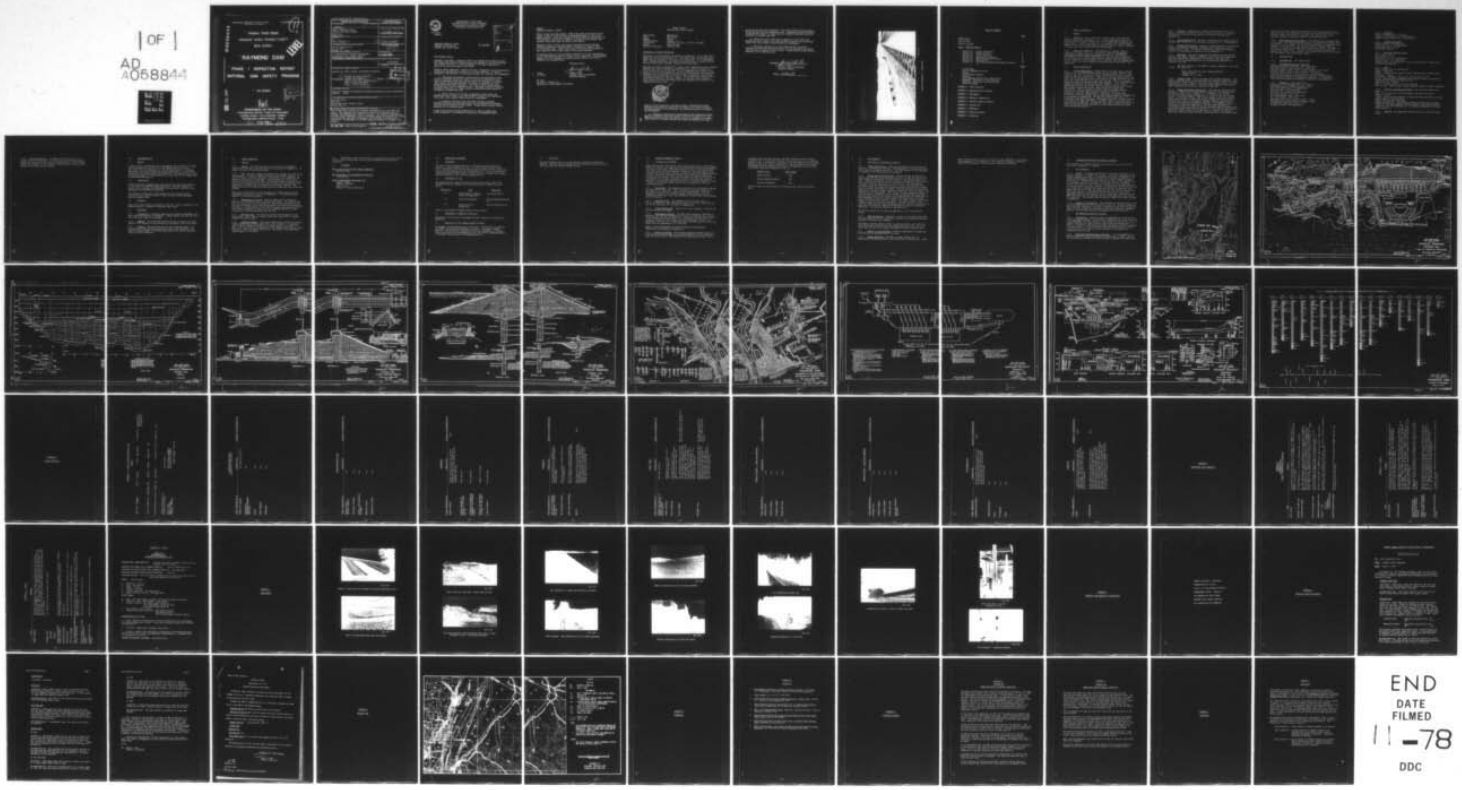
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PASSAIC RIVER BASIN

WANAQUE RIVER, PASSAIC COUNTY

NEW JERSEY

LEVEL II

# RAYMOND DAM

## PHASE I INSPECTION REPORT

## NATIONAL DAM SAFETY PROGRAM

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(NJ 00213)

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

JULY 1978

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

# REPORT DOCUMENTATION PAGE

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| 3. RECIPIENT'S CATALOG NUMBER | |
| 4. TITLE (and Subtitle): Phase I Inspection Report National Dam Safety Program Raymond Dam Passaic County, N.J. | 5. TYPE OF REPORT & PERIOD COVERED: (9) FINAL rept. |
| | 6. PERFORMING ORG. REPORT NUMBER |
| 7. AUTHOR(s): (10) James A. Hagen, P.E. | 8. CONTRACT OR GRANT NUMBER(s): (15) DACW61-78-C-0114 |
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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--New Jersey
Dam Safety
National Dam Safety Program. Phase I
Raymond Dam, N.J.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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

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IN REPLY REFER TO
NAPEN-D

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

25 AUG 1978

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Raymond Dam in Passaic 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 two pages of the report.

