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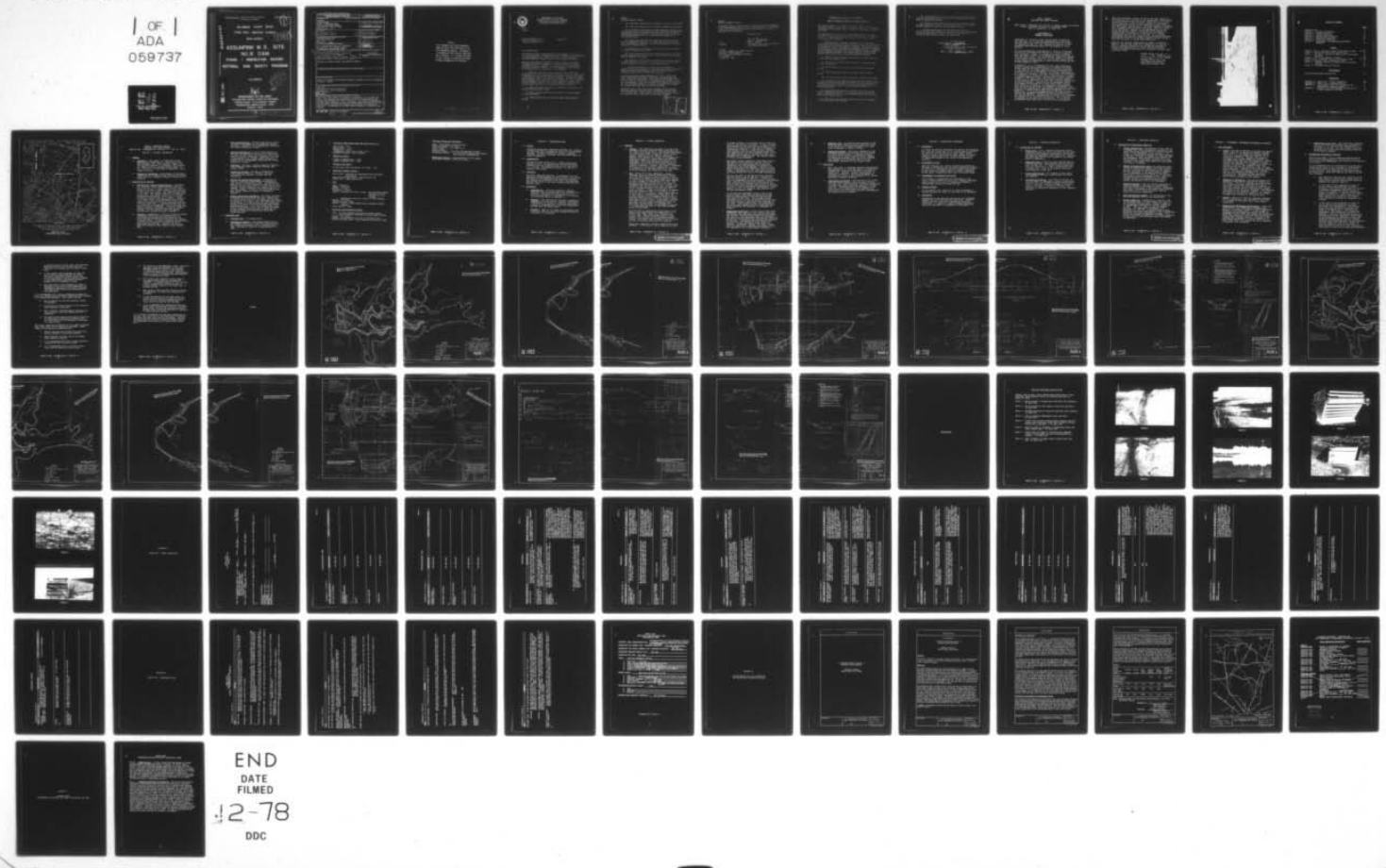

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DELAWARE RIVER BASIN

POND RUN, MERCER COUNTY

NEW JERSEY

ASSUNPINK W.S. SITE NO. 8 DAM

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

NJ 00543

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

AUGUST 1978

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

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3. RECIPIENT'S CATALOG NUMBER:

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National Dam Safety Program
Assunpink W.S. Site No. 8 Dam
Mercer County, N.J.

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7. AUTHOR(s): (10) Michael Baker, III P.E.

8. CONTRACT OR GRANT NUMBER(s): (15) DACW61-78-C-0141

9. PERFORMING ORGANIZATION NAME AND ADDRESS:
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4301 Dutch Ridge Rd.
Box 280
Beaver, Pa. 15009

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: (12) 84p

11. CONTROLLING OFFICE NAME AND ADDRESS:
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Custom House, 2d & Chestnut Streets
Philadelphia, Pennsylvania 19106

12. REPORT DATE: (11) Aug[redacted]78

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Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Copies are obtainable from National Technical Information Service, Springfield, Virginia, 22151.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)
Dams--N.J.
National Dam Safety Program Phase I
Assunpink W.S. Site No. 8 Dam, N.J.
Dam Inspection
Dam Safety

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

20 SEP 1978

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Assunpink W.S. Site No. 8 Dam in Mercer 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 four pages of the report.

Based on visual inspection, available records, calculations and past operational performance, Assunpink W.S. Site No. 8 Dam, a high hazard potential structure, is judged to be in good overall condition and the spillway is considered adequate. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. Within one month of the date of approval of this report the engineering studies and analyses described in the body of the report should be performed by a qualified professional consultant, engaged by the owner, to determine the cause of the embankment sloughage. Any remedial measures found necessary should be initiated within calendar year 1979. In addition, detailed emergency operation and evacuation plans and a warning system, should be promptly developed. Also, during periods of unusually heavy precipitation, around-the-clock surveillance should be provided.

b. Within six months from the date of approval of this report, the following actions should be taken:

(1) Ruts on the dam crest should be filled in to prevent ponding of water and reseeded.

(2) Debris against the riser and in the impact basin should be removed.

(3) Small animal guards should be installed on the toe drain outlets.

(4) A low flow orifice trash rack should be installed on the riser.

(5) All gullies on the embankment slopes, auxiliary spillway slopes and adjacent to the right abutment should be filled in and reseeded. If renewed erosion occurs on the south cut slope of the auxiliary spillway, consideration should be given to constructing paved gutters or to flattening the slope.

(6) Bare eroded areas adjacent to the sides of the impact basin should be regraded and reseeded. If renewed erosion at this location occurs, consideration should be given to placing durable rip-rap of the proper size to protect the toe.

(7) Bare areas in the auxiliary spillway and near the embankment toe should be topsoiled and reseeded.

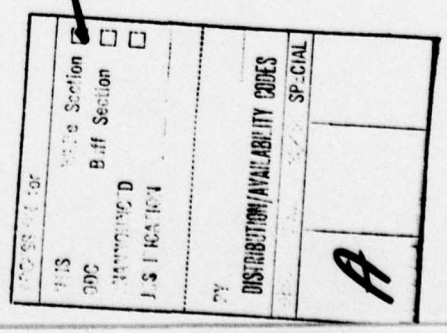
(8) On the upstream side of the dam, areas of slight wave erosion above the bench and the area of slight surface sloughage near the riser should be repaired and reseeded.

(9) Continued efforts should be made to keep unauthorized vehicles, including motor bikes, off the dam and adjacent areas. Damaged fences should be repaired or replaced, or other barriers erected.

c. Periodic inspections of the dam, auxiliary spillway and appurtenant structures including the riser gate valve should be conducted. Special attention should be given to possible seepage through the embankment during periods of higher than normal pool.

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 Frank Thompson, Jr. of the Fourth District. Under the provisions 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 yours,

JOEL T. CALLAHAN
Lieutenant Colonel, Corps of Engineers
Acting District Engineer

1 Incl
As stated

Cy furn:
Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N. J. Dept. of Environmental Protection
P.O. Box 2809
Trenton, NJ 08625

ASSUNPINK W.S. SITE NO. 8 DAM (NJ00543)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 23 June 1978 by Michael Baker, Jr., Inc. Consulting Engineers under contract to the U. S. Army Engineer District, Philadelphia, in accordance with the National Dam Inspection Act, Public Law 92-367.

The Assunpink W.S. Site No. 8 Dam, a high hazard potential structure, is judged to be in good overall condition and the spillway is considered adequate. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. Within one month of the date of approval of this report the engineering studies and analyses described in the body of the report should be performed by a qualified professional consultant, engaged by the owner, to determine the cause of the embankment sloughage. Any remedial measures found necessary should be initiated within calendar year 1979. In addition, detailed emergency operation and evacuation plans and a warning system, should be promptly developed. Also, during periods of unusually heavy precipitation, around-the-clock surveillance should be provided.

b. Within six months from the date of approval of this report, the following actions should be taken:

(1) Ruts on the dam crest should be filled in to prevent ponding of water and reseeded.

(2) Debris against the riser and in the impact basin should be removed.

(3) Small animal guards should be installed on the toe drain outlets.

(4) A low flow orifice trash rack should be installed on the riser.

(5) All gullies on the embankment slopes, auxiliary spillway slopes and adjacent to the right abutment should be filled in and reseeded. If renewed erosion occurs on the south cut slope of the auxiliary spillway, consideration should be given to constructing paved gutters or to flattening the slope.

(6) Bare eroded areas adjacent to the sides of the impact basin should be regraded and reseeded. If renewed erosion at this location occurs, consideration should be given to placing durable rip-rap of the proper size to protect the toe.

(7) Bare areas in the auxiliary spillway and near the embankment toe should be topsoiled and reseeded.

(8) On the upstream side of the dam, areas of slight wave erosion above the bench and the area of slight surface sloughage near the riser should be repaired and reseeded.

(9) Continued efforts should be made to keep unauthorized vehicles, including motor bikes, off the dam and adjacent areas. Damaged fences should be repaired or replaced, or other barriers erected.

c. Periodic inspections of the dam, auxiliary spillway and appurtenant structures including the riser gate valve should be conducted. Special attention should be given to possible seepage through the embankment during periods of higher than normal pool.

APPROVED: Joel T. Callahan

JOEL T. CALLAHAN
Lieutenant Colonel, Corps of Engineers
Acting District Engineer

DATE: 20 September 1978

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam - Assunpink W.S. Site No. 8, Mercer County, New Jersey
Stream - Pond Run (Tributary to Assunpink Creek)
Date of Inspection - 23 June 1978

ASSESSMENT OF GENERAL CONDITIONS

Assunpink W.S. Site No. 8 Dam, locally known as Hamilton Park Lake Dam, is an earth dam approximately 20 feet high and 1450 feet long, owned and operated by Hamilton Township and designed by the U.S. Soil Conservation Service in the Assunpink Creek Watershed Basin for the purpose of flood control.

The visual inspection of Assunpink W.S. Site No. 8 Dam made in June 1978 disclosed that the dam is in overall generally good condition. However, an anomalous slump or sloughage area was found to exist on the embankment immediately upslope from the impact basin. The cause of this slump or sloughage is not known, but may be due to a serious deficiency such as piping through the embankment at this location during periods of high reservoir level.

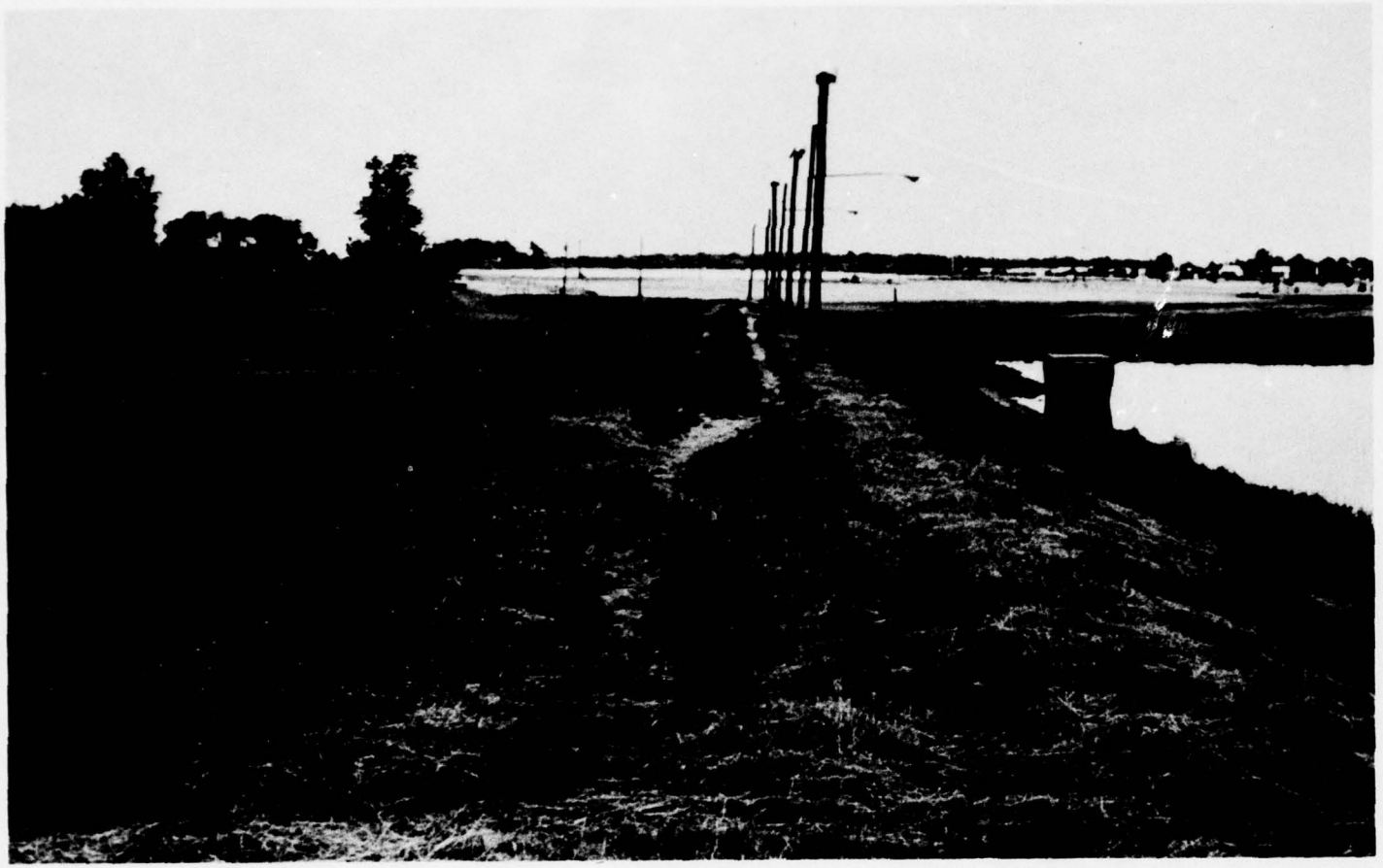
Consequently, it is recommended that the owner immediately conduct an additional investigation to determine the cause of the slump and to develop appropriate corrective measures. If the cause of the slump cannot be readily determined and corrected, then it is recommended that further investigation be conducted, including: borings, installation and monitoring of piezometers or observation walls, installation of a gauge to measure reservoir levels, and surveying to detect possible movement of the impact basin and possible further movement of the slump to determine its cause and to develop appropriate corrective measures. Inspection of the embankment slopes for seepage during periods of higher than normal reservoir level should be included in this additional investigation. Once the cause of the slump or sloughage is determined, work should begin immediately on implementing appropriate corrective measures, including proper repair and revegetation of the slump area. It is also recommended that the owner very soon develop and implement emergency operations procedures for the dam and reservoir, including who to notify in an emergency and preparation of an evacuation plan for areas which will be affected in the event of a dam failure. It is further recommended that other items of work be soon performed by

the owner including: repair of ruts on the dam; removal of debris against the riser and in the impact basin; installation of animal guards on the toe drains; installation of a trash rack on the riser lowflow orifice; filling in, regrading, and revegetating gullies on the embankment slopes, auxiliary spillway slopes, and adjacent to the right abutment; revegetating, including topsoiling where necessary, other bare areas on the embankment, adjacent to the embankment and in the auxiliary spillway channel; and repair or replacement of broken fences or erection of other barriers to prevent unauthorized vehicle traffic on the dam. It is further recommended that periodic inspections of the dam be performed with special attention to possible seepage through the dam when the reservoir is higher than normal pool.

Based on the criteria established for Phase I Inspection Reports, the spillway capacity of Assunpink W.S. Site No. 8 Dam is considered adequate since the dam was designed to prevent overtopping from the runoff resulting from the Probable Maximum Precipitation of 26 inches of rainfall from a six hour storm.

MICHAEL BAKER, JR., INC.

Michael Baker, III, P.E.
Chairman of the Board and
Chief Executive Officer
Registration Number 13385



OVERALL VIEW OF DAM

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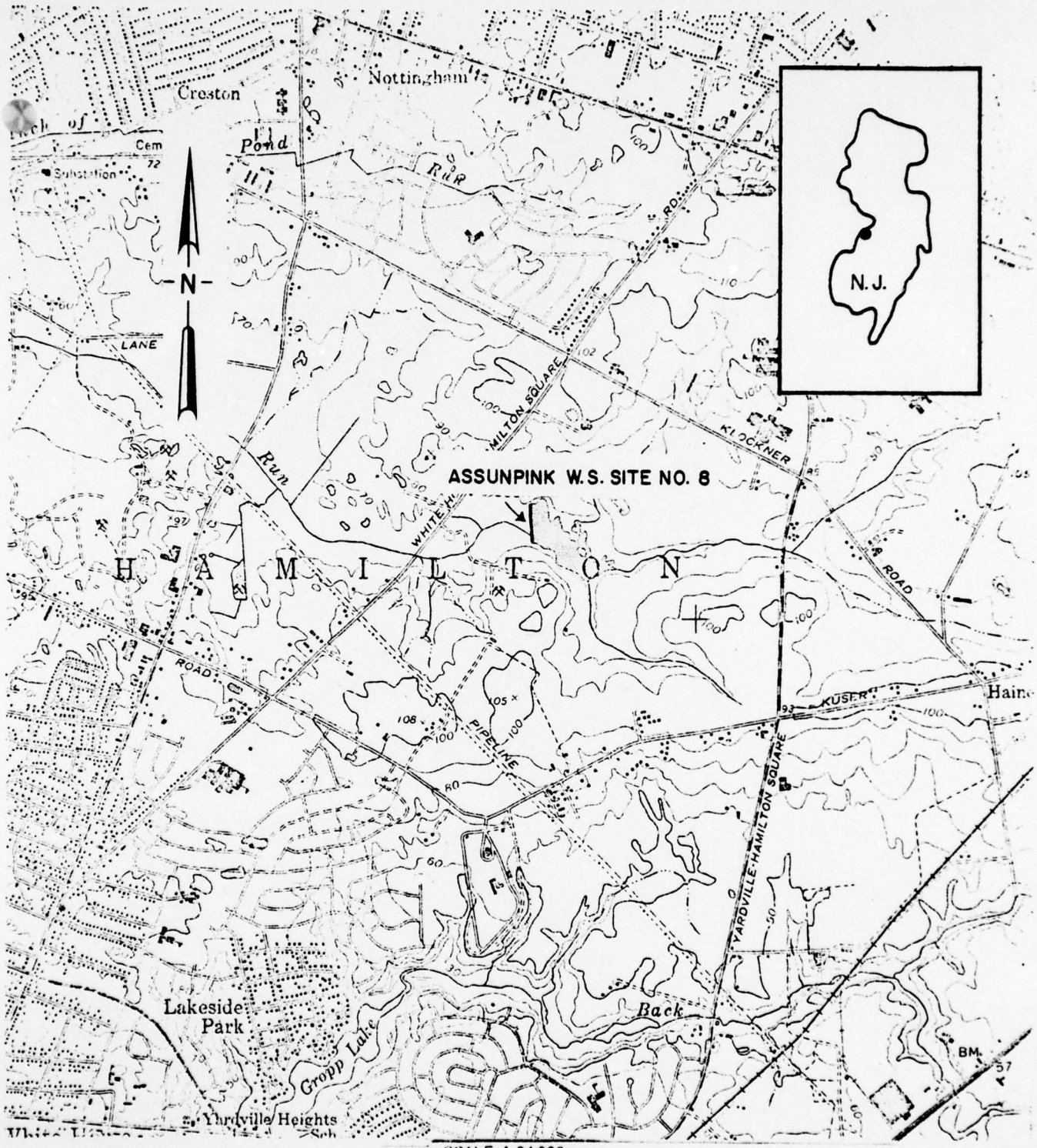

