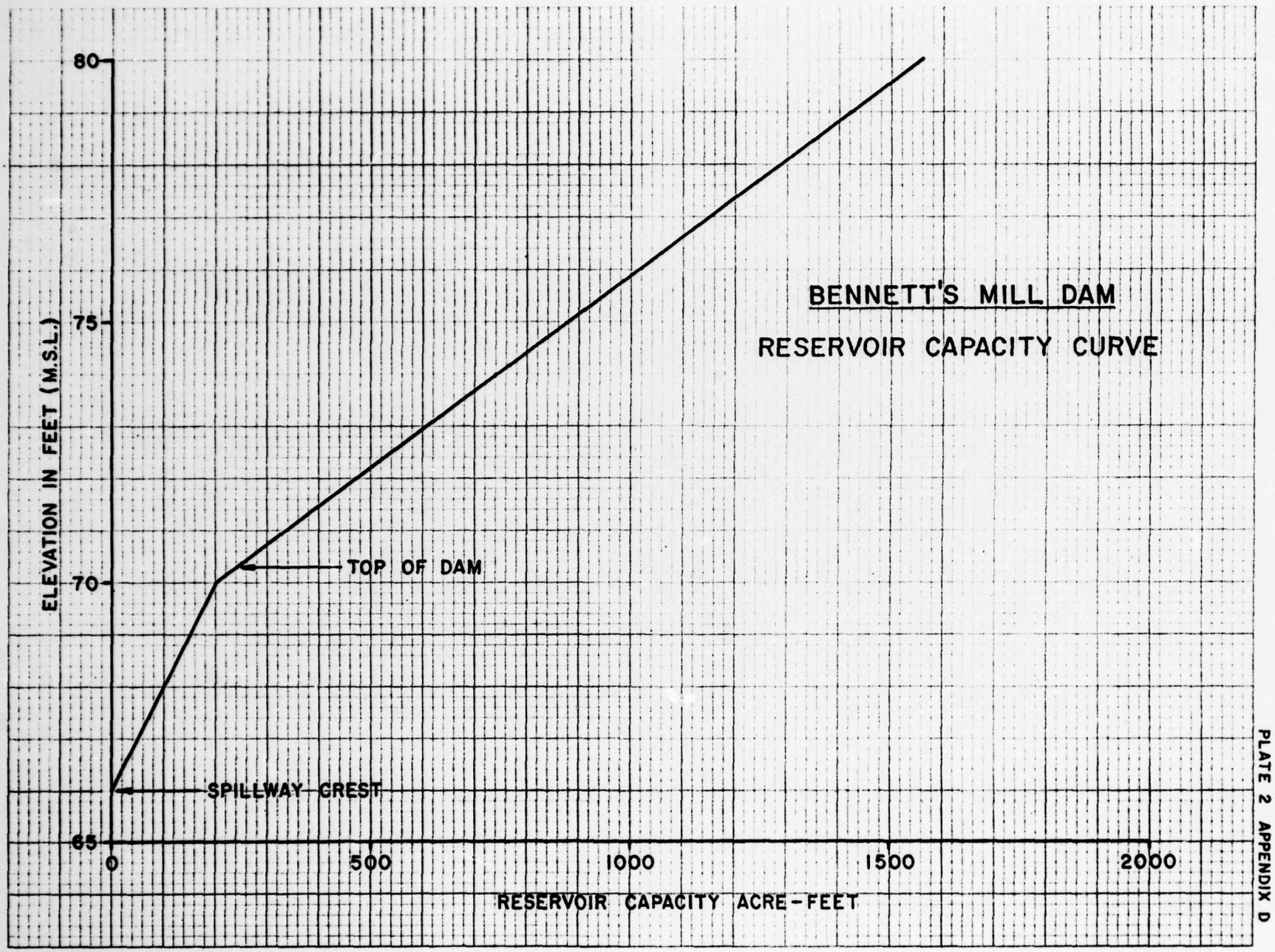


PLATE 2 APPENDIX D

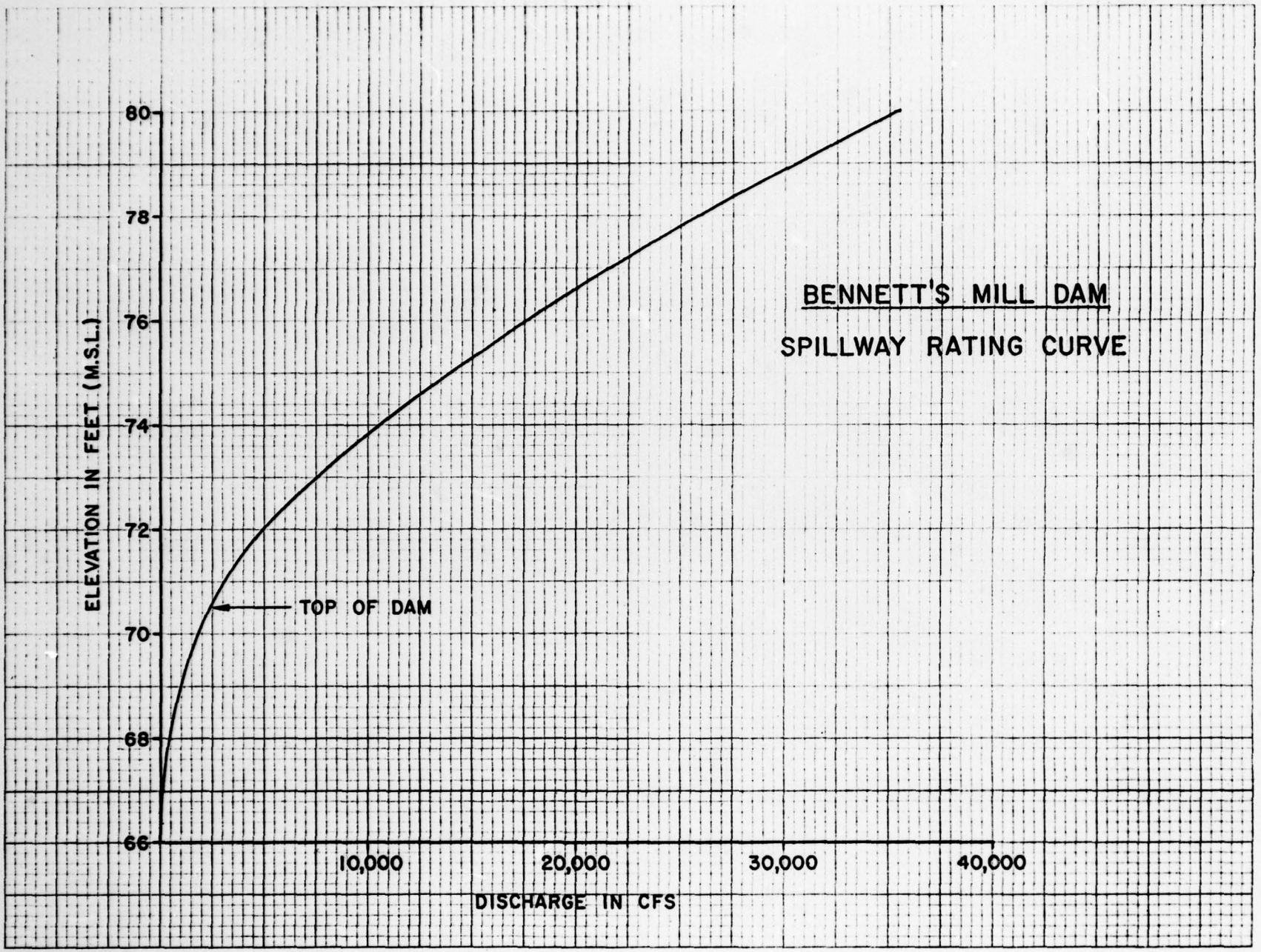


PLATE 3 APPENDIX D

HYDROLOGIC COMPUTATIONS

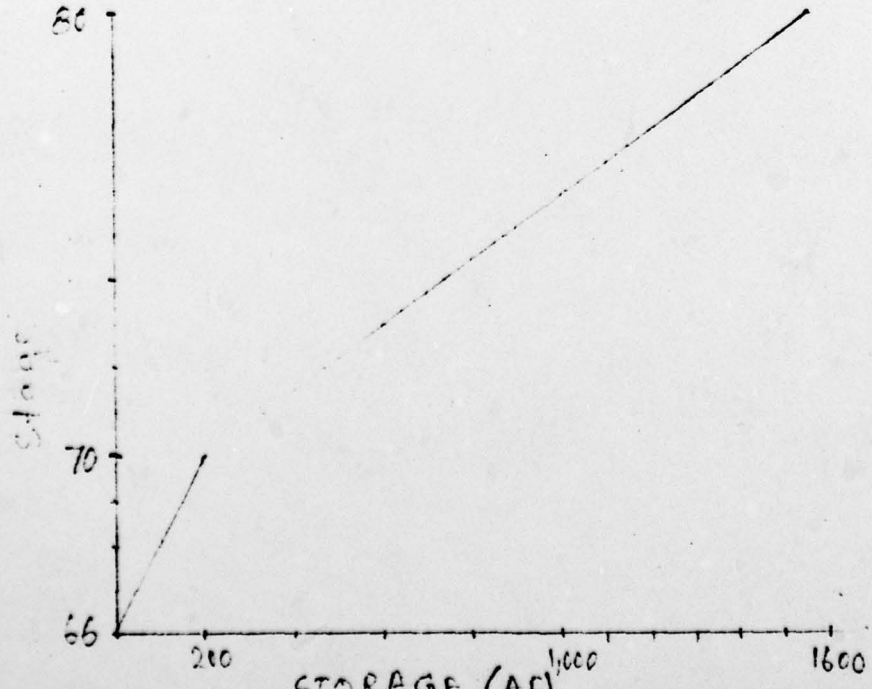
FREDERIC R. HARRIS, INC.
CONSULTING ENGINEERS

SUBJECT N.J. Dam Inspection
Barretts Mills Pond
COMPUTED BY [illegible] CHECKED BY

SHEET NO. 1 OF
JOB NO. 16-924
DATE Aug, 1978

The area of the lake at Pool level is planimetered from USGS maps. Areas at contours 70 and 80 are also planimetered and storage calculated.

Contours	Flow reading	Area	Storage (incremental) AF	Storage AF
Pool level (66')	0.35	$\frac{.35 \times 4 \times 10^6}{43,560}$ = 32 AC	0	0