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

a. Hydrologic and Hydraulic investigations and engineering studies should be performed within nine months of the date of approval of this report to determine corrective actions required to decrease the drawdown time required for Wanaque Reservoir and reduce the potential for soil piping during high water elevations. The latter should include studies of the phreatic line and embankment soils. Necessary corrective measures, including construction of larger capacity drawdown facilities should be initiated in calendar year 1979.

b. Within one year of the date of approval of this report the possibility that a break in the lawn sprinkler system on the downstream slope could cause serious erosion should be investigated.

c. Operation officials of the dam should develop a periodic inspection program and maintenance manual for the dam within six months from the date of approval of this report. Program should include monthly operation of the upstream gates.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State

NAPEN-D
Honorable Brendan T. Byrne

Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Robert A. Roe of the Eighth 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
Colonel, Corps of Engineers
District Engineer

1 Incl
As stated

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

Phase I Report
National Dam Safety Program

| | |
|---|---|
| Name of Dam: | Raymond Dam |
| State: | New Jersey |
| County: | Passaic |
| USGS Quad Sheet: | Wanaque, N. J. |
| Coordinates: | N 41° 02' 42" LAT., W 74° 17' 42" LONG. |
| Stream: | Wanaque River |
| Dates of Inspection: | 8-10 May 1978 |

Assessment of General Conditions

This dam is in good condition as defined in Appendix I. It is the largest among nine dams on Wanaque Reservoir. The sluice gates in the Upper Gate House were not operable at the time of our inspection. It is recommended that a monthly maintenance schedule be established soon to operate each of the four sluice gates through a complete-close open cycle.

This dam will not be overtopped by a water level associated with the probable maximum flood (PMF) although its impermeable core will be exceeded at a level associated with 1/2 the PMF. It is recommended that studies of the phreatic line and the embankment material including vertical and horizontal permeabilities be performed in the near future to determine the potential for piping during high reservoir levels. The drawdown time required now is considered excessive so the owner should, in the near future, provide a water release facility which would allow the reservoir to be lowered in an acceptable period of time.




**Based on visual inspection, available records, calculations and past operational performance, Raymond Dam is judged to be in good condition. To insure adequacy of the structure, the following actions as a minimum, are recommended:**

**a. Hydrologic and Hydraulic investigations and engineering studies should be performed within nine months of the date of approval of this report to determine corrective actions required to decrease the drawdown time required for Wanaque Reservoir and reduce the potential for soil**

piping during high water elevations. The latter should include studies of the phreatic line and embankment soils. Necessary corrective measures including construction of larger capacity drawdown facilities should be initiated in calendar year 1979.

b. Within one year of the date of approval of this report the possibility that a break in the lawn sprinkler system on the downstream slope could cause serious erosion should be investigated.

c. Operation officials of the dam should develop a periodic inspection program and maintenance manual for the dam within six months from the date of approval of this report. Program should include monthly operation of the upstream gates.

APPROVED: James G. Ton

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 25 AUG 78



May 1978

OVERVIEW PHOTOGRAPH - RAYMOND DAM

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## 1.0 PROJECT INFORMATION

### 1.1 GENERAL

1.1.1 Authority: Public Law 92-367, 8 August 1972, authorized the Secretary of the Army, through the U.S. Corps of Engineers to initiate a national program of safety inspections of non-Federal dams throughout the United States. Gilbert Associates, Inc. has entered into contract number DACW61-78-C-0114 with the Philadelphia Office of the U.S. Corps of Engineers to inspect this dam, Gilbert Work Order 06-7249-000.

1.1.2 Purpose of Inspection: The purpose is to conduct a Phase I inspection according to the U.S. Army Corps of Engineers Recommended Guidelines for Safety Inspection of Dams (Reference 1) and contract requirements between Gilbert Associates, Inc. and the Corps of Engineers. The objectives are to expeditiously identify whether this dam apparently poses an immediate threat to human life or property, and to recommend future studies and/or any obvious remedial actions that may be indicated by the inspection.