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LOCATION PLAN
ASSUNPINK W.S. SITE NO. 8

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NAME OF DAM: ASSUNPINK W.S. SITE NO. 8, ID# NJ 00543

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority - This report is authorized by the National Dam Inspection Act, Public Law 92-367, 92nd Congress, H.R. 15951 enacted 8 August 1972 and has been prepared in accordance with Contract No. DACW61-78-C-0141 between Michael Baker, Jr., Inc., and the U.S. Army Corps of Engineers, Philadelphia District.

b. Purpose of Inspection - The purpose of the Phase I Inspection is to expeditiously identify those dams which might be a potential hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances - Assunpink W.S. Site No. 8 Dam, locally known as Hamilton Park Lake Dam, is an earth fill dam with a crest height of 20 feet, a crest length of 1450 feet and a crest width of 15 feet. The emergency spillway is an earth, side channel type with a bottom width of 210 feet. The outlet structure is a two-way, standard covered concrete riser with a 36 inch reinforced concrete pipe for a conduit. There is a low stage inlet on the embankment side of the riser with a crest elevation of 65.96 feet which controls normal pool. A crank operated lift gate is installed on the upstream side of the riser to drain the lake if necessary. "As built" plans and typical sections of the dam are shown on Plates 1 through 5 and the "Design" plans and typical sections are included as Plate 6 through 10.

b. Location - Assunpink W.S. Site No. 8 Dam is located on Pond Run about four miles upstream of its confluence with Assunpink Creek and about two miles upstream of the city of Trenton, New Jersey in Mercer County. A highly urbanized and industrialized section of Trenton is located two miles downstream from the dam. Regional and Vicinity Maps are included in this report as the Location Plan.

c. Size Classification - The dam classifies as being of "Small" size based on its height and storage capacity as defined by the "Recommended Guidelines for Safety Inspection of Dams."

d. Hazard Classification - Due to the proximity of the city of Trenton, New Jersey with a population of about 115,000, many lives could be lost in the event of failure of the dam. Therefore, this dam is considered in the "High" hazard category as defined by the "Recommended Guidelines for Safety Inspection of Dams."

e. Ownership - The dam is owned by Hamilton Township, 2090 Greenwood Avenue, Hamilton Township, New Jersey 08609.

f. Purpose of the Dam - The dam is designed as a flood control structure. However, the area surrounding the reservoir is also used for recreation.

g. Design and Construction History - Assunpink W.S. Site No. 8 Dam was investigated and designed in 1966 and was constructed in 1967. The design was done by the U.S. Soil Conservation Service (S.C.S.). The dam was constructed by E.J. Crosby Construction Company. Yearly inspectons are made by the S.C.S. and the township. A copy of the Design Report and most recent inspection report is included in Appendix C.

h. Normal Operational Procedures - No formal operating procedures are followed on this dam. Normal pool is controlled by the riser low stage orifice crest elevation of 65.96 feet. Two high stage riser crests at elevation 72.5 feet control the high stage pool. Excess flows are diverted through the side channel emergency spillway. An 18 inch square drain lift gate at the bottom of the riser is normally opened by the township during periods of heavy rain to minimize flooding of recreational facilities around the dam.

1.3 PERTINENT DATA

a. Drainage Area - 3.0 square miles

b. Discharge at Damsite - The maximum known flow at this damsite was in 1971 when the auxiliary spillway flowed approximately one and one-half feet deep, reaching an elevation of approximately 75.7 feet.

c. Elevation [feet above Mean Sea Level (M.S.L.)] -

Top of Dam - 80.2
Maximum Pool - 76.4
Normal Pool - 66.0
Streambed at Centerline of Dam - 62.0
Maximum Tailwater - Not available

d. Reservoir (feet) -

Length of Maximum Pool - 7000
Length of Normal Pool - 1900

e. Storage (acre-feet) -

At Spillway Crest (Elevation 74.2 Feet) - 500

f. Reservoir Surface (acres) -

Top of Dam - Could not be determined from available information.
Auxiliary Spillway Crest - Approximately 136
Normal Pool - Approximately 13

g. Dam -

Type - Earthfill
Length - 1450 feet
Height - 20 feet
Top Width - 15 feet
Slopes - Upstream "as built" slope - two and three-tenths horizontal to one vertical (2.3:1) maximum
- Downstream "as built" slope - 2.35:1 maximum
Zoning - Two zones
Impervious Core - None
Cutoff - Cutoff trench extends below permeable gravel stratum
Grout Curtain - None

h. Diversion and Regulating Tunnel -

Type - 36 inch diameter reinforced concrete outlet pipe (Principal Spillway) with anti-seep collars
Length - 97.0 feet
Access - Through manhole at top of concrete riser
Regulating Facilities - Crank operated sliding lift gate

i. Spillway (Auxiliary Spillway) -

Type - Side channel earth spillway
Width of Channel - 210 feet
Crest Elevation - 74.2 feet M.S.L.
Gates - None
Upstream Channel - 210 feet wide approach channel
Downstream Channel - 210 feet wide releasing into nearly level heavily forested area

j. Regulating Outlets - Crank operated 18 inch square drain gate located at bottom of riser.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

Available design data considered necessary for a Phase I Investigation were furnished by the S.C.S. who designed the dam. The data included the original "design" drawings, "as built" drawings, and the Design Report as found in Appendix C.

2.2 CONSTRUCTION

The dam was constructed by E.J. Crosby Construction Company in 1967. No construction records were made available for this inspection but are on file at the S.C.S. Office, 1370 Hamilton Street, P.O. Box 219, Somerset, New Jersey.

2.3 OPERATION

The owner, Hamilton Township, is responsible foı all operation and maintenance including liming, fertilizing and mowing of the embankment and auxiliary spillway; the seeding and mulching of bare areas; and repairing gullies that occur in the dam, auxiliary spillway and adjacent areas.

2.4 EVALUATION

a. Availability - "As built" drawings, "design" drawings, and the Design Report for Assunpink W.S. Site No. 8 Dam were obtained from the S.C.S. Hydrology and hydraulic information are included in the Design Report in Appendix C.

b. Adequacy - The information available is generally adequate for design review. However, additional investigation is needed to determine the cause of a slump or sloughage area on the dam immediately upslope from the impact basin.

c. Validity - There is no reason at the present time to believe that the available engineering data is inaccurate or misleading.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General - The inspection was made on 23 June 1978. No unusual weather conditions were experienced and the lake was at normal pool. The dam and appurtenant structures were found, in general, to be in good overall condition at the time of inspection. However, the presence of a slump or sloughage area immediately above the impact basin may possibly have been caused by a serious deficiency in the embankment. The other problems observed are not considered serious and do not require immediate remedial treatment. However, the slump or sloughage area should be investigated immediately in order to determine if it has been caused by a deficiency which may endanger the integrity of the dam.

b. Dam - During the visual inspection a slump or sloughage area was observed immediately upslope from the impact basin as shown in Photos 6 and 7. The slump or sloughage area was measured to extend 21 feet upslope from the impact basin and appeared to have a length of approximately 37 feet. The maximum displacement at the top of the slump or sloughage area was measured to be 22 inches. Soil exposed at the surface in this area was observed to be a medium-fine sand with some silt and a trace of gravel. Slopes in the slump or sloughage area were measured to be 2.3 horizontal to one vertical (2.3:1) or flatter. Small areas adjacent to the slump or sloughage were observed to be slightly eroded, but no seepage from this area or from any other portion of the dam slope or areas downstream could be found. A very small (one-half foot deep or less) gully extended down from the dam crest into the slump or sloughage area. Additional investigation, as discussed in Section 7, to determine the cause of the slope movement should be performed.

The toe drain or underdrains which outlet at the sides of the impact basin were observed to be flowing with clear water at an estimated one G.P.M., each. These discharges cause a slight reddish iron staining of the discharge channel, locally. The small animal guards at the toe drain outlets were missing and should be replaced.

During the inspection, several eroded gullies were observed. A few gullies, one as deep as two feet,

as shown in Photo 2, are present on the south cut slope of the auxiliary spillway. At this location, the steepness of the cut slope (as steep as 1.3:1 versus 2.5:1 shown on the "as built" drawings) has contributed to erosion. Other gullies, varying from one-half foot to one and one-half feet deep, were observed near the left abutment (Photo 1), at the impact basin and just upslope from the right abutment near a parking area. All gullies should be filled in and reseeded.

Bare spots without vegetative cover were noted in the bottom of the auxiliary spillway (Photo 3) adjacent to the impact basin and in the area downstream from the embankment toe between the impact basin and right abutment. Except for the auxiliary spillway, the bare areas are of limited extent. Revegetation of all bare spots should be performed during the course of normal maintenance.

Ruts on the crest of the dam were also observed and were found to be as deep as 12 inches with water locally ponded in the ruts. Filling of the ruts is recommended to prevent ponding. Unauthorized motor vehicles including trail bikes should be kept off the dam to prevent ruts as well as gully erosion where such vehicles have previously traveled on slopes. The use of fences, barricades or other means of control is needed to keep vehicles off the dam and adjacent areas.

On the upstream embankment slope a very slight wave cut bench, less than six inches wide, was observed approximately three feet above normal pool south of the riser. Very slight surface sloughage of soil in an area about six by ten feet was also noted just above this level adjacent to the riser. These features have not progressed to the point where remedial action, other than very minor regrading and reseeding, is necessary at present.

c. Appurtenant Structures - At the time of the visual inspection, the riser low flow orifice trash rack was missing and some debris was partially blocking the orifice. The hand crank wheel for operating the gate valve was removed by the owner to avoid the possibility of vandalism and unauthorized operation of the gate. The impact basin was noted to be partially filled with debris which should be removed. In general; however, the riser, outlet pipe and impact basin forming the principal spillway appeared to be in good overall condition.

d. Reservoir Area - No problems were observed in the reservoir area. Reservoir side slopes were noted to be nearly flat to gently sloping with a good cover of grasses or stands of forest.

e. Downstream Channel - The outlet channels for the principal spillway and auxiliary spillway showed no signs of past erosion. Although no riprap lining of the principal spillway outlet channel was observed as shown on the "as built" drawings, none appears to be necessary due to the well established vegetation on the channel banks.

3.2 EVALUATION

a. Dam - The slump or sloughage observed and described in paragraph 3.1.b. does not appear to immediately endanger the structural stability of the dam at normal pool. However, further investigation, as discussed in Section 7, should be performed to determine the cause of the sloughage and to devise appropriate remedial measures.

b. Appurtenant Structures - The missing orifice trash rack and animal guards on the toe drain outlets, although not a serious problem, should be reinstalled to insure the proper operating condition of these features. The accumulation of the debris at the riser and in the impart basin is hindering the functioning of the principal spillway. Consequently, the debris should be removed.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

No formal operational procedures are used at the Assunpink W.S. Site No. 8 Dam since it is a flood control structure and does not require the use of water supply intake valves or gates. The reservoir under normal conditions remains at approximately El. 66 feet and has 8.2 feet of additional storage to the crest of the emergency spillway.

4.2 MAINTENANCE OF DAM

Hamilton Township has a yearly maintenance program for the dam in conjunction with an annual inspection assisted by the S.C.S. Maintenance which is normally performed by the township includes removal of debris, repairing eroded areas, revegetating bare spots and mowing grass.

4.3 MAINTENANCE OF OPERATING FACILITIES

The township is responsible for maintenance of the riser. During periods of heavy rain, township personnel open the gate in the riser to minimize flooding of recreational facilities around the lake.

4.4 WARNING SYSTEMS

At the present time, there are no warning systems or evacuation plans in effect in the event of an emergency.

4.5 EVALUATION

Maintenance of the operating facilities are considered adequate for the functions that they serve. However, formal records of lift gate inspections should be instituted. In addition, formal emergency procedures should be developed as recommended in paragraph 7.2.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data - S.C.S. hydraulic/hydrologic design criteria included the use of the auxiliary spillway hydrograph and freeboard hydrograph to select the spillway and embankment crest elevations. Hydraulic and hydrologic details are included in the Design Report in Appendix C.

b. Experience Data - Based on visual observations of township personnel, approximately one and one-half feet of water (El. 75.7 feet) flowed through the auxiliary spillway as a result of Hurricane Doria in August 1971. This is the highest known pool level observed at the dam.

c. Visual Observations - No evidence of past flood flow damage to the dam or appurtenant structures was observed.

d. Overtopping Potential - The crest of the dam, at El. 80.2 feet, is designed to contain flood waters resulting from the Probable Maximum Precipitation (P.M.P.) six hour storm of 26 inches of rainfall. Based on the Phase I Inspection criteria, the spillway is considered; therefore, to have adequate capacity.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations - The presence of the slump or sloughage area located immediately adjacent to the impact basin may indicate that a serious deficiency exists in the embankment of this location. No slumps or significant sloughage was noted elsewhere on the dam. Although no seepage was observed from the embankment, some seepage or piping may occur during periods of high pool elevation in the area adjacent to the impact basin which may have caused the slump or sloughage.

b. Design and Construction Data - No stability calculation or construction records were made available for review during the preparation of this report. However, according to the Design Report (Appendix B), the embankment as designed should be amply stable due to the low fill height of the dam with the proposed design embankment slopes. The toe or foundation drains were designed to intercept seepage through the permeable material and to control the phreatic line in the embankment.

c. Operating Records - The last yearly inspection as found in Appendix C indicates no deteriorating conditions beyond minor surface erosion. Apparently, the slump or sloughage at the impact basin occurred after April 1978 or occurred earlier and was missed in previous inspections.

d. Post Construction Changes - No alterations of the dam were apparent since it was constructed.

e. Seismic Stability - Assunpink W.S. Site No. 8 Dam is in Seismic Zone 1 on the "Seismic Zone Map of the Contiguous United States," Figure 1, page D-30 of "Recommended Guidelines for Safety Inspection of Dams." This is a zone of very low seismic activity. As indicated in paragraph 6.1.b., Assunpink W.S. Site No. 8 could be shown to meet the static stability requirements of the "Recommended Guidelines for Safety Inspection of Dams." As a result, no further consideration of seismic stability is evaluated as being necessary under the present circumstances.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety - The dam is designed to prevent overtopping under conditions exceeding the Probable Maximum Flood (P.M.F.). No seepage was observed during the visual inspection when the reservoir was at normal pool elevation. However, the slump or sloughage area located immediately upslope from the impact basin may have been caused by a serious problem with the dam such as seepage or piping through the embankment, or seepage flow around the exterior of the 36 inch diameter outlet pipe during periods when the reservoir level is higher than normal pool. Because of such possible problems, which if present could possibly cause a piping failure, the safety of Assunpink W.S. Site No. 8 Dam can not be determined without additional investigation. Although some erosion exists, major erosion problems are not present.

b. Adequacy of Information - The data available were generally sufficient to evaluate the adequacy of the design. "As built" drawings and visual inspection indicated no great departure from design conditions, except for the south cut slope of the auxiliary spillway which is substantially steeper than shown on the "as built" drawings. The available information is not adequate, however, to evaluate the safety of the dam with respect to the slump or sloughage area adjacent to the impact basin.

c. Urgency - There is no need for emergency measures, but an investigation into the cause of the slump or sloughage at the impact basin should begin immediately.

d. Necessity for Additional Investigation - Additional investigation is recommended to determine the cause of the slump or sloughage located immediately adjacent to the impact basin. If this slump or sloughage has been caused by seepage through the embankment during higher than normal pool elevations; future high reservoir levels may cause additional slumping and a seepage failure. A portion of the "Recommended Guidelines for Safety Inspection of Dams" which deals with seepage failure is presented in Appendix D for reference.

e. Responsibility of Owner - The additional investigation of the slump or sloughage area recommended in paragraph 7.1.d. should be the responsibility of the owner of the dam. The owner should secure the necessary data and perform any necessary analyses at the owner's expense.

7.2 RECOMMENDATIONS/REMEDIAL MEASURES

Based on the Phase I Visual Inspection and the review of available engineering data, the following items of work should begin immediately and should be soon completed by the owner.

It is recommended that an investigation be conducted to determine the cause of the sloughage or slump adjacent to the impact basin and that appropriate corrective action be taken. This additional investigation should be conducted by a qualified engineer and should include the following:

1) The interior of the principal spillway outlet pipe should be examined for leaking joints or other defects and any defects found should be promptly and properly repaired.

2) If the cause of the sloughage or slump can not be readily determined and the cause corrected, then test borings should be drilled to determine embankment conditions and to obtain soil samples for testing appropriate physical properties. A portion of the "Recommended Guidelines for Safety Inspection of Dams" dealing with foundation and material investigations is presented in Appendix D as a guide.

3) If the cause of the sloughage or slump can not be readily determined and the cause corrected, then piezometers or observation wells should be installed in and near the slump or sloughage area to determine the elevation of the phreatic line through the embankment, and to determine the effect of seepage, if observed, on the piping potential and stability of the embankment. Monitoring of the piezometers or observation wells and examining the embankment slope for seepage should be done during periods when the reservoir is above normal pool elevation, especially when the reservoir level is very high. A gauge should be installed so that readings of the reservoir level can be taken when piezometer

or observation well water levels are measured. Monitoring should also be done when the reservoir is at normal pool to obtain a data base.

4) If the cause of the sloughage or slump can not be readily determined and the cause corrected, additional surveys should then also be performed to detect possible movement of the impact basin and possible further movement of the sloughage or slump.

5) Once the cause of the sloughage or slump is determined, work should begin immediately on implementing appropriate corrective measures, including proper repair and revegetation of the slump area.

It is recommended that a formal emergency procedure be very soon prepared and prominently displayed and furnished to all operating personnel. This should include:

1) How to operate the dam and reservoir during an emergency.

2) Procedures for rapid drawdown of the reservoir under emergency conditions.

3) Who to notify, including public officials, in case evacuation from the downstream area is necessary.

4) The owner should assist other public officials in developing an emergency evacuation plan for areas which will be affected in the event of a dam failure.

The visual inspection conducted for this report revealed that other items of work should be performed. These items of work should be completed soon.

1) Ruts on the dam crest should be filled in to prevent ponding of water and reseeded.

2) Debris against the riser and in the impact basin should be removed.

3) It is recommended that small animal guards be installed on the toe drain outlets.

4) It is recommended that a low flow orifice trash rack be installed on the riser.

5) All gullies on the embankment slopes, auxiliary spillway slopes and adjacent to the right abutment should be filled in and reseeded. If renewed erosion occurs on the south cut slope of the auxiliary spillway; consideration should be given to constructing paved gutters or to flattening the slope.

6) Bare eroded areas adjacent to the sides of the impact basin should be regraded and reseeded. If renewed erosion at this location occurs, consideration should be given to placing durable riprap of the proper size to protect the toe.