70'	1.75	$\frac{1.75 \times 4 \times 10^6}{43,560}$ = 68 AC	$\frac{32+68}{2} \times 4$ = 200	200
80'	2.25	$\frac{2.25 \times 4 \times 10^6}{43,560}$ = 204 AC	$\frac{68+204}{2} \times 10$ = 1360	1560



FREDERIC R. HARRIS, INC.
CONSULTING ENGINEERS

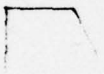
SUBJECT N.J. Dam Inspection
Bennetts Mills Dam
COMPUTED BY S.B. CHECKED BY

SHEET NO. 2 OF
JOB NO. 10-924
DATE Aug, 1978

Spillway

Outflow through the pipes are neglected

---------- Head (Dam) El. 73.3



Outflow $Q = C_w L H^{3/2}$

Spillway length = 60'
Dam crest = 350 - 60 = 290'

In Spillway $Q_{SP} = 3.3 \times 60 \times H^{3/2}$
$= 198 H^{3/2}$

In Dam $Q_D = 2.85 \times 290 \times (H - 4.3)^{3/2}$
$= 826 (H - 4.3)^{3/2}$

Where H = head over spillway

If $H \leq 4.3$ $Q_D = 0$

Water level	H above spillway	Outflow $198 H^{3/2} + 826 (H-4.3)^{3/2}$	Storage AF
66	0	0	0
67	1	198	50
68	2	560	100
69	3	1029	150
70	4	1584	200
71	5	2697	336
72	6	4741	472
73	7	7331	608
74	8	10,358	744
75	9	13,762	880
76	10	17,502	1016
77	11	21,548	1152
78	12	25,879	1288

FREDERIC R. HARRIS, INC.
CONSULTING ENGINEERS

SUBJECT N.J. Dam Inspection
Zerrells Mills Dam
COMPUTED BY S.B. CHECKED BY

SHEET No. 3 OF
JOB No. 10-924
DATE Aug. 1976

Reservoir Evaluation

a) Discharge Vs. Head

Gate = 42" ϕ pipe = $\frac{\pi}{4} \times \left(\frac{42}{12}\right)^2$ = [illegible] sq ft