### 1.2 PROJECT DESCRIPTION

1.2.1 Dam and Appurtenances: Raymond Dam is the major dam on Wanaque Reservoir. It is a 105-foot high (above original ground), 1600-foot long earthfill dam, with a concrete core-wall extending 83 feet below original ground to the final rock surface. There are two conduits passing under the right side of the dam which can be controlled at an Upper Gate House on the dam or at a Lower Gate House at the toe of the dam. There is a concrete surge tank located on the downstream right abutment. It is connected to the Aqueduct leaving the Lower Gate House and, therefore, is not a true appurtenant structure of the dam. The two conduits passing under the dam were stream diversion and access tunnels during the original dam construction. They now provide for multi-level discharges from the reservoir to the water supply Aqueduct leaving the reservoir. The maintenance, security, administration, laboratory, and engineering facilities of the North Jersey District Water Supply Commission (NJDWSC) are on the grounds of Raymond Dam. The current meteorological station is located near the Lower Gate House. The gaging station for Wanaque reservoir is located in the Upper Gate House on the dam. There are no storm water level controls on this dam. As with the other dams on Wanaque Reservoir, it relies on the Overflow Weir (NJ 00214) to pass excess storm water runoff (see location map, Figure 1).

1.2.2 Location: Raymond Dam is located about one mile north of the center of Wanaque, New Jersey and west of New Jersey Route 511 (Figure 1). The location of the dam is also shown on the regional geologic map (Appendix F).

1.2.3 Size Classification: The dam is classified as a "large" structure (storage 105,570 Acre-ft.), in accordance with Section 2.1.1 of Reference 1.

1.2.4 Hazard Classification: The dam is located upstream of a populated valley and floodplain area with a moderately heavy population, which includes several towns. The dam is classified as a high hazard potential based on the requirements of Section 2.1.2 of Reference 1.

1.2.5 Ownership: The dam is owned and maintained by the North Jersey District Water Supply Commission (NJDWSC), a New Jersey state commission. They have engineering, administration, maintenance, and laboratory facilities for the Wanaque Reservoir and all associated dams which are located at this dam.

The Chief Engineer of the NJDWSC in Wanaque (NJDWSC-W) is Mr. Dean C. Noll. The address is:

North Jersey District Water Supply Commission
Ringwood Avenue
Wanaque, N. J. 07465

1.2.6 Purpose of Dam: This is the main dam at Wanaque Reservoir. The reservoir provides water to the municipalities of Paterson, Montclair, Glen Ridge, Newark, Kearny, Passaic, and Clifton, New Jersey. There is no other intended use for this reservoir. The water supply Aqueduct which serves these communities starts and is controlled at this dam.

1.2.7 Design and Construction History: This dam was constructed from November 9, 1920 to July 14, 1928 and was originally called Wanaque Dam. The work was done by W. H. Gahagan, Inc. of Brooklyn, N.Y. and the Clifford F. MacEvoy Company of Newark, N.J. as part of the total Wanaque Project. The project began in 1920 and was completed with the reservoir being filled by March 4, 1929. The original design records could not be located by the staff of the NJDWSC at Wanaque. However, publications indicate the design was performed by employees of the NJDWSC-W with the assistance of individual consultants. The New Jersey Department of Environmental Protection (DEP) has monthly progress inspection reports and several photographs taken during construction. There are no indications of revisions or major repairs to the dam since its original construction. There were some minor additions which included paving of the roadway along

the crest of the dam, adding air compressors at the Upper Gate House and associated small air pipes leading into the reservoir along the top of the riprap to improve the quality of the water, and adding a buried lawn sprinkler system to the grassed slopes on the downstream face.

1.2.8 Normal Operational Procedures: The upper gates are normally open at all times. The controls typically used are in the Lower Gate House where the pressure can be regulated in the downstream aqueduct by pumping from the conduits to the surge tank. The quantity of water withdrawn from the reservoir is controlled by demand in the communities served. The pumps are not used for flood control. This dam relies on adequate freeboard to contain storm surges in the reservoir, with overflow handled by the Overflow Weir (NJ 00214). See Location Map, Figure 1.