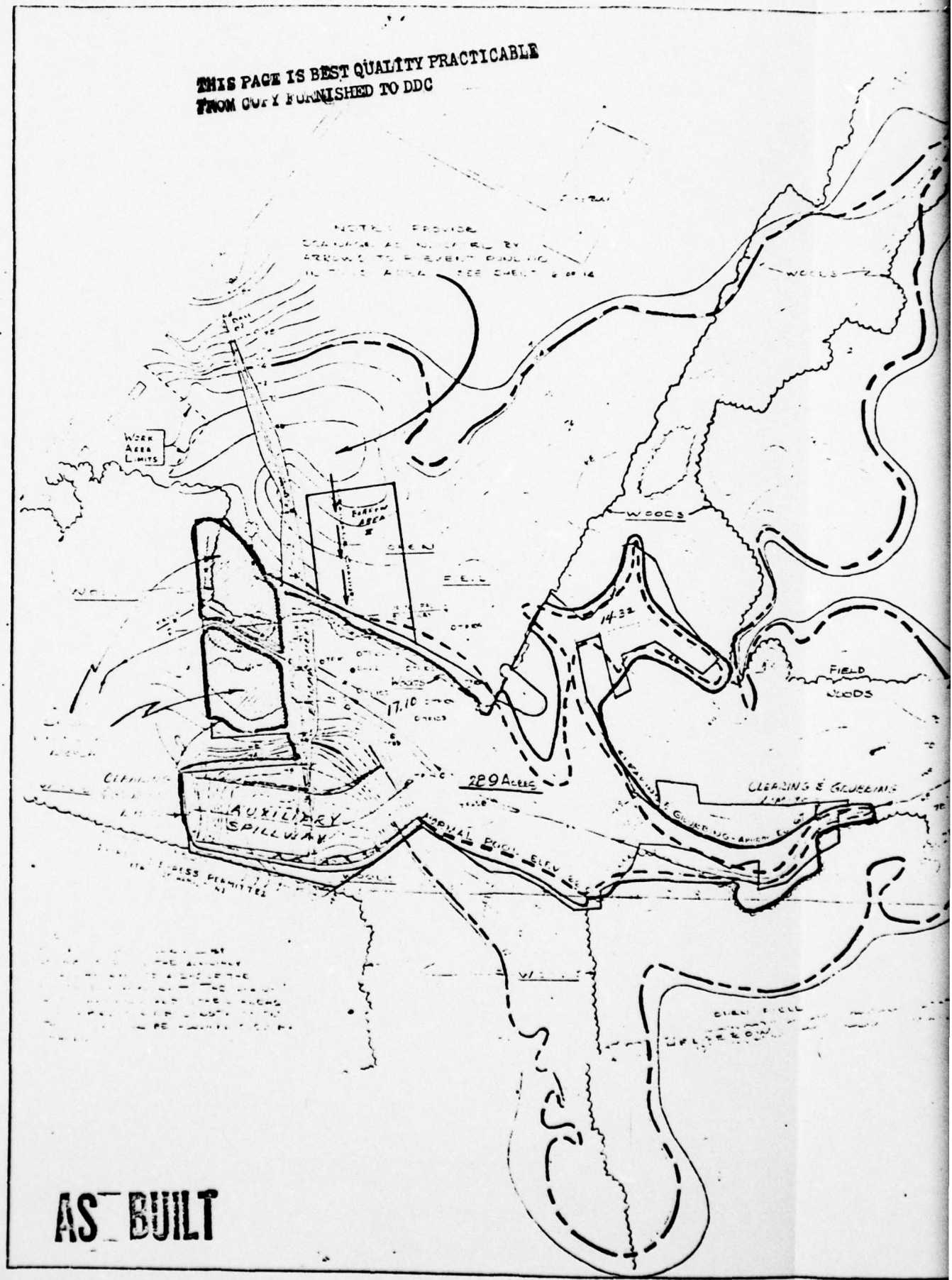
7) Bare areas in the auxiliary spillway and near the embankment toe should be topsoiled and reseeded.

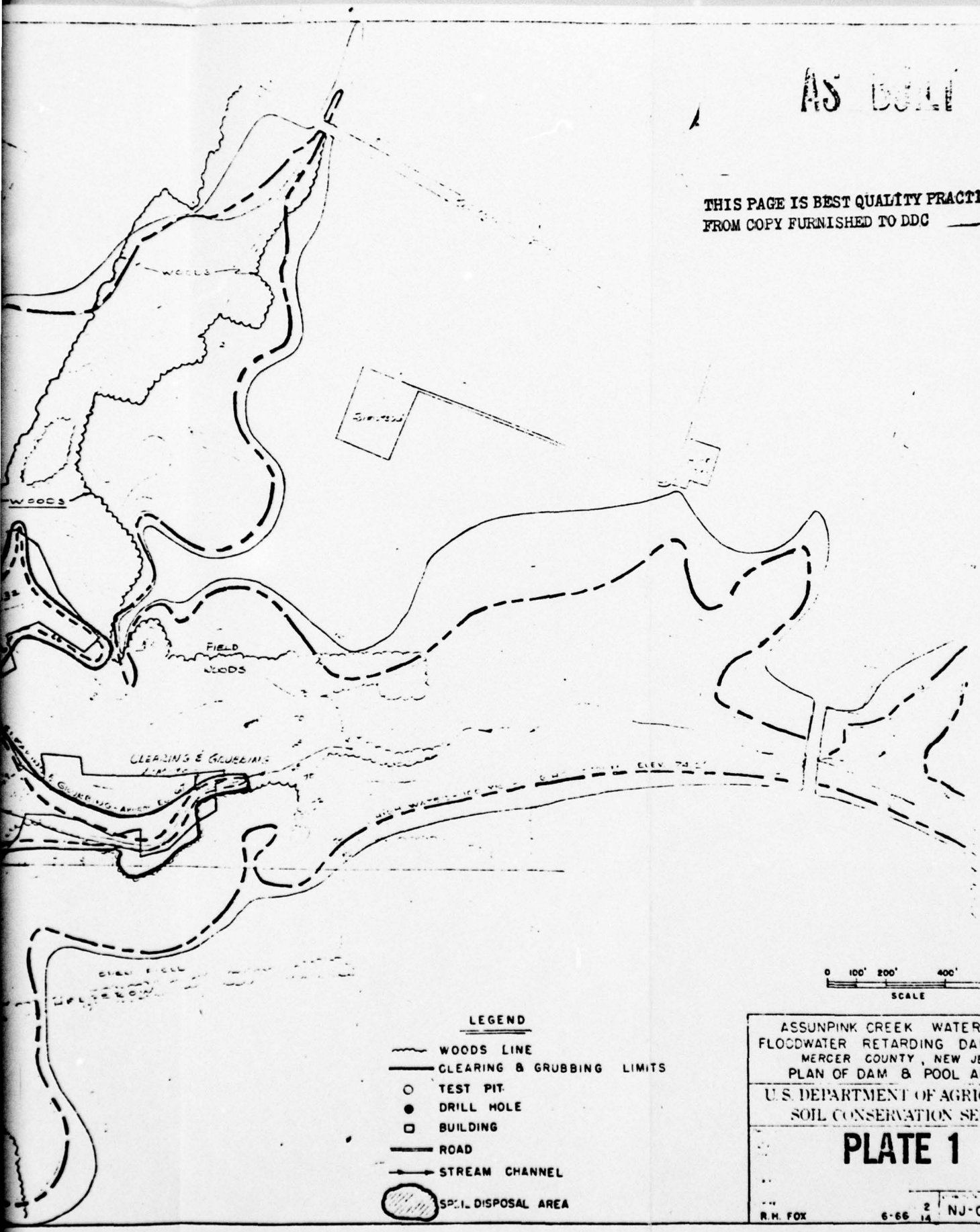
8) On the upstream side of the dam, areas of slight wave erosion above the bench and the area of slight surface sloughage near the riser should be repaired and reseeded.

9) It is recommended that continued efforts be made to keep unauthorized vehicles, including motor bikes, off the dam and adjacent areas. Damaged fences should be repaired or replaced, or other barriers erected.

It is further recommended that periodic inspections of the dam, auxiliary spillway and appurtenant structures including the riser gate valve be conducted. Special attention should be given to possible seepage through the embankment during periods of higher than normal pool.

PLATES





ASSUNPINK CREEK WATERSHED
FLOODWATER RETARDING DAM NO 8
MERCER COUNTY, NEW JERSEY
PLAN OF DAM & POOL AREA

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PLATE 1

R.H. FOX | 6-66 | 2/14 | NJ-08-2010-8

AS BUILT

AS BUILT

LEGEND

- WOODS LINE
- CLEARING & GRUBBING LIMITS
- TEST PIT
- DRILL HOLE
- BUILDING
- ROAD
- STREAM CHANNEL

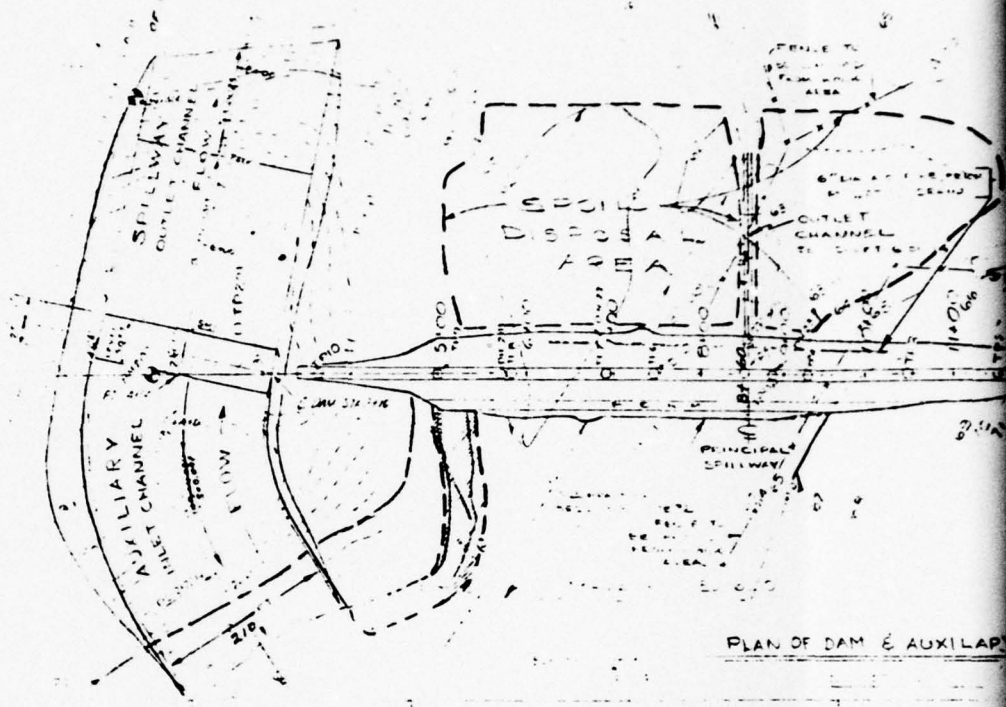
0 100' 200' 400'

ASSUNPINK CREEK WATERSHED
FLOODWATER RETARDING DAM NO. 8
MERCER COUNTY, NEW JERSEY
PLAN OF DAM & POOL AREA

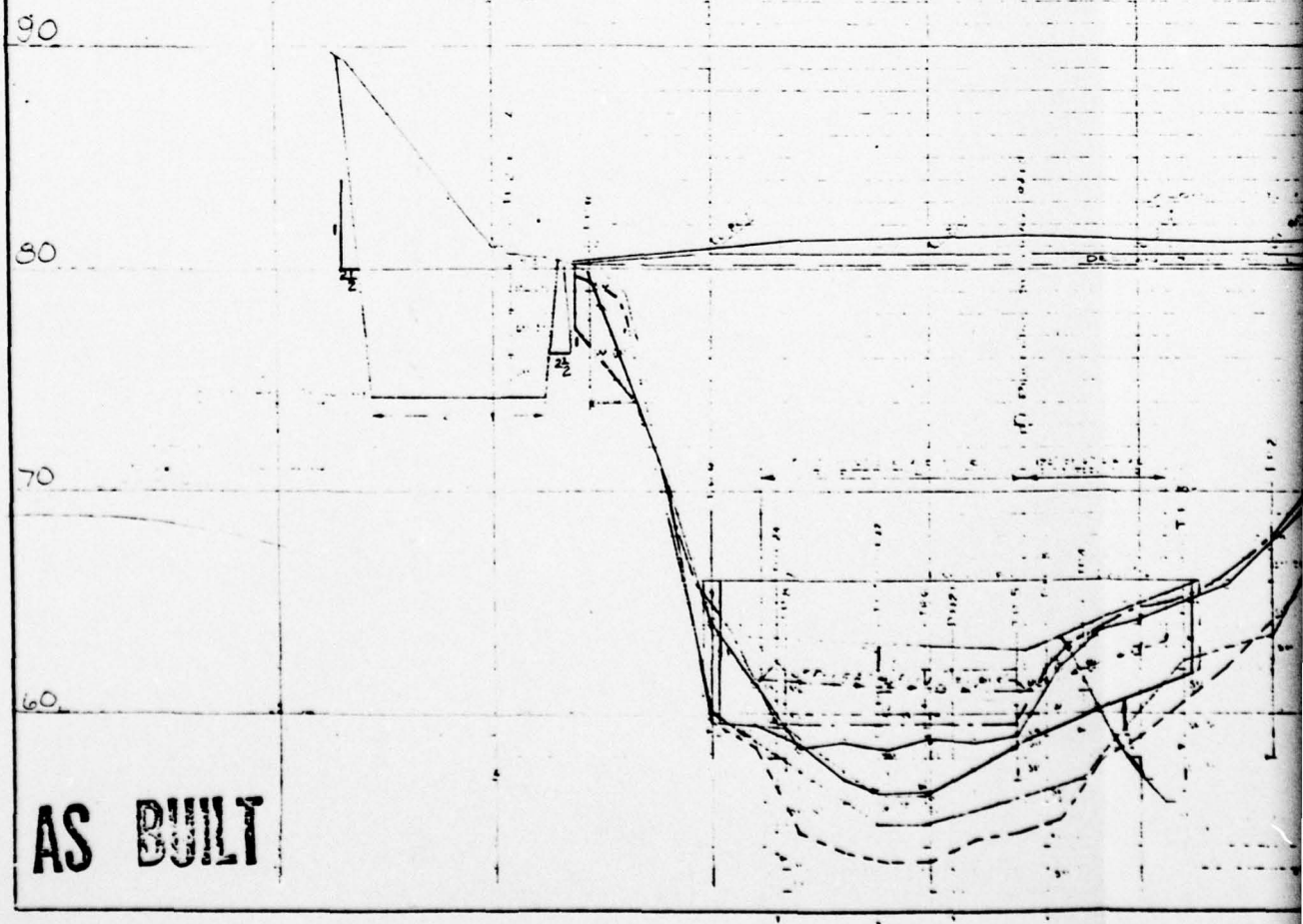
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PLATE 2