$Q = C_d \times A \times \sqrt{2gh}$

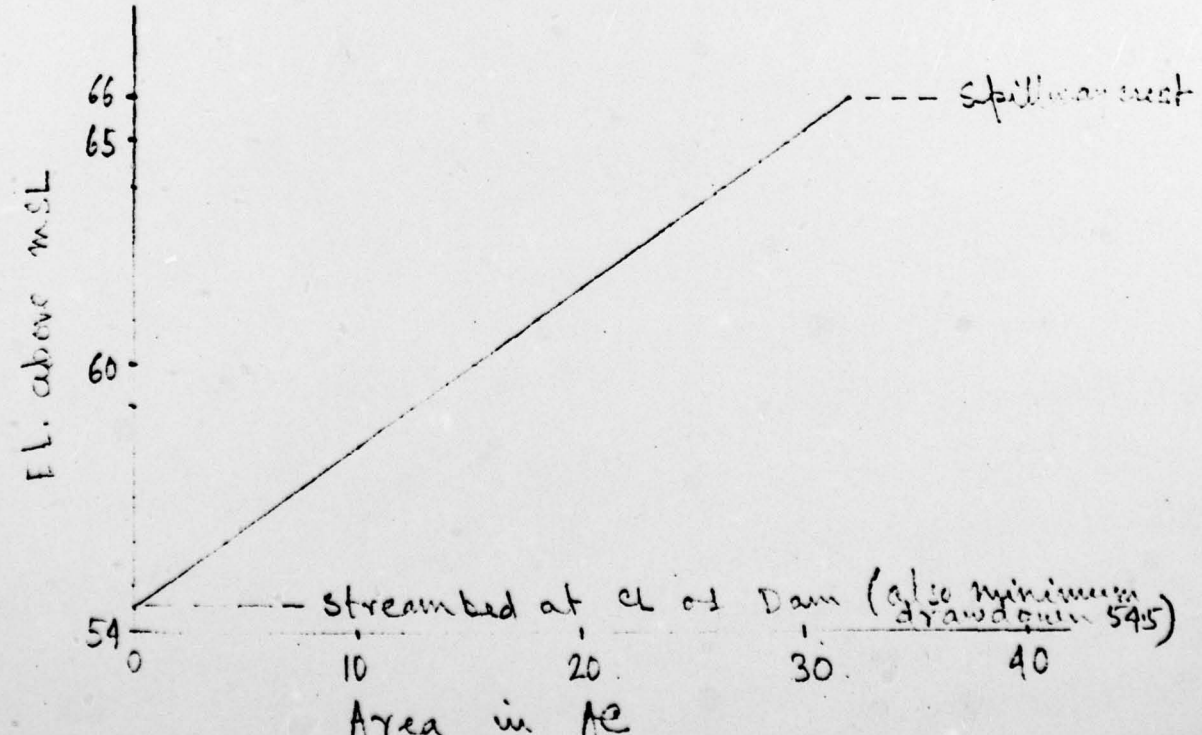
$= .9 \times 9.62 \times 2 \times \sqrt{h}$

$= 6.3 \sqrt{h}$

b) Area Vs. Head

Assume a straight line relationship from normal water surface to streambed at centerline of Dam (54.5 Ft)

At 66 Area = 32 AC
At 54.5 Area = 0



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SUBJECT N.J. Dam Inspection
Bennetts Mill Dam
COMPUTED BY S.B. CHECKED BY

SHEET NO. 4 OF
JOB NO. 10-924
DATE Aug. 1978

Drainage area = 16.4 sq miles
Inflow = 2 CFS / sq mile @ 36.8

EL	Area	Av. Area	Vol	Head on outlet (h_1)	Outlet Q $69.3\sqrt{h}$	Time to draw t_1 $\frac{Vol \times 2.4}{1.98 \times Q}$	Time to draw 2 cfs SH @ 36.8 cfs $\frac{36.8 \times t_1}{Q}$ t_2	Total time $t_1 + t_2$
(FT)	(AC)	(AC)	(AF)	(FT)	(CFS)	(HRS)	(HRS)	(HRS)
60	32							
		29.2	58.4	10.5	224.6	3.15	.52	3.67
55	26.43							
		23.7	47.4	8.5	202.0	2.84	.52	3.36
50	20.87							
		18.1	36.2	6.5	176.7	2.48	.52	3.00
45	15.30							
		12.5	25.0	4.5	147.0	2.06	.52	2.58
40	9.74							
		7.0	14.0	2.5	109.6	1.55	.52	2.07
35	4.17							
		2.1	3.2	.75	60.0	.65	.40	1.05
33.5	0							
						12.73		15.73

Time of complete drawdown with no inflow
≈ 13 hrs.

Time of complete drawdown with inflow of
2 cfs / sq mile ≈ 16 hrs.

FREDERIC R. HARRIS, INC.
CONSULTING ENGINEERS

SUBJECT N.J. Dam Inspection
Bennetts Mills Dam
COMPUTED BY S.B CHECKED BY

SHEET NO. 5 OF
JOB NO. 10-924
DATE Aug, 1978

Determination of Peak Discharges from Delaware River Basis Regionalized Frequency Relationships :-

S = Main Channel slope, in feet per mile, defined as the average slope of the main channel between points 10 and 85 percent of the distance upstream from the runoff site to the watershed boundary.
Estimated from from U.S.G.S Quad

Length of the watercourse = 9.19
El 10% u/s = 75 Ft
El 85% u/s = 160 Ft

$$S = \frac{160 - 75 \text{ Ft}}{6.89 \text{ mi}} = 12.34 \text{ Ft/mile}$$

DA = 18.4

$\therefore A\sqrt{S} = 64.64$

Considering the Upper reach of Delaware River Basin (Zone B) and extrapolating for $A\sqrt{S} = 64.64$

$Q_{100} \approx 980$ cfs

$Q_{50} \approx 1,200$ cfs

Ref:- "Basin wide Program for Flood Plain Delineation" Delaware River Basin Commission. June 1973