R.H. FOX 6-66 3/14 NJ-C8-2010-8

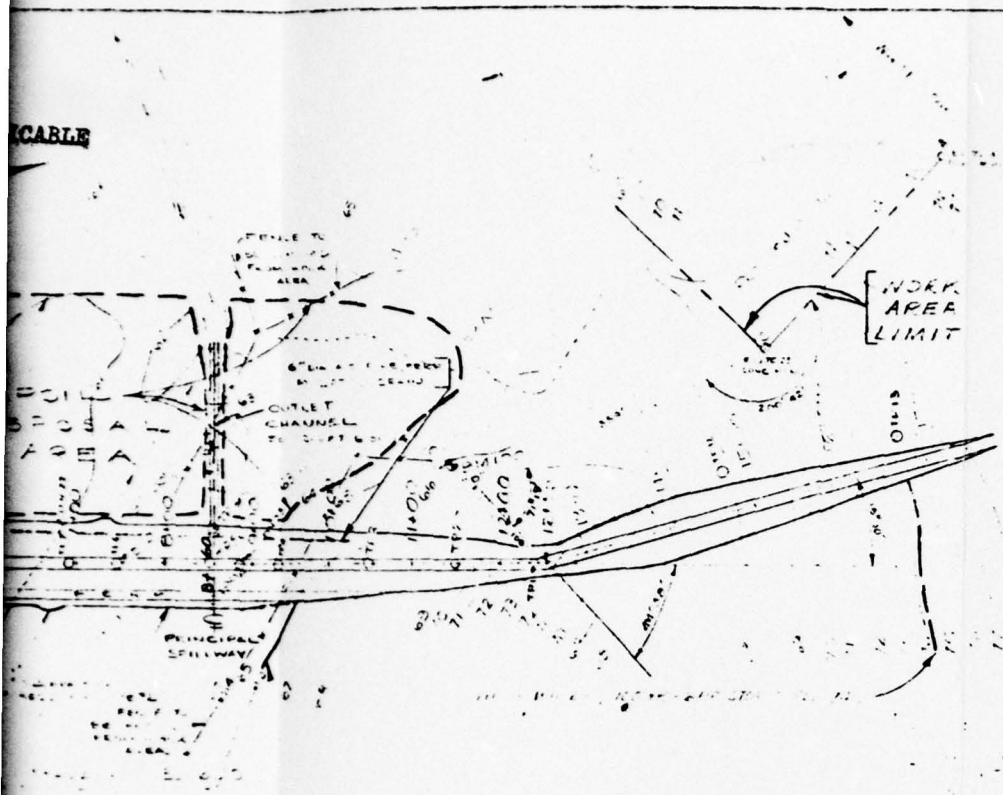


PLAN OF DAM & AUXILIARY

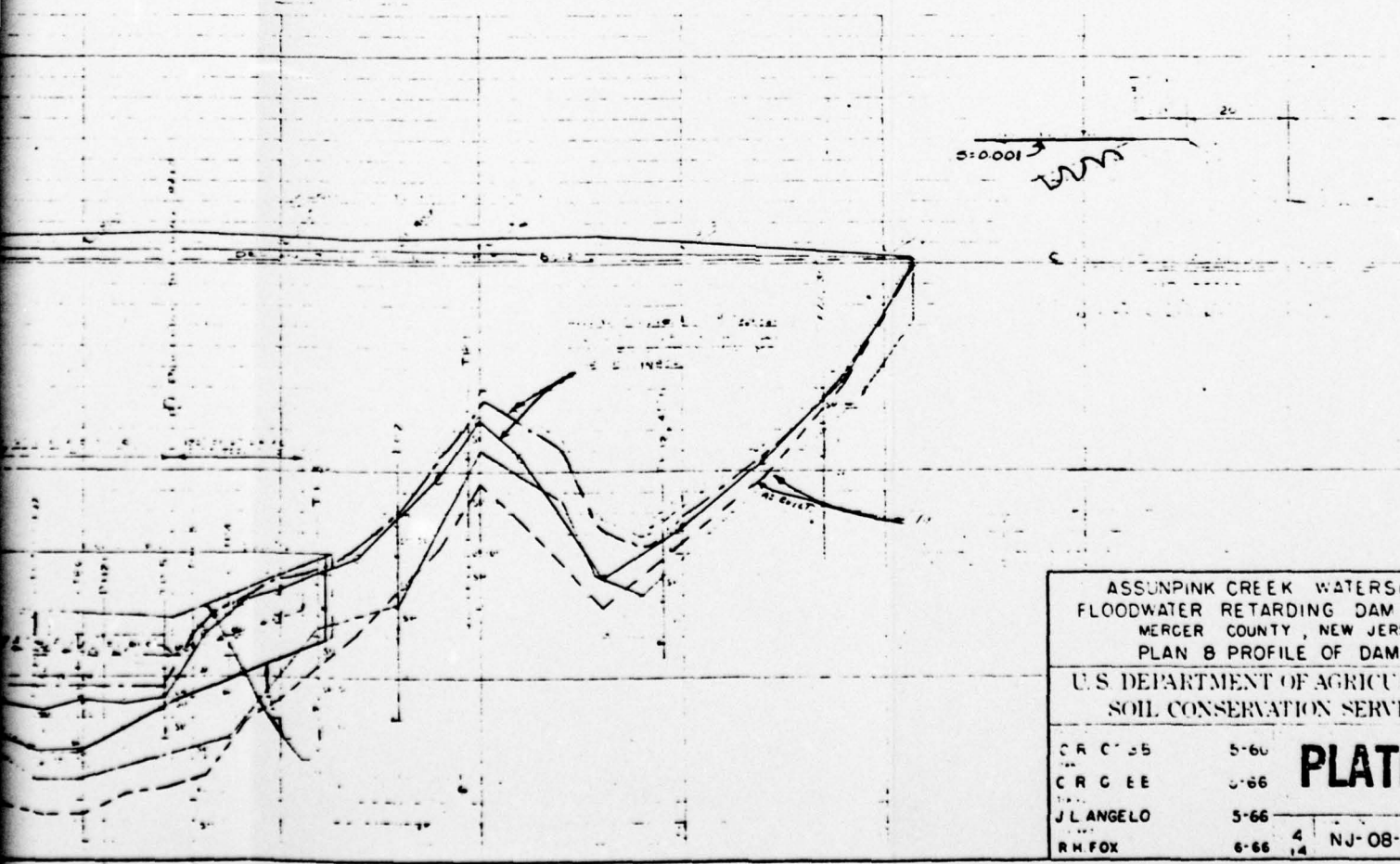


AS BUILT

AS BUILT



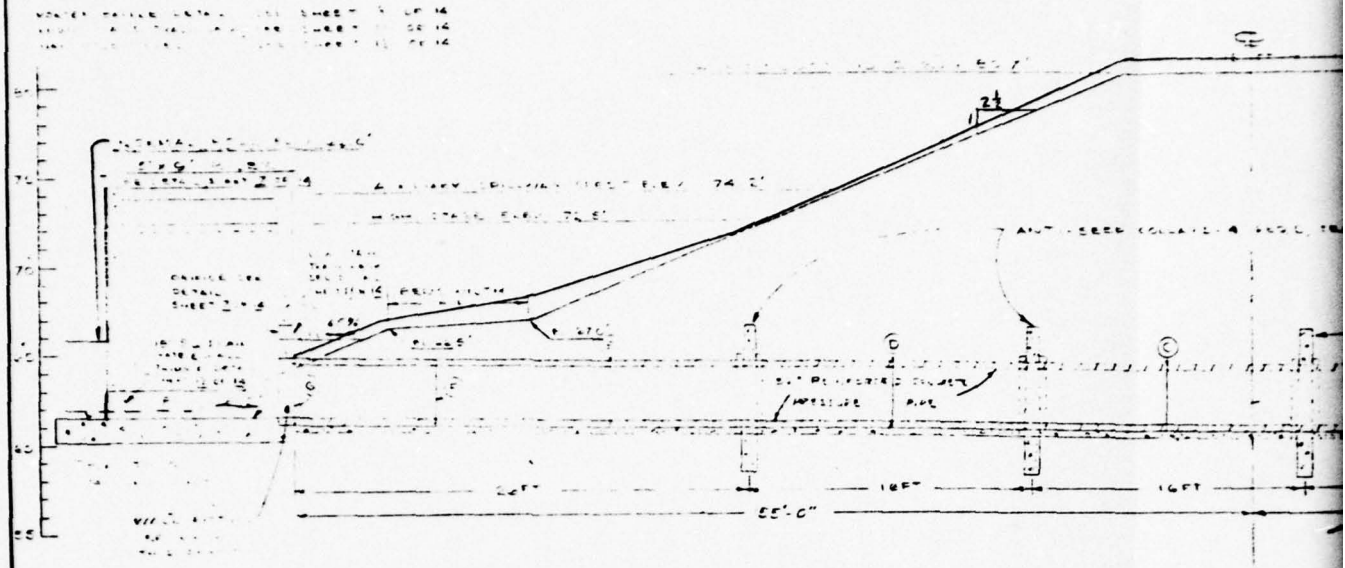
PLAN OF DAM & AUXILARY SPILLWAY



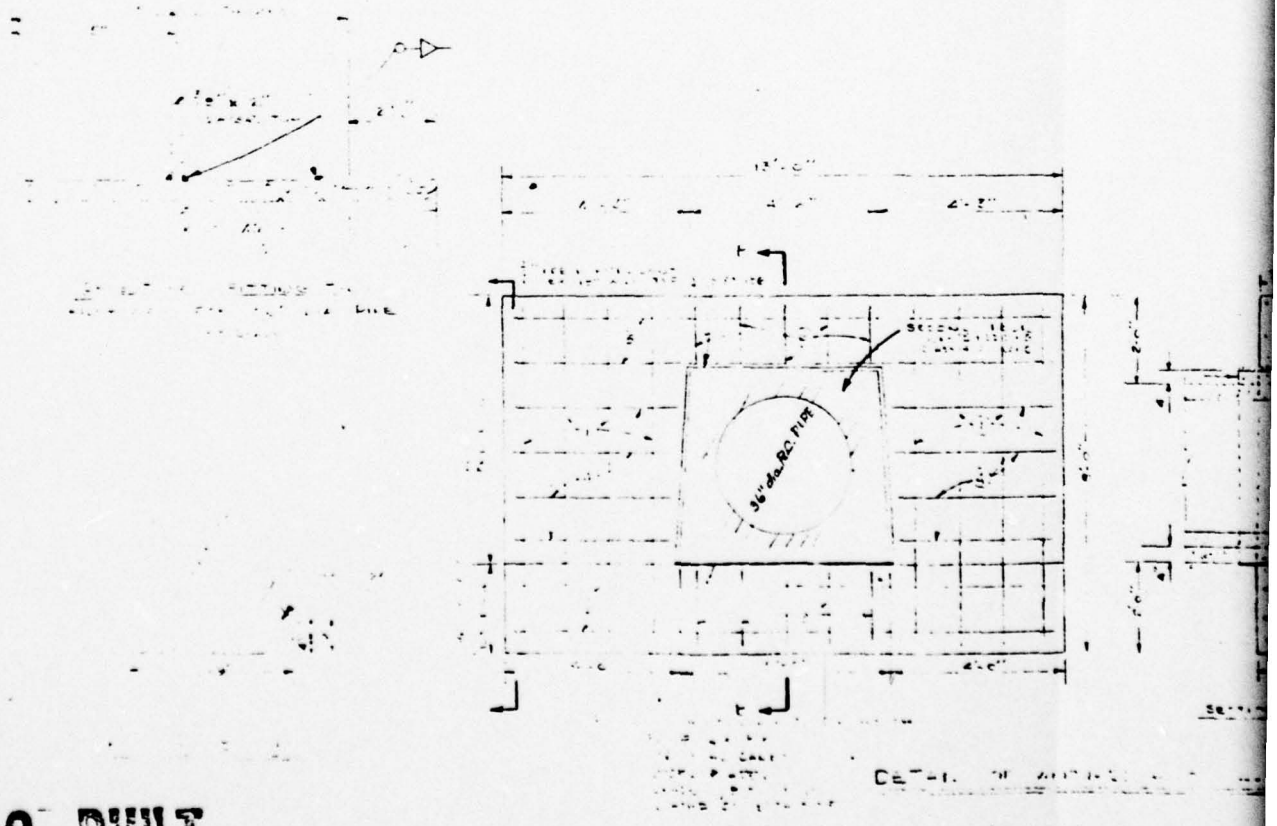
ASSUNPINK CREEK WATERSHED
FLOODWATER RETARDING DAM NO 8
MERCER COUNTY, NEW JERSEY
PLAN & PROFILE OF DAM

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

C R C 5-65	5-66	PLATE 3
C R G E E	5-66	
J L ANGELO	5-66	
R H FOX	6-66	4 / 14 NJ-08-2010-8

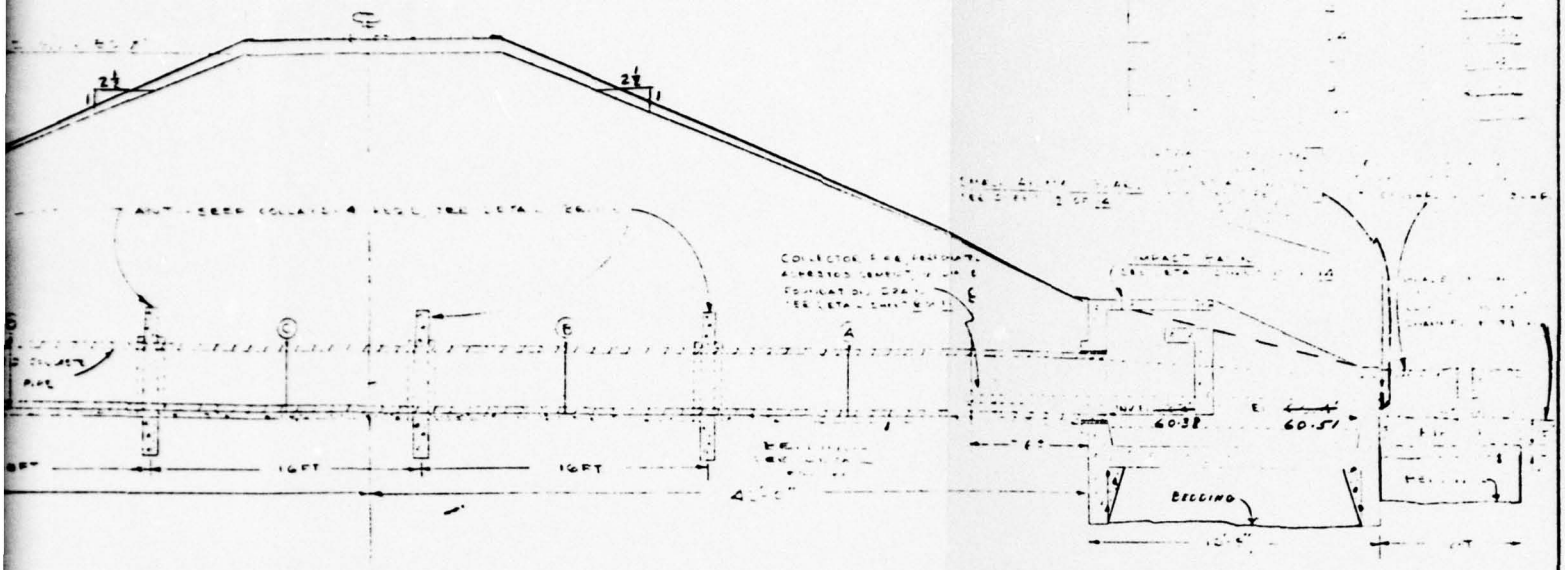


SECTION ON ℄ OF

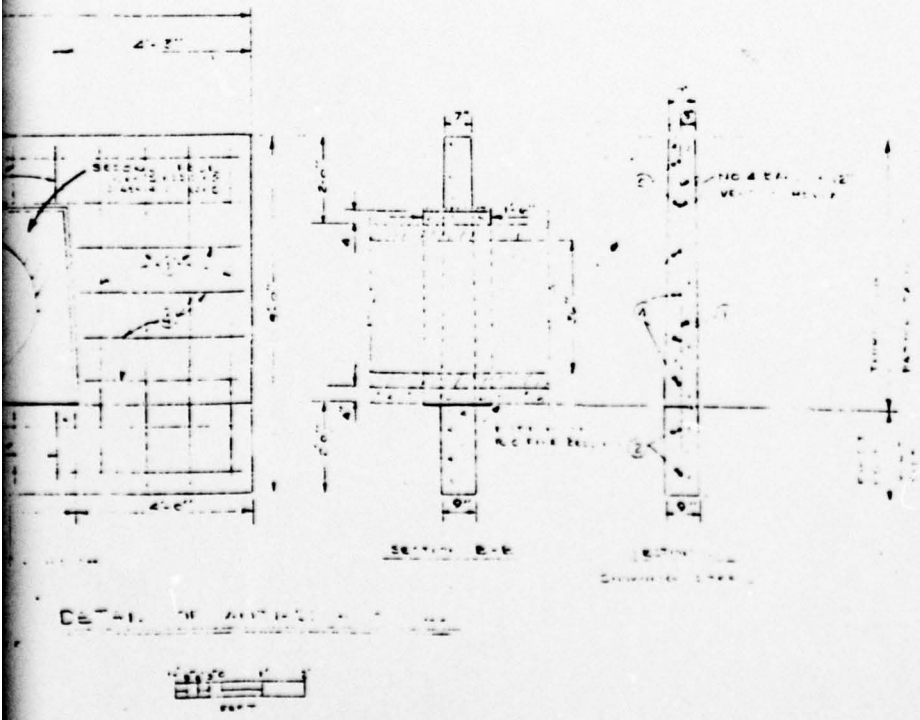


AS BUILT

AS BUILT



SECTION ON ℄ OF PRINCIPAL SPILLWAY



DETAIL OF ANTI-SEEP COLLAR

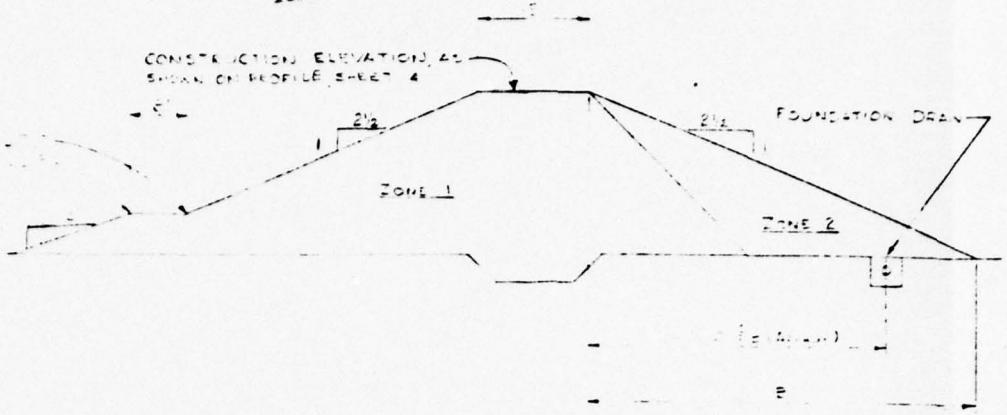
ASSUNPINK CREEK WATERSHED
FLOODWATER RETARDING DAM NO 8
MERCER COUNTY, NEW JERSEY
SECTION ON C OF PRINCIPAL SPILLWAY

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PLATE 4

5
14. NJ-08-2010

2



(1) Zone 1 shall consist of ... typified ...

(2) Zone 2 shall consist of ... sands (SM) ... Spillway.

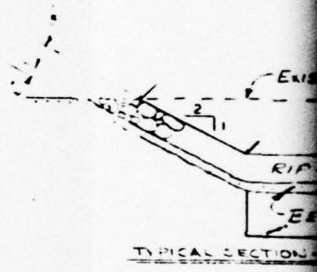
(3) Compaction ... shall be ... maximum dry ... by Method ...

(4) The moisture ... time of ... below optimum.

(5) The moisture ... time of ... optimum.

(6) The maximum ... matrix shall ...

(7) The maximum ... 9 inches.



TYPICAL SECTION

EXCAVATED IN BORROW AREA

AS BUILT

AS BUILT

(1) Zone 1 shall be constructed of slightly plastic clayey sands (SC) and silty sands (SM) as typified by material found in Test Pit 1C.

(2) Zone 2 shall be constructed of non-plastic silty sands (SM) found in borrow within the Auxiliary Spillway.

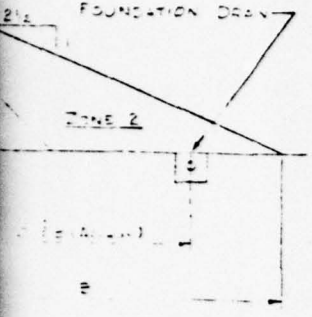
(3) Compaction shall be class A. The fill matrix shall be compacted to at least 95 percent of the maximum density obtained in compaction test performed by Method A, ASTM Designation: D698.

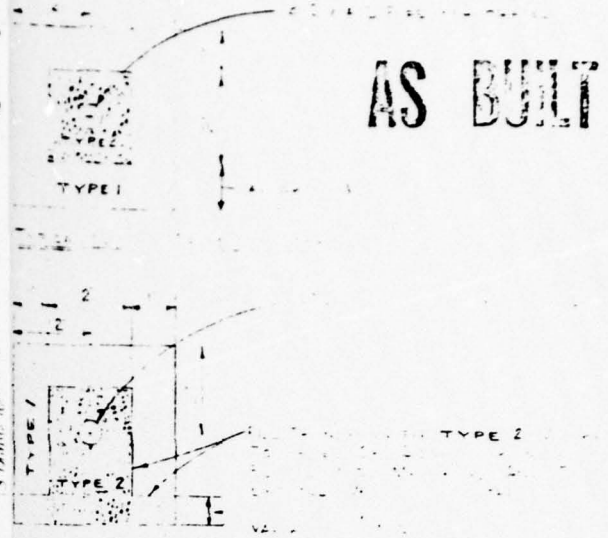
(4) The moisture content of zone 1 fill material at time of compaction shall not be more than 1 percent below optimum or 3 percent above optimum.

(5) The moisture content of zone 2 fill material at time of compaction shall be within 3 percent of optimum.

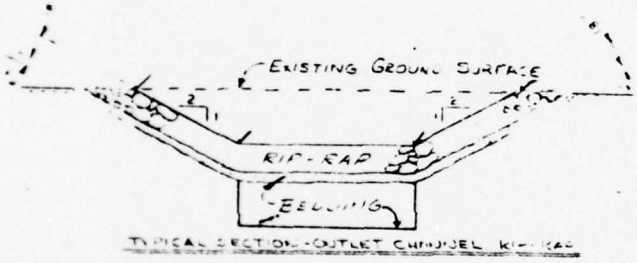
(6) The maximum size rock incorporated into the fill matrix shall be 6 inches.

(7) The maxium lift thickness before compaction shall be 9 inches.



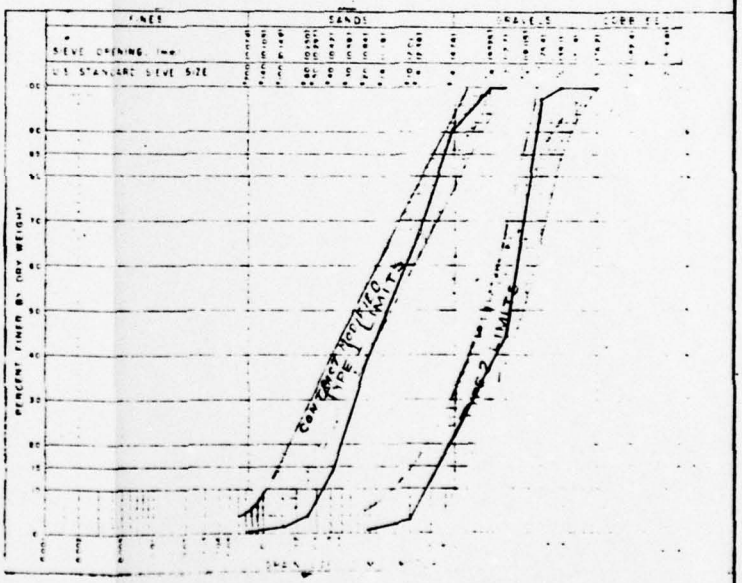


TYPICAL SECTION OF FOUNDATION DRAIN WHERE COARSE GRAINED FOUNDATION MATERIAL IS ENCOUNTERED. USE TYPE 2 MATERIAL IN CONTACT WITH GRAVEL (GW OR GP-GW) MATERIAL AS SHOWN IN TEST PITS 2 AND 7



TYPICAL SECTION-OUTLET CHANNEL RIP-RAP

TYPICAL SECTION



GRAIN SIZE DISTRIBUTION CHART FOR ZONE 1

EXCAVATED IN BORROW AREA

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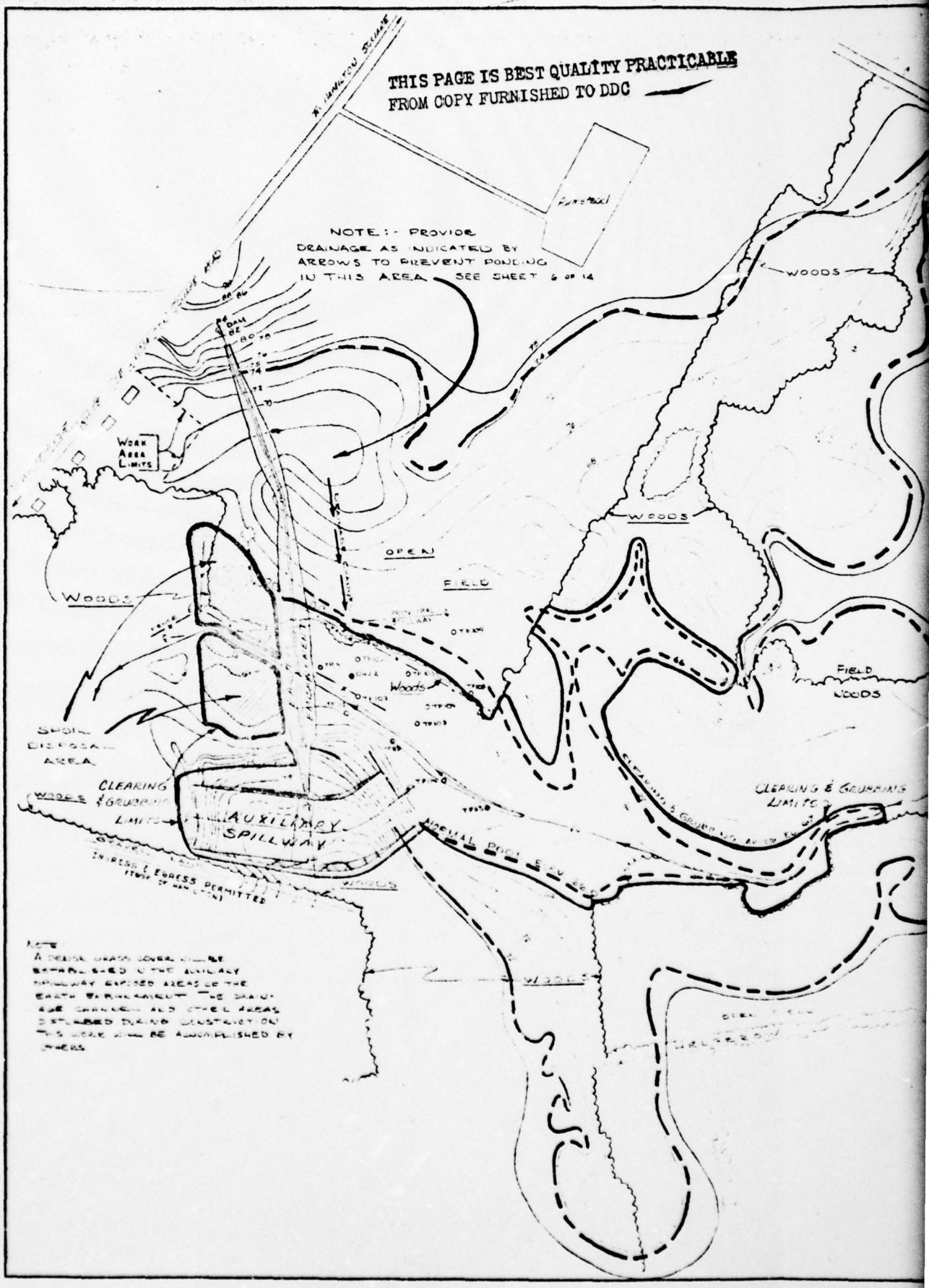
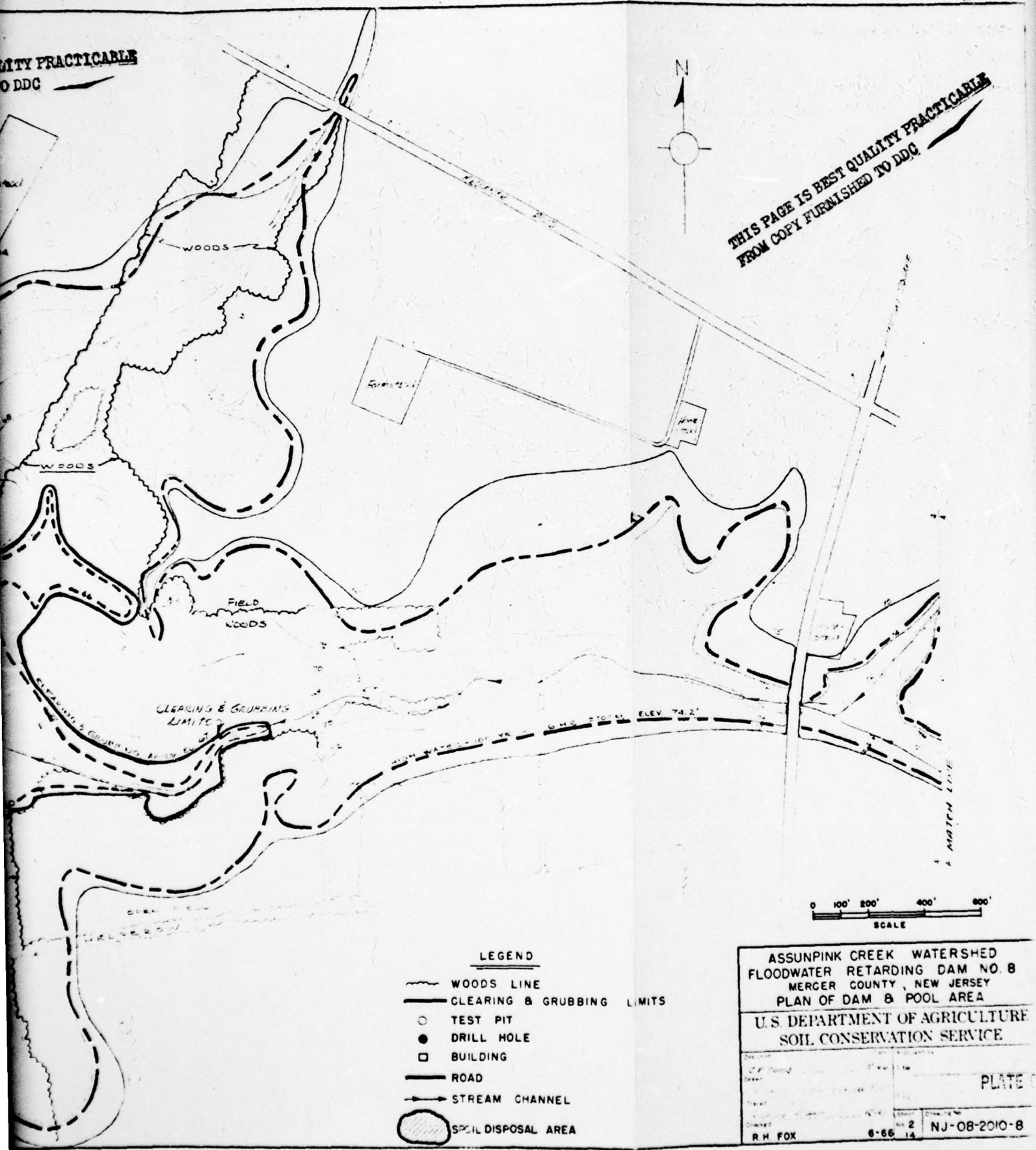
ASSUNPINK CREEK WATERSHED
FLOODWATER RETARDING DAM NO. 8
MERCER COUNTY, NEW JERSEY
TYPICAL SECTIONS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

C.R. COBB	5-66	PLATE 5
C.R. COBB	5-66	
K.L. FARR	6-66	
R.H. FOX	6-66	NJ-08-2010-8





LEGEND

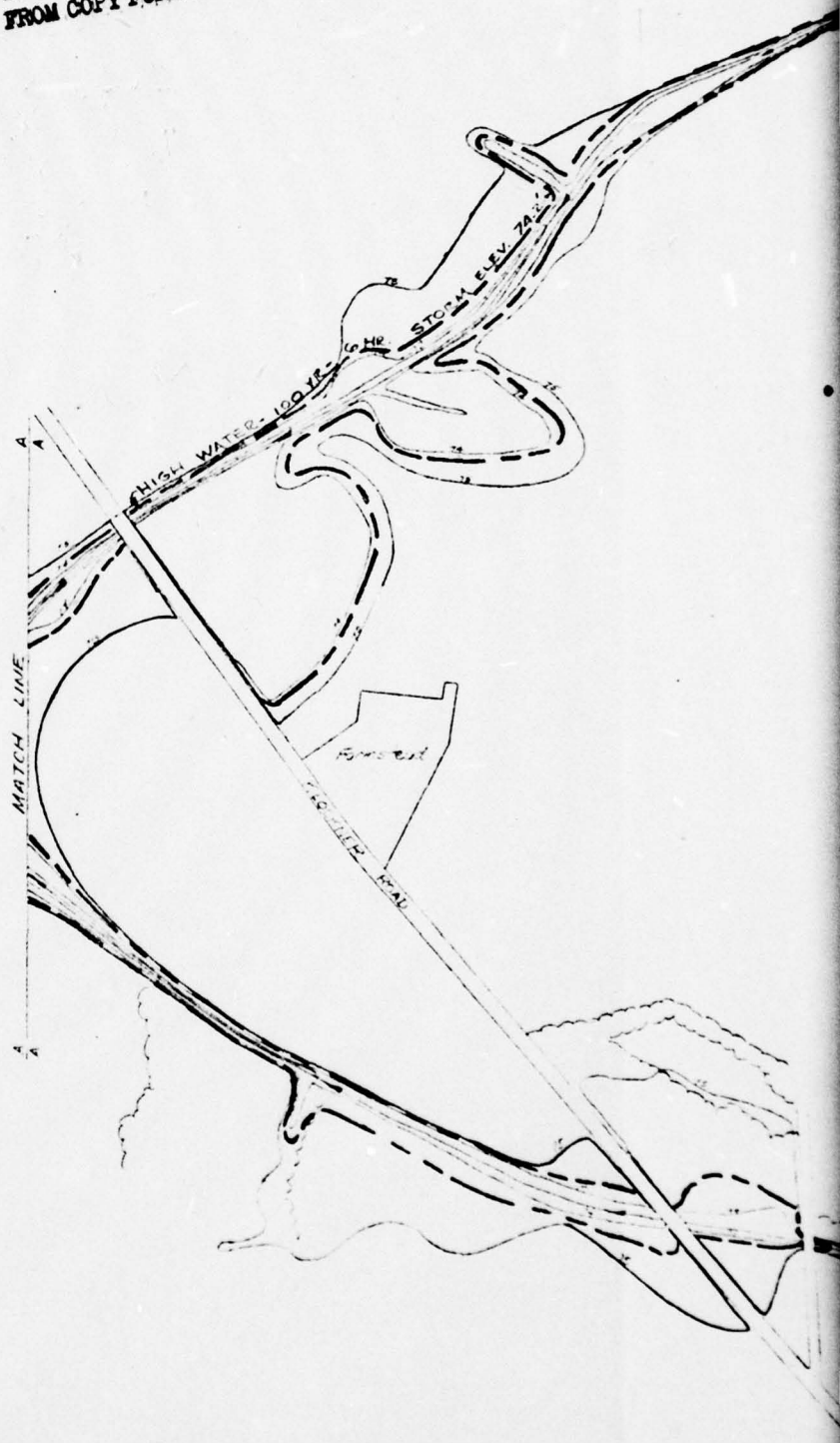
- WOODS LINE
- CLEARING & GRUBBING LIMITS
- TEST PIT
- DRILL HOLE
- BUILDING
- ROAD
- STREAM CHANNEL
- SPOIL DISPOSAL AREA

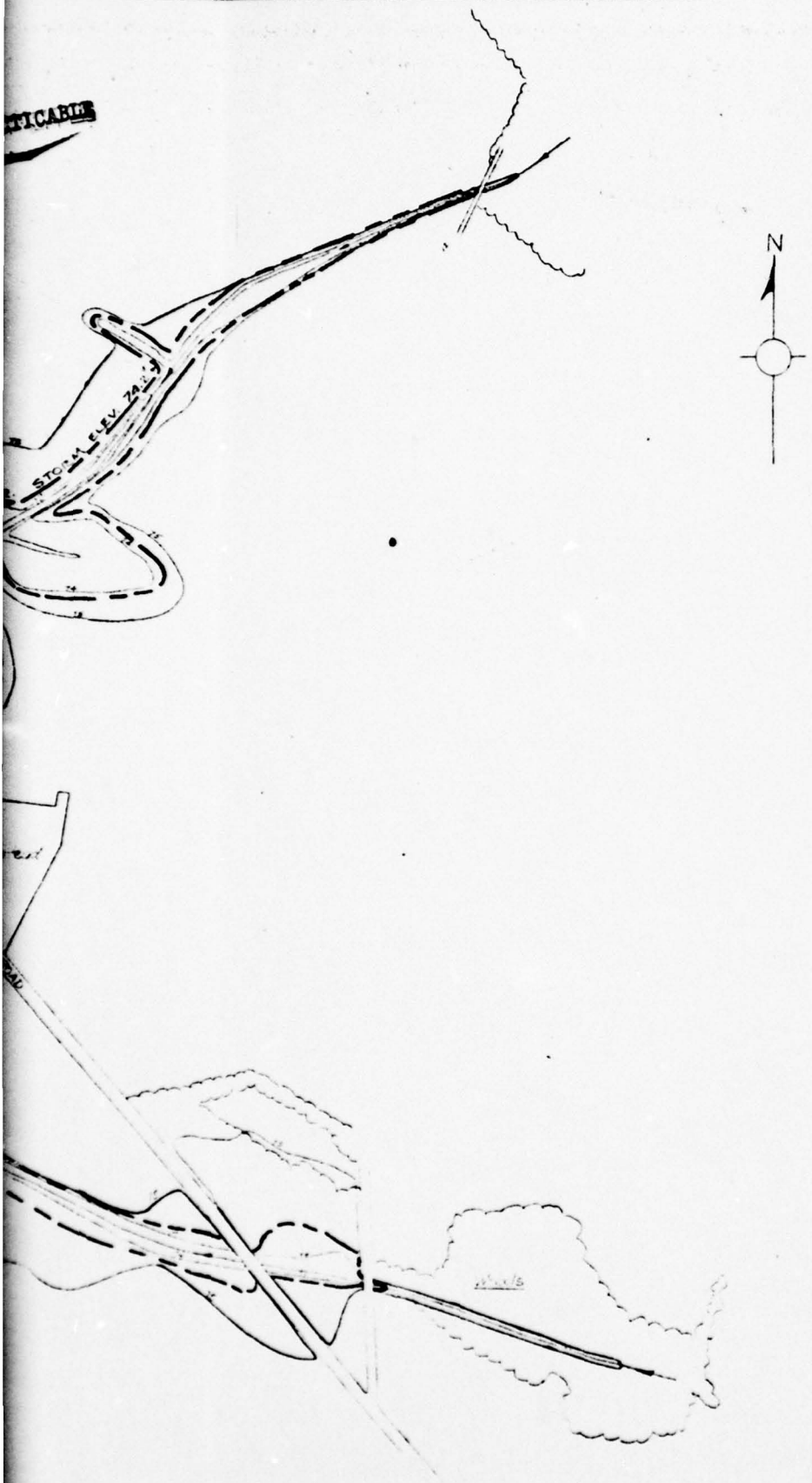
ASSUNPINK CREEK WATERSHED
FLOODWATER RETARDING DAM NO. 8
MERCER COUNTY, NEW JERSEY
PLAN OF DAM & POOL AREA

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PLATE

R.H. FOX 6-66 SHEET 2 OF 14 NJ-08-2010-8





LEGEND

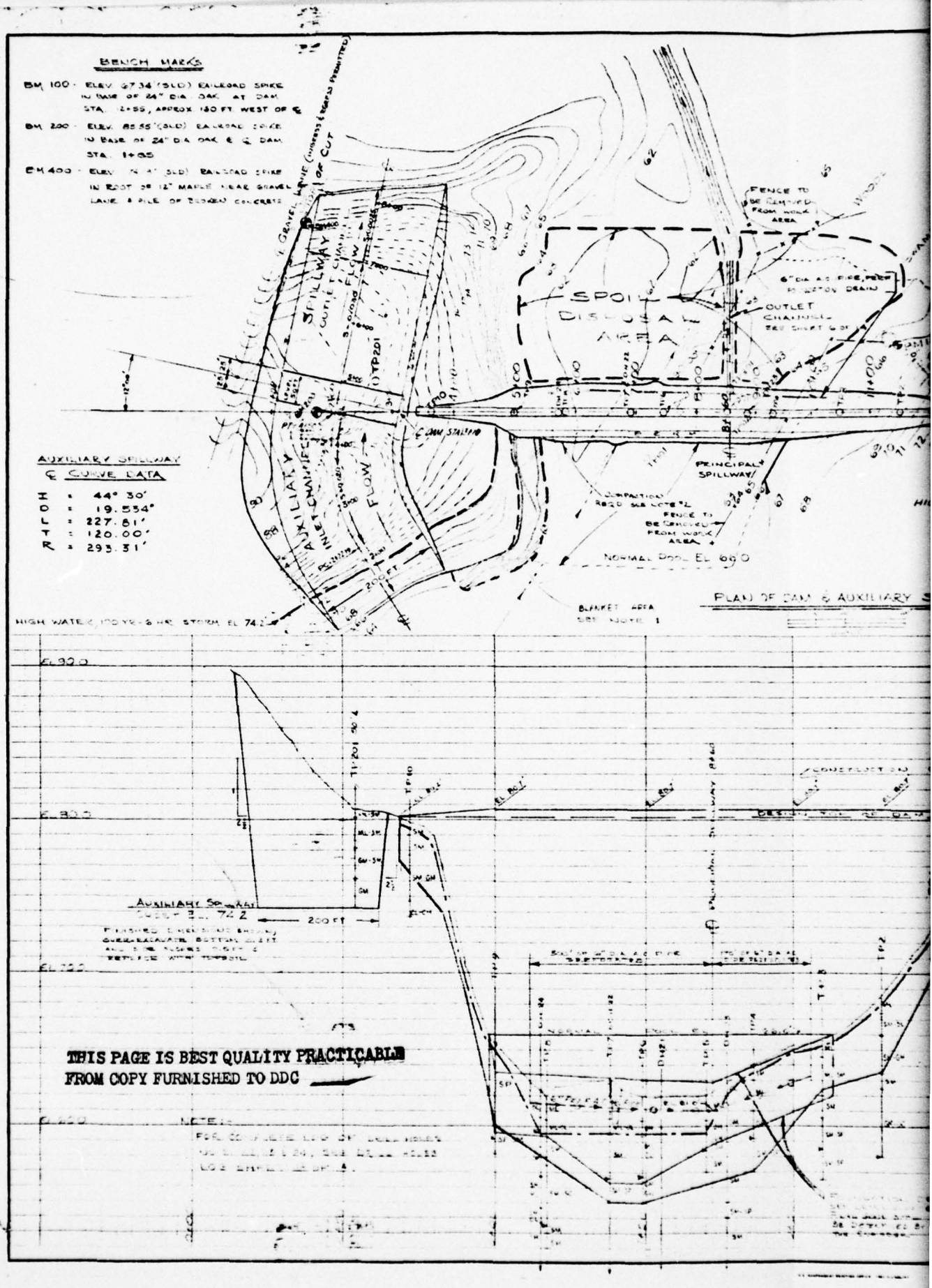
- WOODS LINE
- CLEARING & GRUBBING LIMITS
- TEST PIT
- DRILL HOLE
- BUILDING
- ROAD
- STREAM CHANNEL

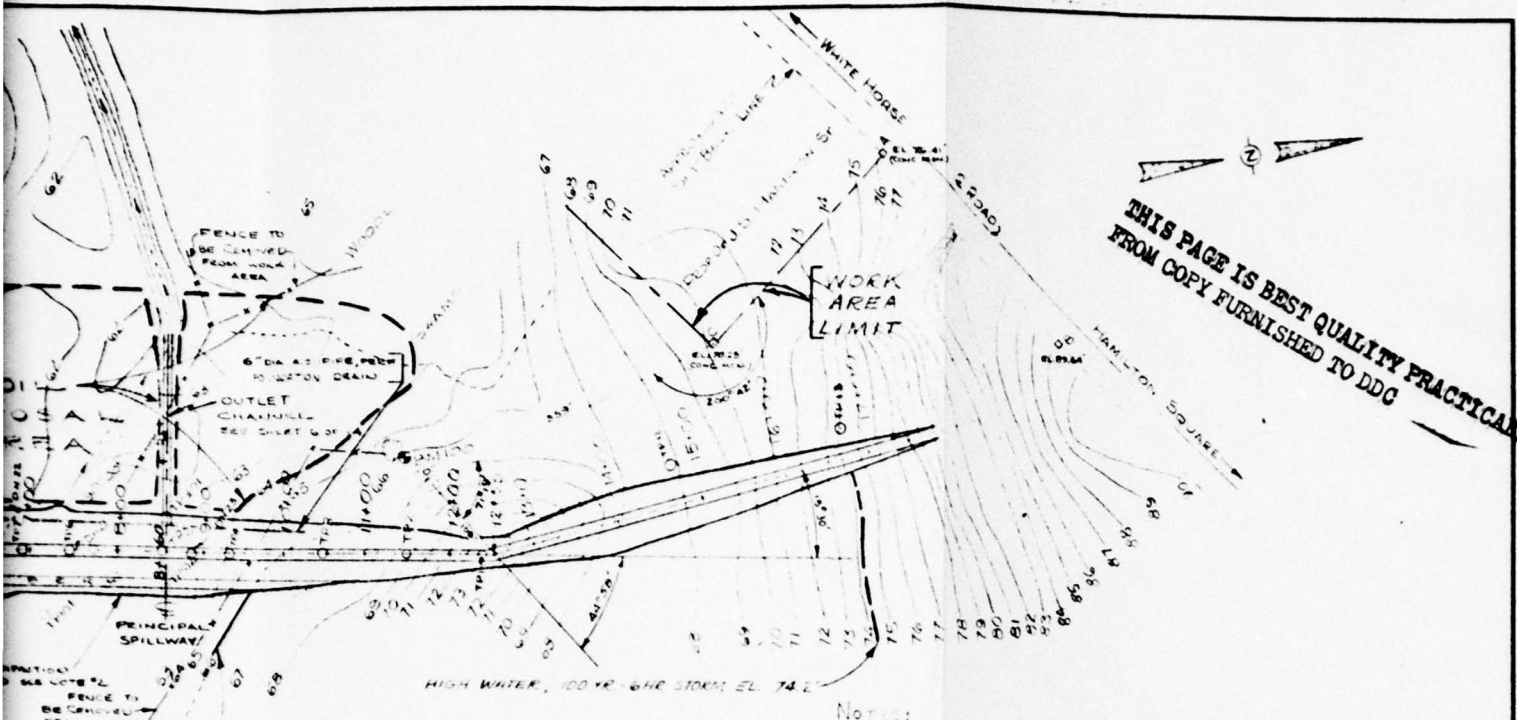
ASSUNPINK CREEK WATERSHED
FLOODWATER RETARDING DAM NO. 8
MERCER COUNTY, NEW JERSEY
PLAN OF DAM & POOL AREA

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PLATE 7

R.H. FOX 6-66 3/4 NJ-08-2010-8





PLAN OF DAM & AUXILIARY SPILLWAY

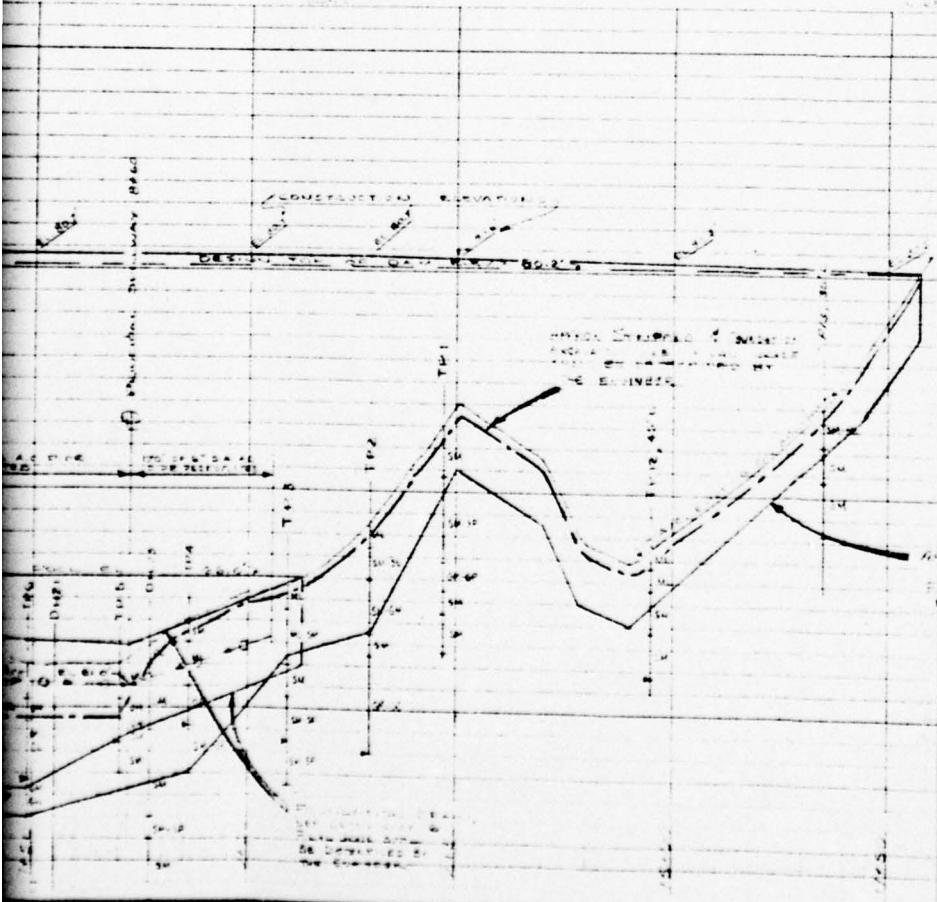
Notes:

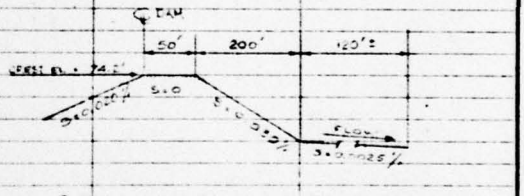
1) PROVIDE A FILL OF CLASS C MATERIAL IN THE OLD CHANNEL AND IN THE INDICATED AREA FOR 200' UPSTREAM FROM THE EMBANKMENT TOE.

2) AFTER CLEARING AND GRUBBING THE NORMAL POOL AREA WITHIN 200' OF THE EMBANKMENT TOE, THE SOIL SHALL BE COMPACTED TO THE REQUIREMENTS FOR EARTH FILL.

3) THE PRINCIPAL SPILLWAY SHALL BE CONSTRUCTED WITH THE BASE INCLINED ON THE TRANSVERSE AXIS OF THE CHANNEL OF THE RESERVOIR.

4) SOIL SHALL BE SPREAD IN A LOOSE LIFT NOT TO EXCEED 6" AND SHALL BE SHAPED TO PREVENT PONDING OF WATER.





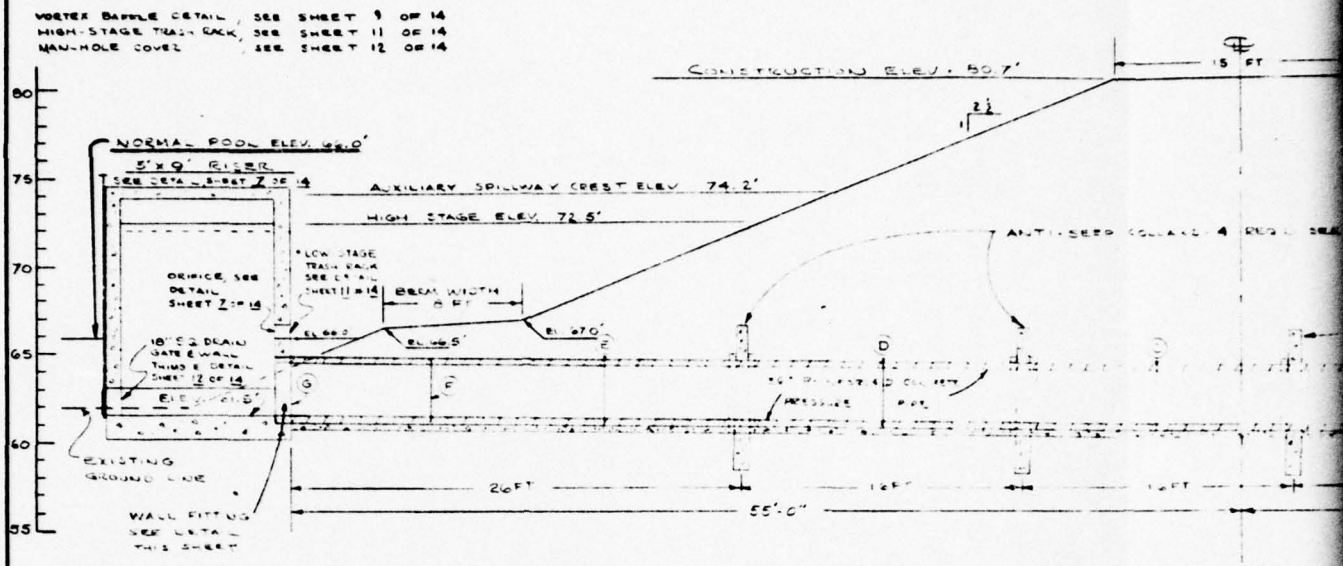
℄ PROFILE OF AUXILIARY SPILLWAY

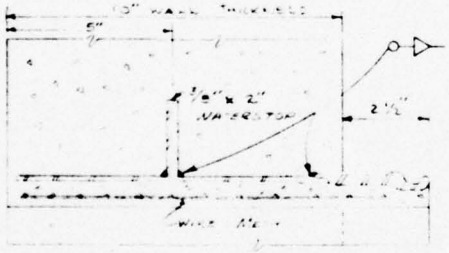
FOR DETAILED DIMENSIONS SEE SHEET 3 & 4
0.5 FT & SPRUCE WITH TOPSOIL

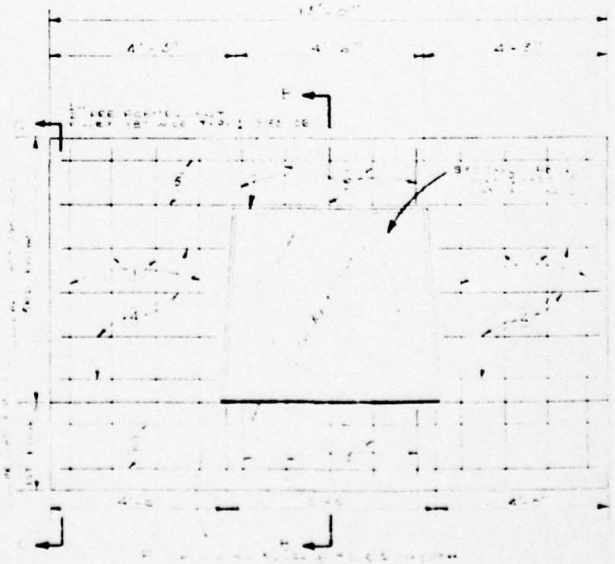
CUT-OFF TRENCH EXCAVATION
FOR DETAILS SEE SHEET 6
TRENCH BACKFILL SHALL BE DONE BY
THE EARTHWORK

ASSUNPINK CREEK WATERSHED FLOODWATER RETARDING DAM NO. 8 MERCER COUNTY, NEW JERSEY PLAN & PROFILE OF DAM		
U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE		
DESIGNED C.R. COBB	DATE 5-66	APPROVED
DRAWN C.R. COBB	5-66	PLATE 3
TRACED J.L. ANGELO	5-66	
CHECKED R.H. FOX	6-66	SHEET 4 OF 4 SHEETS
		DRAWING NO. NJ-08-2010-8

2







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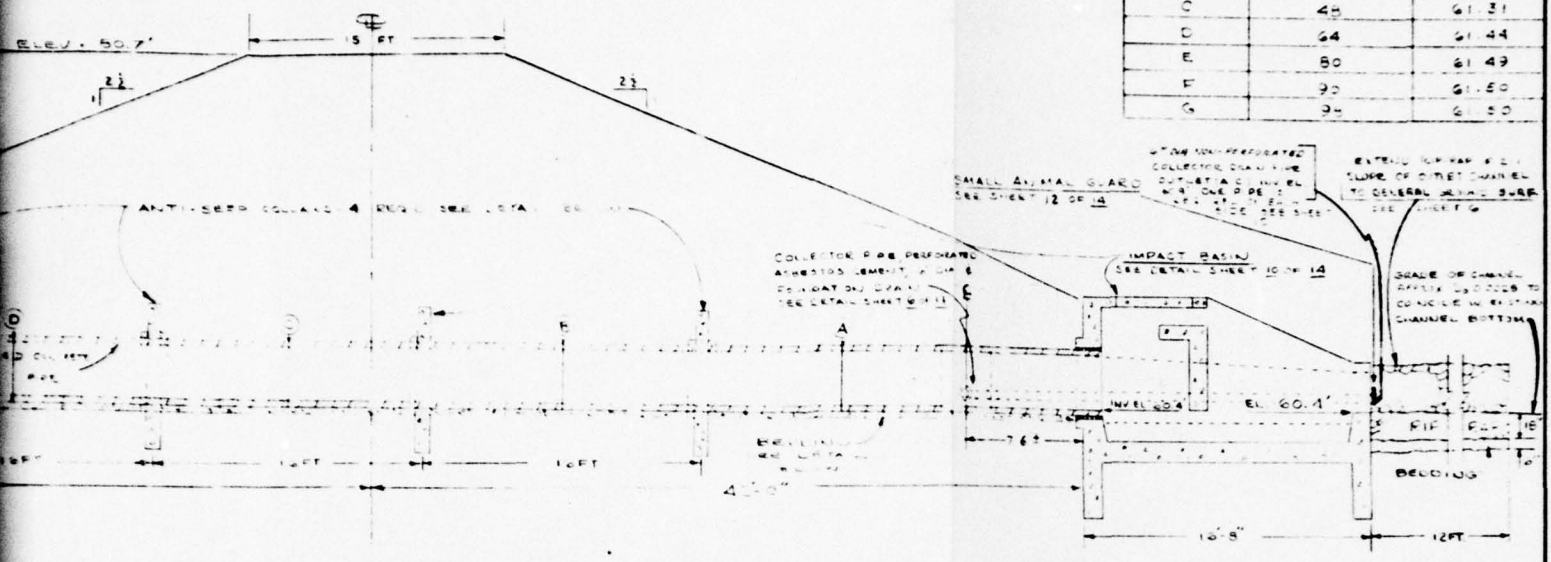
PIPE JOINT ELEVATION SCHEDULE		
JOINT	DISTANCE FROM OUTLET END OF 16"ø R.C. PIPE	INVERT ELEVATION
A	16	60.77
B	32	61.07
C	48	61.31
D	64	61.44
E	80	61.49
F	90	61.50
G	94	61.50



SECTION ON ℄ OF PRINCIPAL SPILLWAY

NOTES

ROCK RIPRAP SHALL BE WELL GRADED TO A MAXIMUM SIZE OF 18" AND NOT MORE THAN 10% BY WEIGHT SHALL BE LESS THAN
FILTER BLANKET
EXCAVATION SHALL BE DONE BEFORE PLACEMENT OF RIPRAP
DRAIN FILL AS SHOWN ON SHEET 6
SEE DETAIL ON SHEET 6

STEEL ANTI-SEEP COLLARS

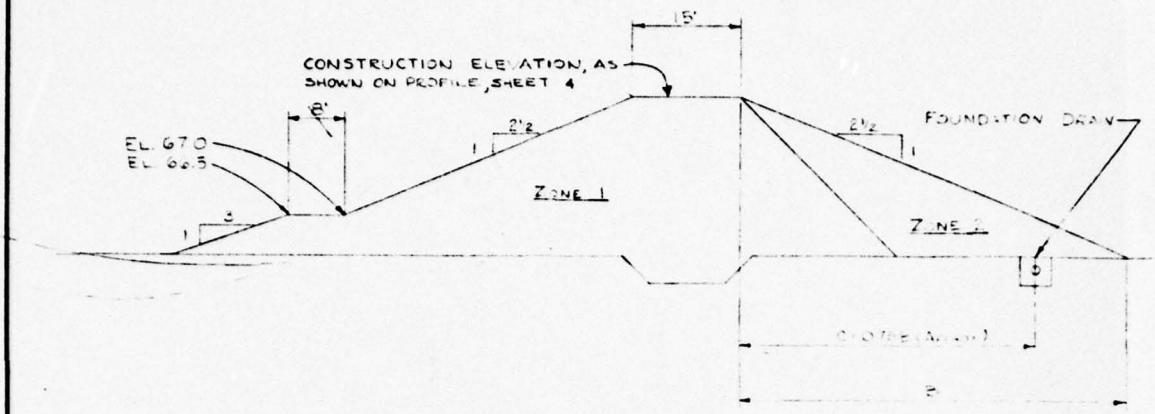
MARK	LOCATION	NO.	SIZE	ELEVATION	DIA. A	D.	TOTAL FT
		4					
		4					
		4					
		4					
		4					
		4					
		4					

ASSUNPINK CREEK WATERSHED
FLOODWATER RETARDING DAM NO 8
MERCER COUNTY, NEW JERSEY
SECTION ON C OF PRINCIPAL SPILLWAY

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PLATE 9

SHEET 5 OF 14 SHEETS
NJ-08-2010



TYPICAL EMBANKMENT SECTION

NOT TO SCALE

EMBANKMENT NOTES:

(1) Zone 1 shall ... clayey sands ... typified by ...

(2) Zone 2 shall ... sands (SM) fr... Spillway.

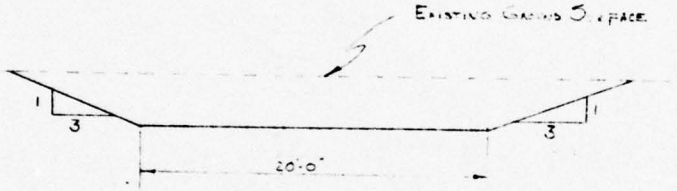
(3) Compaction of ... shall be comp... maximum densi... by Method A, ...

(4) The moisture ... time of compa... below optimum.

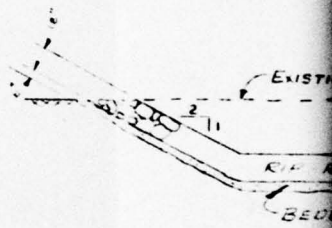
(5) The moisture ... time of compa... optimum.

(6) The maximum ... matrix shall ...

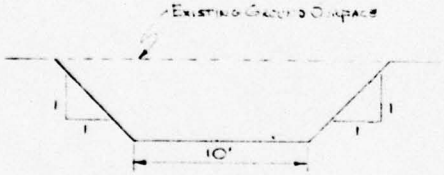
(7) The maximum ... 9 inches.



IMPACT BASIN TRENCH

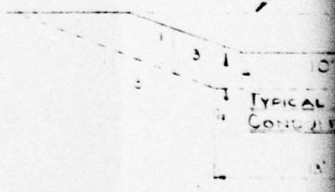


TYPICAL SECTION - C...



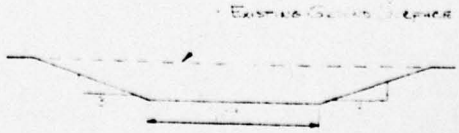
TYPICAL SECTION
CUTOFF TRENCH

NOTE:
AT THE INTERSECTION OF THE CONDUIT AND THE CUTOFF TRENCH, THE CUTOFF TRENCH SHALL BE EXTENDED ... FEET ON EACH SIDE OF THE CONDUIT TRENCH.



TYPICAL ... CONDUIT ...

TYPICAL SECTION
DRAINAGE TRENCH



TYPICAL SECTION
DRAINAGE TRENCH

NO SCALE

EMBANKMENT NOTES:

(1) Zone 1 shall be constructed of slightly plastic clayey sands (SC) and silty sands (SM) as typified by material found in Test Pit 10.

(2) Zone 2 shall be constructed of non-plastic silty sands (SM) found in lenses within the Auxiliary Spillway.

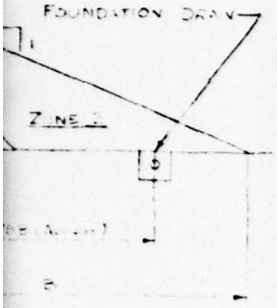
(3) Compaction shall be class A. The fill matrix shall be compacted to at least 95 percent of the maximum density obtained in compaction test performed by Method A, ASTM Designation: D698.

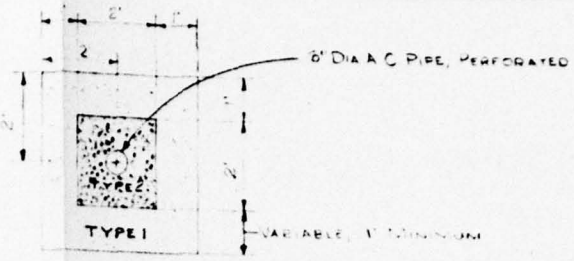
(4) The moisture content of zone 1 fill material at time of compaction shall not be more than 1 percent below optimum or 3 percent above optimum.

(5) The moisture content of zone 2 fill material at time of compaction shall be within 3 percent of optimum.

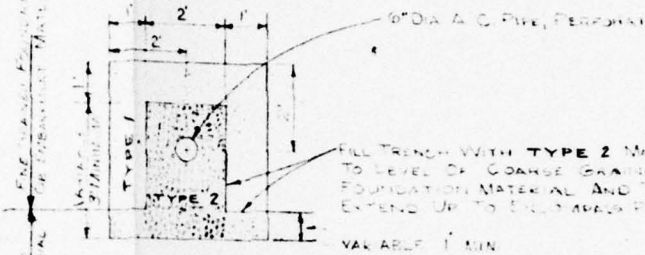
(6) The maximum size rock incorporated into the fill matrix shall be 6 inches.

(7) The maxium lift thickness before compaction shall be 9 inches.

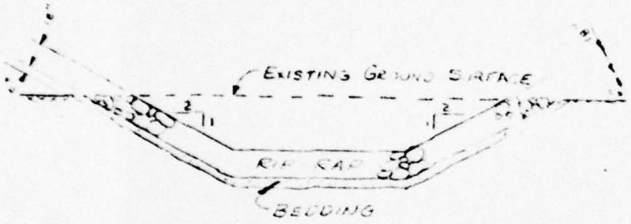




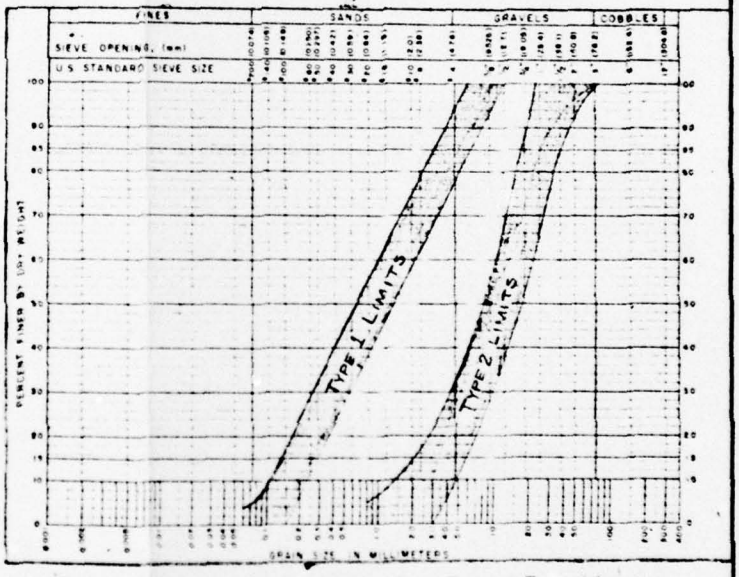
TYPICAL SECTION OF FOUNDATION DRAIN



TYPICAL SECTION OF FOUNDATION DRAIN WHERE COARSE GRAINED FOUNDATION MATERIAL IS ENCOUNTERED USE TYPE 2 MATERIAL IN CONTACT WITH GRAVEL (GW, GP, GW) MATERIALS AS FOUND IN TEST PITS 6 AND 7

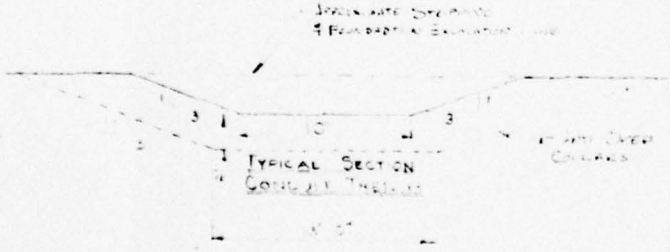


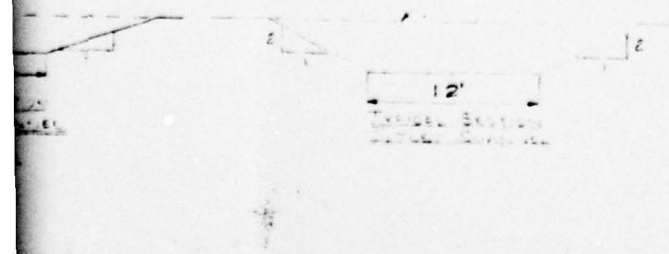
TYPICAL SECTION - OUTLET CHANNEL RIP RAP



GRAIN SIZE DISTRIBUTION LIMITS FOR DRAIN FILL MATERIAL

NOTE: FOUNDATION DRAIN IS CONTINUOUS UNDER THE PRINCIPAL SPILLWAY





TYPE 1		TYPE 2	
Sieve No.	% Passing	Sieve No.	% Passing
		3"	100
		1"	84-100
		3/4"	57-100
		3/8"	34-89
		#4	21-52
		#10	0-4
		#20	0-5

ASSUNPINK CREEK WATERSHED
FLOODWATER RETARDING DAM NO. 8
MERCER COUNTY, NEW JERSEY
TYPICAL SECTIONS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	C.R. COBB	5-66	PLATE 10
Drawn	C.R. COBB	5-66	
Traced	K.L. FARR	6-66	
Checked	R.H. FOX	6-66	NJ-08-2010-8

6/4

2

PHOTOGRAPHS

DETAILED PHOTOGRAPH DESCRIPTIONS

Overall View of Dam - View Looking North Along Crest of Dam From Near South Abutment (Riser of Principal Spillway is shown at right)

Photo 1 - Gully Erosion of Downstream Slope Near Left Abutment - 23 June 1978

Photo 2 - Gully Erosion of Left Slope of Auxiliary Spillway - 23 June 1978

Photo 3 - Unvegetated Areas of Auxiliary Spillway Inlet Channel - 23 June 1978

Photo 4 - View of Upstream Embankment Slope and Riser - 23 June 1978

Photo 5 - Closer View of Riser Showing Debris Against Low Pool Orifice and Trash Rack (Note that low pool orifice trash rack is missing.) - 23 June 1978

Photo 6 - View of Slump or Sloughage of Downstream Slope Just Above Impact Basin - 23 June 1978

Photo 7 - Closer View of Slump or Sloughage Area (Maximum vertical displacement at top is approximately 22 inches.) - 23 June 1978

Photo 8 - View of Debris in Impact Basin looking Down From Top - 23 June 1978

PHOTO 1

PHOTO 2

PHOTO 3

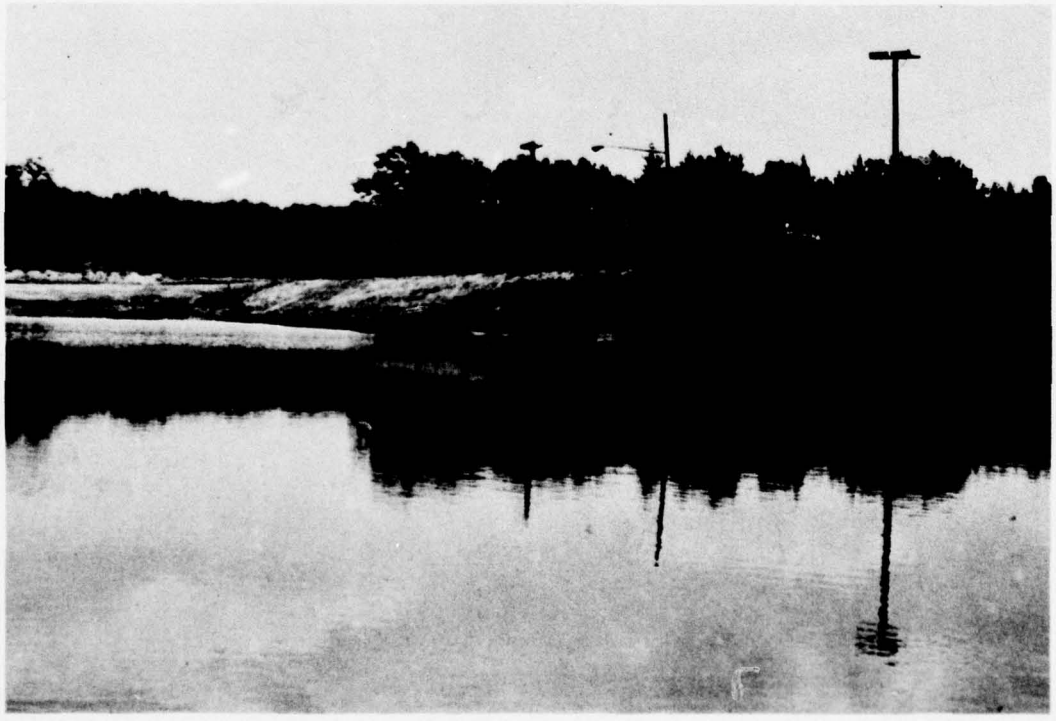


PHOTO 4

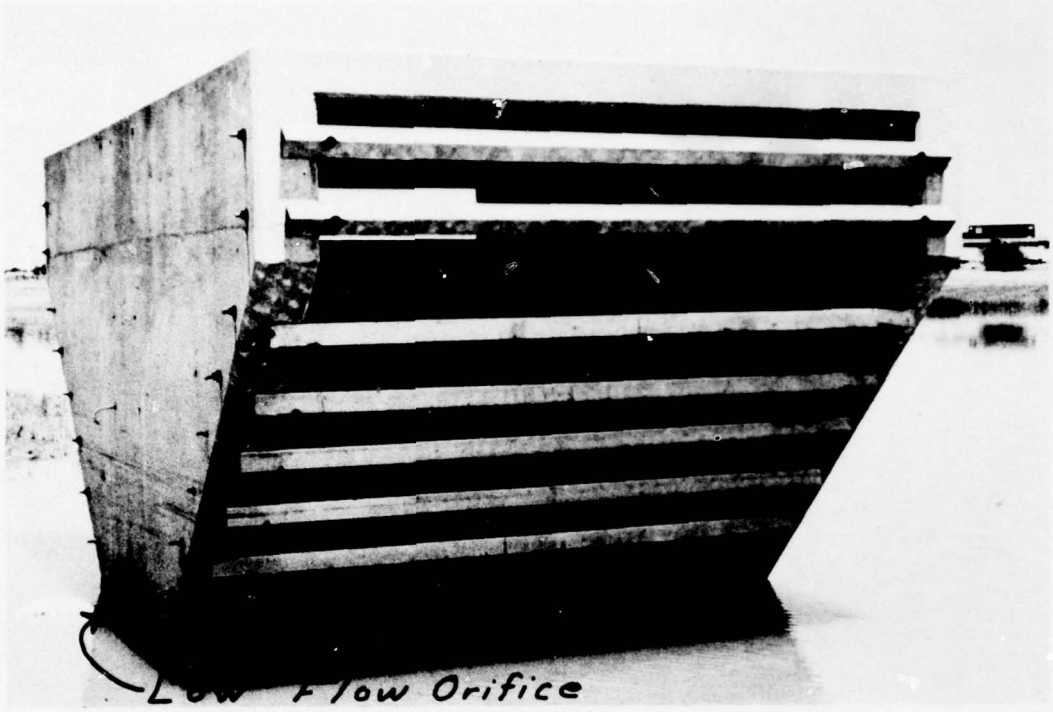


PHOTO 5

PHOTO 6

PHOTO 7

PHOTO 8

APPENDIX A

CHECK LIST - VISUAL INSPECTION

Check List
Visual Inspection
Phase 1

Name Dam Assunpink W.S. Site No.8 (Hamilton Park Lake, sometimes referred to as Greene Acres Lake, Official Name is Robert G. Martin Lake) County Mercer State New Jersey Coordinates Lat. 40°12.7' N Long. 74°40.6'W

Date Inspection 23 June 1978 Weather Sunny Temperature 75° to 80°F. +

Pool Elevation at Time of Inspection 66.0 M.S.L. Tailwater at Time of Inspection 60.5 M.S.L.

Inspection Personnel:

E.U. Gingrich
(Michael Baker, Jr., Inc.)

T. J. Dougan
(Michael Baker, Jr., Inc.)

J.R. Rapp
(Michael Baker, Jr., Inc.)

J.R. Rapp Recorder

CONCRETE/MASONRY DAMS

Assunpink W. S. Site No. 8

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SEE PAGE ON LEAKAGE	Not Applicable	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Not Applicable	
DRAINS	Not Applicable	
WATER PASSAGES	Not Applicable	
FOUNDATION	Not Applicable	

CONCRETE/MASONRY DAMS

Assunpink W. S. Site No. 8

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Not Applicable	
STRUCTURAL CRACKING	Not Applicable	
VERTICAL AND HORIZONTAL ALIGNMENT	Not Applicable	
MONOLITH JOINTS	Not Applicable	
CONSTRUCTION JOINTS	Not Applicable	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	No surface cracks were observed except for a sloughage or slump scarp on the downstream embankment slope, upstream from the impact basin.	See "SLOUGHAGE OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES" below.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	No bulges, cracks or apparent earth movements were observed at or beyond the embankment toe, except for slight sloughage at the embankment toe immediately adjacent to the impact basin.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	1) A small sloughage or slump area was observed immediately upslope from the concrete outlet impact basin. The maximum vertical displacement was measured to be approximately 22 inches.	1) Further investigation is recommended to determine the cause of this sloughage, or slump, including an inspection of the interior of the outlet pipe for possible defects. Installation of piezometers or observation wells is recommended if the cause of the sloughage cannot be readily determined and corrected. This area should be monitored periodically to determine if seepage from the embankment occurs, especially during periods when the reservoir level is above normal pool. The sloughage area should be repaired after the cause of the slough is determined and corrected.
	2) Some eroded gullies, as deep as two feet, were observed on the downstream embankment slope and near the left and right abutments. Ruts as deep as 12 inches, with ponding of water, were also observed on the embankment crest.	2) All eroded gullies and ruts should be filled and reseeded, including the gully connecting the crest with the sloughage area. Efforts should be continued to keep vehicular traffic including motor bikes, off of the dam and adjacent areas.

(continued on next page)

EMBANKMENT

Assunpink W.S. Site No. 8

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES (Continued)	3) Bare areas with some sloughage and erosion were observed at the embankment toe immediately adjacent to the impact basin.	3) The bare eroded areas should be repaired and reseeded. Riprap should be provided adjacent to the impact basin if sloughage or erosion reoccurs.
RIPRAP FAILURES	No riprap was designed or placed on the upstream slope. Very slight erosion of the 2.3:1 slope, due to wave action, was observed on the embankment just above the bench on the upstream embankment slope near the riser.	The limited areas of slope erosion, and the area of small soil sloughs, should be regraded and reseeded. Minor erosion should be repaired promptly. If in the future serious erosion occurs, protection of the slope with riprap could become necessary.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	No problems noted.	
ANY NOTICEABLE SEEPAGE	No seepage was observed during the visual inspection when the reservoir was at normal pool elevation. It is not known if seepage would occur if the reservoir level were higher.	Monitoring of the embankment slope in the vicinity of the sloughage or slump, adjacent to the impact basin, is recommended during higher than normal reservoir levels in order to determine if seepage does occur.
STAFF GAGE AND RECORDER	None have been installed.	

EMBANKMENT

Assunpink W. S. Site No. 8

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
DRAINS	Six inch perforated asbestos cement foundation underdrains were observed to be functioning. Estimated flow from each was about one G.P.M. Flow from underdrains causes localized iron staining of stream banks. No small animal guards were in place as shown on "as built" drawings.	Installation of small animal guards on underdrain outlets is recommended.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	1) Horizontal Alignment - No misalignment was observed. 2) Vertical Alignment - A very gradual slight sag in the crest elevation of the dam was observed about 150 feet north of the riser which also appears on the "as built" profile. This deflection may have been "built in" during construction, or may be the result of settlement.	

OUTLET WORKS

Assunpink W.S. Site No. 8

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	The interior of the 36 inch concrete outlet pipe (principal spillway) could not be inspected due to flow. No cracking or spalling of concrete surface at end of outlet pipe was observed.	It is recommended that the interior of the outlet pipe be inspected for defects that could result in loss of water into the embankment during periods of full flow. This should be done as part of an additional investigation to determine the cause or causes of the sloughage or slump adjacent to the concrete impact basin.
INTAKE STRUCTURE (RISER)	The low flow orifice trash rack was absent resulting in some debris blocking the low flow orifice. Riser concrete surfaces appeared to be in good condition.	A low flow orifice trash rack should be installed on the riser.
OUTLET STRUCTURE (IMPACT BASIN)	No noticeable defects were observed except for an accumulation of debris in the impact basin. The concrete surfaces of this structure appeared to be in good condition.	It is recommended that the debris in the impact basin be removed. If the cause of the sloughage or slump adjacent to the impact basin, upslope, cannot be readily determined and the cause corrected, surveys should be performed to detect possible movement of the impact basin.
OUTLET CHANNEL	No erosion or other problems were noted. A good growth of grasses and shrubs was observed on the gently sloping banks. According to the "as built" drawings, riprap was to be provided in the outlet channel. However, no riprap was observed.	Riprap should provided if an erosion problem develops in the future.
EMERGENCY GATE	The 18 inch square drain gate at the bottom of the riser could not be inspected but reportedly functions normally.	

UNGATED SPILLWAY (AUXILIARY SPILLWAY)

Assunpink W. S. Site No. 8

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	None	
APPROACH CHANNEL	Auxiliary spillway approach channel bottom is grass covered, except for a few bare areas which are subject to potential erosion. A few small gullies have eroded south channel slope.	All erosion channels should be filled and reseeded. All bare areas on channel bottom should be topsoiled and reseeded.
DISCHARGE CHANNEL	Auxiliary spillway discharge channel bottom is mostly grass covered except for some bare spots and bare paths caused by motor bikes. One deep (three feet maximum) gully was observed on south channel slope.	All erosion channels should be filled and reseeded. Paved gutters may be needed if erosion is not arrested. All bare areas on channel bottom should be topsoiled and reseeded. Efforts should continue to keep motor vehicles off of dam and adjacent areas including the auxiliary spillway.
BRIDGE AND PIERS	None	

GATED SPILLWAY

Assunpink W. S. Site No. 8

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	Not Applicable	
APPROACH CHANNEL	Not Applicable	
DISCHARGE CHANNEL	Not Applicable	
BRIDGE AND PIERS	Not Applicable	
GATES AND OPERATION EQUIPMENT	Not Applicable	

INSTRUMENTATION

Assunpink W.S. Site No. 8

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	No survey monuments were observed. No surveys have been performed since the "as built" plans were prepared.	If the cause of the sloughage cannot be readily determined and corrected, then surveys should be performed to detect possible movement of the impact basin and possible further movement of the slough or slump.
OBSERVATION WELLS	None	See "PIEZOMETERS" below.
WEIRS	None	
PIEZOMETERS	None	It is recommended that piezometers or observation wells be installed near and/or in the sloughage or slump area, *immediately upslope from the impact* basin if the cause of the sloughage cannot be readily determined and corrected. The piezometers or observation wells should be designed to measure the elevation of the phreatic surface during normal and high reservoir levels. The piezometers or wells should be monitored, periodically, especially during periods when the reservoir is above normal pool elevation. A gauge should be installed to measure the level of the reservoir when piezometer readings are taken.

INSTRUMENTATION

Assunpink W.S. Site No. 8

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
OTHER (ADDITIONAL BORINGS)		Drilling of test borings is recommended to determine soil conditions and soil properties (by testing) of the embankment in the sloughage or slump area if the cause of the sloughage cannot be readily determined and corrected. The completed drill holes may then be used for installation of piezometers or observation wells.

RESERVOIR

Assunpink W.S. Site No. 8

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Most slopes are nearly flat or very slightly sloping. Some nearly flat slopes are marshy. A good growth of grasses is present on the reservoir slopes. Some slopes adjacent to the reservoir are heavily forested.	
SEDIMENTATION	No sedimentation studies have been performed, but sedimentation of the reservoir is believed to be minimal.	

DOWNSTREAM CHANNEL

Assunpink W.S. Site No. 8

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	The downstream channel (a natural stream bed below the principal spillway outlet channel) is located in a wooded marshy area. The downstream channel sides are lined with brush and trees.	No action is recommended.
SLOPES	Downstream channel side slopes are gentle. The stream channel gradient is less than one-half percent.	
APPROXIMATE NO. OF HOMES AND POPULATION	A highly urbanized portion of Trenton, New Jersey (population 115,000) is located two miles downstream.	

APPENDIX B

CHECK LIST - ENGINEERING DATA

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

Assunpink W.S. Site No. 8

ITEM	REMARKS
PLAN OF DAM	Complete sets of "design" and "as built" plans are available from the S.C.S. "As built" drawings showing the dam in plan view are included in this report as Plates 1 through 3. For clarity the "design" plans of these drawings are included as Plates 6 through 8.
REGIONAL VICINITY MAP	The Location Plan is attached.
CONSTRUCTION HISTORY	The foundation investigation was done in 1966. The dam was designed by the S.C.S. in 1966 and constructed by E.J. Crosby Construction Co. of Port Monmouth, New Jersey during 1967. Construction was completed on 17 November 1967. No problems were reportedly encountered during construction.
TYPICAL SECTIONS OF DAM	"As built" typical sections of the dam are enclosed in the Phase I Inspection Report as Plates 4 and 5, and the "design" drawings of these two plates are shown as Plates 9 and 10.
HYDROLOGIC/HYDRAULIC DATA	In summary form, hydrologic/hydraulic data are included in the Design Report, Appendix C.
OUTLETS - PLAN AND DETAILS	are shown on Plates 3 and 4 ("as built" drawings) and on Plates 8 and 9 ("design" drawings) in this report.
- CONSTRAINTS AND DISCHARGE RATINGS	are included in the S.C.S. Design Report included in Appendix C.
RAINFALL/RESERVOIR RECORDS	No rainfall or reservoir level records are available at the dam. Rainfall data are available from New Jersey Climatological Records.

Assunpink W.S. Site No. 8

ITEM	REMARKS
DESIGN REPORTS	The S.C.S. Design Report is included in Appendix C.
GEOLOGY REPORTS	A subsurface investigation consisting of test pits and test borings are part of the design drawings. The site soils and geology are briefly discussed in the Design Report.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Design computations were done by the S.C.S. for hydrology and hydraulics. No stability or seepage calculations were made available at the time of preparation of this report.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	A foundation and borrow investigation was performed with test borings and test pits.
POST-CONSTRUCTION SURVEYS OF DAM	The dam is inspected yearly by the S.C.S. along with personnel from Hamilton Township. A copy of the 1978 Operations and Maintenance Inspection Report is included in Appendix C. The joints of the outlet pipe (principal spillway) were reportedly inspected about 1970.
BORROW SOURCES	The "as built" drawings indicate the borrow sources as follows: 1) Zone 2 embankment material shall be constructed of non-plastic silty sands (SM) found in lenses within the auxiliary spillway. 2) Zone 1 shall be constructed of slightly plastic clayey sands (SC) and silty sands (SM) as typified by material found in Test Pit 10. 3) A borrow area is also shown on Plate 1 and is designated as "Borrow Area II" northeast of Test Pit 10.

Assunpink W.S. Site No. 8

ITEM	REMARKS
MONITORING SYSTEMS	No monitoring systems were designed into the dam.
MODIFICATIONS	Fences have been erected to limit vehicular traffic. A slope drain was constructed in 1970 along the south cut slope of the auxiliary spillway to intercept seepage which was causing erosion.
HIGH POOL RECORDS	The highest observed pool elevation is approximately 75.7 feet, when the auxiliary spillway flowed about one and one-half feet deep in 1971.
POST-CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Stability calculations were apparently made after preparation of the Design Report. These calculations were not made available at the time of this Report preparation.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None
MAINTENANCE OPERATION RECORDS	Yearly inspections are made by the S.C.S. along with Hamilton Township personnel. Maintenance performed has included erosion repair, liming, fertilizing, reseeding and mowing of the embankment and surrounding areas.

Assunpink W.S. Site No. 8

ITEM	REMARKS
SPILLWAY PLAN	A plan of the earthen auxiliary spillway is shown on Plates 3 and 8.
SECTIONS	The bottom width of the auxiliary spillway was measured to be approximately 205 feet, versus 210 feet shown on the "as built" plans. The side slopes of the auxiliary spillway in general closely match that shown on the plans. However, the south cut slope, opposite the left abutment, was measured to be as steep as 1.3:1 where a one and one-half feet deep eroded gully has formed.
DETAILS	Earth with minimal growth. Slight erosion was noted from hillside drainage. Plans and details are available at the S.C.S. Richmond Office. The auxiliary spillway, excavated in the inlet channel and control section. The outlet channel is mostly well vegetated with grass and discharges into a heavily wooded area, as designed.
OPERATING EQUIPMENT PLANS & DETAILS	A water control gate is provided in the riser. Plans and details are available from the S.C.S. During periods of heavy rains the gate (18 inches x 18 inches) is opened by the Township to minimize flooding of recreational facilities around the lake.

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 3.0 square miles of rolling topography consisting of woodland, cropland, meadows and rural residential development

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 66.0 feet (26 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 74.2 feet (500 acre-feet)

ELEVATION MAXIMUM DESIGN POOL: 76.2 feet

ELEVATION TOP DAM: 80.2 feet

CREST: Auxiliary (emergency) spillway

a. Elevation 74.2 feet
b. Type Earthfill dam with earth auxiliary spillway
c. Width of auxiliary spillway equals 210 feet
d. Length of auxiliary spillway equals approximately 700 feet (see plate 3)
e. Location Spillover Side channel adjacent to left abutment
f. Number and Type of Gates None

OUTLET WORKS: Drop inlet type principal spillway

a. Type Drop inlet concrete riser with 36 inch diameter pipe conduit
b. Location center of dam
c. Entrance inverts 61.5 feet
d. Exit inverts 60.4 feet
e. Emergency draindown facilities 18 inches x 18 inches drain gate in riser

HYDROMETEOROLOGICAL GAGES: None

a. Type
b. Location
c. Records

MAXIMUM NON-DAMAGING DISCHARGE Not available

Assunpink W.S. Site No. 8

APPENDIX C

DESIGN REPORT AND 1978 OPERATIONS AND MAINTENANCE INSPECTION REPORT

DESIGN REPORT

FLOODWATER RETARDING DAM NO. 8
ASSUNPINK CREEK WATERSHED

HAMILTON TOWNSHIP
MERCER COUNTY, NEW JERSEY

REFERENCE:	U.S.DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE 73	DRAWING NO. NJ-CS-2010-8 SHEET___ OF___ DATE_____

DESIGN REPORT

NJ-08-2010-8

Floodwater Retarding Dam No. 8
Assunpink Creek Watershed

Hamilton Township
Mercer County, New Jersey

Location

The site is located on the upper reaches of Pond Run. It is approximately 1,200 feet upstream of the White Horse-Hamilton Square Road, 1.5 miles south of Hamilton Square.

Hydrology

The contributing watershed for the dam consists of 3.0 square miles of woodland, cropland, meadow and rural residential development. A study of the runoff producing characteristics was conducted following the methods outlined in Soil Conservation Service National Engineering Handbook, Section 4, Hydrology-Supplement A. This study considered the infiltration and permeability of the various soils in the watershed and the modification of the hydrologic characteristics by vegetative cover and land use. Consideration was given to future land development and use. A time of concentration was developed based on the topography of the watershed and the slope and physical characteristics of the stream channel.

Priliminary analysis indicated that a storm duration of approximately six hours would be most critical for the watershed. Rainfall data for the flood benefit storm was obtained from U. S. Weather Bureau Technical Paper No. 40. Rainfall data for the auxiliary spillway design storm and the freeboard storm was obtained from a series of six hours storms developed by the Soil Conservation Service and incorporated into Engineering Memorandum 27 (Rev. March 19, 1965). Hydrographs were developed which reflect the net effect of the combination of factors determining the amount and time distribution of the runoff from the watershed resulting from the design storms. These hydrographs were graphically routed through the reservoir to determine the maximum stages produced by these storms.

A summary of hydrologic criteria and the results of flood routing is contained in Table I.

REFERENCE:	U.S.DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE 74	DRAWING NO. NJ-08-2010-8 SHEET 1 OF 3 DATE 6/13/66

DESIGN REPORT

Hydraulics of Spillways

The principal spillway is a 36 inch I. D. reinforced concrete pipe with a two stage drop inlet riser. The drop inlet riser is a standard design developed by the Agriculture Research Service at the Saint Anthony Falls Hydraulic Laboratory, Minneapolis, Minnesota. An orifice is installed at the level of the 100 year sediment storage. The release rate through the orifice provides complete flood protection for approximately the 13 year and more frequent storm events. The release rate for the 36 inch I. D. conduit give partial protection for all storms more frequent than the 100 year six hour used to set the crest of the auxiliary spillway. The stage-discharge relationship of the spillway was determined using the results of the Saint Anthony Falls model studies as the coefficients of the classical formulas.

An impact basin energy dissipator has been provided at the outlet to prevent the formation of a scour hole. It is the standard design adapted from the impact basin developed by The Bureau of Reclamation, U. S. Department of the Interior. This type of energy dissipation functions almost independently of tail water elevation and will not be affected by the low tail water available at this site.

The auxiliary spillway is an open channel excavated in the south abutment. It is the primary source of embankment borrow. It consists of a negatively sloped entrance, a 50' level reach, a control section, and a positively sloped outlet. The stage-discharge relationship was determined from a nomograph developed in the New Jersey SCS State Design Section using Technical Release No. 2 and Standard Drawing No. ES-124. In order to insure these relationships held true, the slope of the outlet channel has been selected so all major flows pass through critical at the control section and exit as super critical flow. The topography of the site dictated that the slope of the outlet channel be flattened to less than the required slope at its termination. This situation has been analyzed to assure that it will not cause the control section to flood out and destroy the predicted stage-discharge relationship. It is recognized that this slope change will create a possible erosion hazard but the infrequent use of the spillway and the planned vegetative cover will make this a very minor maintenance problem.

Subsurface Investigation and Embankment Design

The subsurface investigation was conducted by the Acting Watershed Geologist, Soil Conservation Service, New Jersey and the analysis and report was prepared by the Geologist, Soil Conservation Service, New Jersey. Laboratory tests and the test report were prepared by the Soil Conservation Service Soil Mechanics Laboratory, Lincoln, Nebraska. Test pits were excavated with a tractor mounted backhoe. Drill holes were made with a 3½ inch diameter piston sampler and a 1 3/8 inch minimum diameter split spoon sampler.

DESIGN REPORT

The site lies in the coastal plain physiographic area. It is situated above a channel carved in the Magothy-Raritan formation and filled with quaternary and recent sediments. The thickness of these younger sediments exceed 50 feet in the flood plain. A permeable gravel layer under the dam is overlain with 1 to 6 feet of slowly permeable alluvium of silt, sand, clay and organic material. A foundation drain has been designed to intercept seepage through the permeable material and to control the phreatic line in the embankment.

The low density, low strength silt and organic material is to be removed from the foundation area. An impermeable cutoff is planned through the permeable gravel layer under the dam. The embankment material is to be selectively placed with the bulk of the dam being the plastic sand-silt-clay materials and the back slope being the non-plastic silty-sand and gravel. No stability analysis was made due to the low fill height but it should be amply stable with the proposed side slopes. Consolidation and the associated settlement strains should present no problems. Vegetation is to be established on all exposed cut and fill surfaces to prevent surface erosion.

Table I

Factor Which Determines Stage	Rainfall (inch)	Runoff (inch)	Peak Inflow (cfs)	Maximum Stage (Ft-SLD)	Total Storage (Ac-Ft)	Element Determined by Maximum Stage
100 year Sediment deposit plus storage to maintain trap efficiency	-	-	-	66.0	26	Low Stage Crest
100 yr.-6 hr. Storm	5.4	3.06	1701	74.2	500	Auxiliary Spillway Crest
Percentage of Prob. Max. 6 hr. Storm	10.70	7.94	3933	76.4	880	-
Probable Max. 6 hr. Storm	26.0	22.9	11398	80.2	1590	Top of Dam

NOTE: Elevation datum - Sea Level Datum, 1929 Adjustment, U. S. Coast and Geodetic Survey.

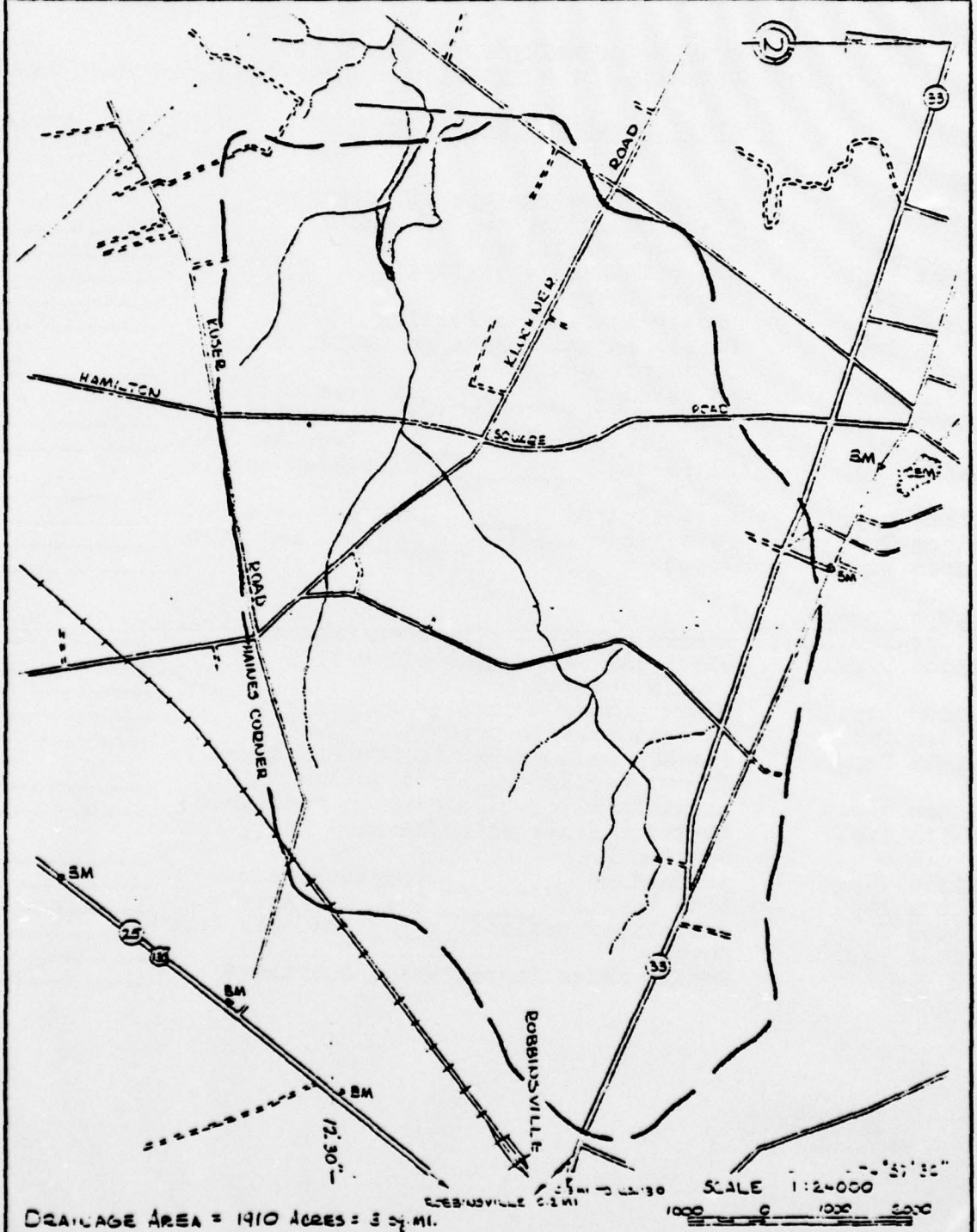
PREPARED BY: _____
Charles R. Cobb
Civil Engineer

CONCURRED: _____
Robert H. Fox, PE
State Design Engineer

REFERENCE:	U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE 76	DRAWING NO. NJ-08-2010-8 SHEET 3 OF 3 DATE 6/13/66

WATERSHED MAP

ASSUNPINK CREEK WATERSHED FLOODWATER RETARDING DAM NO. 5



REFERENCE:	U.S. DEPARTMENT OF AGRICULTURE	DRAWING NO.
TOPOGRAPHIC MAP U.S. GEOLOGICAL SURVEY TRENTON EAST QUADRANGLE 1948	SOIL CONSERVATION SERVICE 77	DJ-CE-2010-S SHEET ___ OF ___ DATE ___

ASSUNPINK WATERSHED - HAMILTON TWP.
1978 OPERATIONS & MAINTENANCE INSPECTION (Late April 1978)

	Items Requiring Maintenance	Date Completed
Site 8		
Hamilton Twp.	Topsoil & revegetate all damaged areas including top of dams &	
Hamilton Twp.	emergency spillway	
Hamilton Twp.	Control Vehicle traffic	
Hamilton Twp.	Remove debris	
Hamilton Twp.	Repair or replace fencing	
Hamilton Twp.	Repair animal guards on outlet drains at impact basin	
Hamilton Twp.	pH reading _____ dam area	
Hamilton Twp.	Lime applied _____lbs. per acre	
Hamilton Twp.	Fertilizer applied _____ lbs. per acre	
Hamilton Twp.	pH reading _____ emergency spill-way area	
Hamilton Twp.	Lime applied _____ lbs. per acre	
Hamilton Twp.	Fertilizer applied _____lbs. per acre	
Hamilton Twp.	Mowed	
Pond Run Channel		
Hamilton Twp.	Remove debris & silt from Channel	
Hamilton Twp.	Check all weep holes after silt & debris removal	
Hamilton Twp.	Clean gutter drains as neccessary	
Hamilton Twp.	Control vehicle traffic	
Hamilton Twp.	Install curb on Bromley Tennis Court to divert surface water to gutter	
Hamilton Twp.	Maintain older shrubbery on Section 2	
Hamilton Twp.	Re-grout Fence as neccesary in Section 2	
Hamilton Twp.	pH reading _____ vegetated areas	
Hamilton Twp.	Lime applied _____ lbs. per Acre	
Hamilton Twp.	Fertilizer applied _____ lbs. per Acre	
Hamilton Twp.	Mowed	
S.C.S.	Repair fence installation Section 2	

APPENDIX D

EXCERPTS FROM
"RECOMMENDED GUIDELINES FOR SAFETY INSPECTIONS OF DAMS"

EXCERPTS FROM
"RECOMMENDED GUIDELINES FOR SAFETY INSPECTIONS OF DAMS"

"4.4.3.5. Seepage Failure. A critical uncontrolled underseepage or through seepage condition that develops during a rising pool can quickly reduce a structure which was stable under previous conditions, to a total structural failure. The visually confirmed seepage conditions to be avoided are (1) the exit of the phreatic surface on the downstream slope of the dam and (2) development of hydrostatic heads sufficient to create in the area downstream of the dam sand boils that erode materials by the phenomenon known as "piping" and (3) localized concentrations of seepage along conduits or through pervious zones. The dams most susceptible to seepage problems are those built of or on pervious materials of uniform fine particle size, with no provisions for an internal drainage zone and/or no underseepage controls."

"4.4.1. Foundation and Material Investigations. The scope of the foundation and materials investigation should be limited to obtaining the information required to analyze the structural stability and to investigate any suspected condition which would adversely affect the safety of the dam. Such investigations may include borings to obtain concrete, embankment, soil foundation, and bedrock samples; testing specimens from these samples to determine the strength and elastic parameters of the materials, including the soft seams, joints, fault gouge and expansive clays or other critical materials in the foundation; determining the character of the bedrock including joints, bedding planes, fractures, faults, voids and caverns, and other geological irregularities; and installating instruments for determining movements, strains, suspected excessive internal seepage pressures, seepage gradients and uplift forces. Special investigations may be necessary where suspect rock types such as limestone, gypsum, salt, basalt, claystone, shales or others are involved in foundations or abutments in order to determine the extent of cavities, piping or other deficiencies in the rock foundation. A concrete core drilling program should be undertaken only when the existence of significant structural cracks is suspected or the general qualitative condition of the concrete is in doubt. The tests of materials will be necessary only where such data are lacking or are outdated."