1.3 PERTINENT DATA

1.3.1 Drainage Area: 90.4 square miles

1.3.2 Discharge Elevations at Dam Site:
Maximum known flood at dam site - 303.0 feet M.S.L.
Warm water outlet at pool elevation - 278.0 feet
Diversion tunnel low pool outlet at pool elevation - 222.0 feet
Diversion tunnel outlet at pool elevation - 256.0 feet
Gated spillway capacity at pool elevation - Not Applicable
Gated spillway capacity at maximum pool elevation - Not Applicable
Ungated spillway capacity at maximum pool elevation - Not Applicable
Total spillway capacity at maximum pool elevation - Not Applicable

1.3.3 Elevation: (feet above M.S.L.)
Top of Dam - 310.0 (Roadway built up to 315.0)
Spillway Design Flood (SDF) surcharge - 308.8
Full flood control pool - Not Applicable
Recreation pool - Not Applicable
Spillway crest (gated) - Not Applicable
Sill upper intake - 278.0 feet
Sill intermediate intake - 256.0 feet
Sill lower intake - 222.0 feet
Upstream portal invert diversion tunnel - 213.0
Downstream portal invert diversion tunnel - 209.0
Streambed at centerline of dam - 210.0
Maximum tailwater - Not Applicable

1.3.4 Reservoir:
Length of maximum pool - 6.6 miles
Length of recreation pool - Not Applicable
Length of flood control pool - Not Applicable

1.3.5 Storage (acre-feet):
Recreation pool - Not Applicable
Flood control pool - Not Applicable
Design surcharge - 103,115
Top of dam - 105,570

1.3.6 Reservoir Surface (acres):
Top of dam - 2,620
SDF Surcharge - 2,590
Flood-control pool - Not Applicable
Recreation pool - Not Applicable
Spillway crest - No spillway (at crest of Overflow Weir 0.3 mile south, 2,400 with flashboards)

1.3.7 Dam:
Type - Earthfill with a concrete core
Length - 1,603 feet
Height - 105 feet above original surface, 188 feet above corewall base
Top Width - 20 feet
Side Slopes - Upstream 3 (H) to 1 (V), D/S 2.5 (H) to 1 (V)
Zoning - Sand and gravel embankment with concrete corewall and upstream impervious zone adjacent to the core wall.
Impervious Core - Concrete
Cutoff - Concrete cutoff to final rock surface
Grout curtain - Shallow grout curtain along the concrete corewall foundation

1.3.8 Diversion and Regulating Tunnel: For plan and sections see Figure 3.
Type - Two cast in place 14 foot diameter, concrete arch tunnels
Length - 555 feet
Closure - Gated concrete bulkheads at Upper Gate House and valves on water supply pipes in Lower Gate House
Access - Through Lower Gate House
Regulating Facilities - The diversion tunnels are being used as supply conduit to the Wanaque Aqueduct (84-inch diameter steel pipe) which has controls at the Lower Gatehouse but is normally operated only for water supply purposes.

1.3.9 Spillway: Not Applicable (Uses Overflow Weir about 0.3 miles south)

1.3.10 Regulating Outlets: See Regulating Facilities in 1.3.8. Additionally, it is possible to discharge through the Wanaque Aqueduct system, the system which has a 60-inch diameter drain to the discharge channel and through a 36-inch diameter blowoff pipeline located in the bottom of the stream control conduits.

## 2.0 ENGINEERING DATA

### 2.1 DESIGN

A plan, profile, and maximum section through the dam are shown on original record tracings which are on file at the NJDWSC engineering office (Mr. Dean C. Noll) at Wanaque, N.J. (see attached Figures). No original design data was available other than results mentioned in the North East Water Works Association publication (Reference 2) and mention of the design procedure on pages 34-44 and elsewhere in a 1925 report by the Commissioner of the NJDWSC (Reference 3).

### 2.2 CONSTRUCTION

Contract drawings, specifications, grouting records, and record drawings, are available at the NJDWSC engineering office. Periodic inspection reports, news clippings, and photographs are available at the New Jersey Department of Environmental Protection.

The foundation conditions of the concrete core wall observed during construction were reported on May 3, 1922 in the New Jersey Geological Society permanent notes.

### 2.3 OPERATION

There are no flood control operations at this dam. Water is supplied to the Wanaque Aqueduct in response to municipal water usage.

### 2.4 EVALUATION

2.4.1 Availability: Foundation exploration and specific embankment data were either not available or incomplete. Design analysis data may not exist due to the early stage of technology.

2.4.2 Adequacy: The design and construction data received or reviewed appeared to be adequate for an evaluation in this Phase I dam safety report.

2.4.3 Validity: The specifications and record drawings appear to be consistent with existing structures based on the visual inspection. The contract drawings appear to have been superceded by the record drawings to reflect as-built conditions.

## 3.0 VISUAL INSPECTION

### 3.1 FINDINGS

3.1.1 General: For detailed results of the electrical equipment inspection of the Upper Gate House and Lower Gate House see Appendix H. No signs of distress of the dam were found.

3.1.2 Dam: The paved roadway and masonry walls forming the crest of the dam appear to be in good alignment and properly maintained. There is no visual evidence of unusual settlement. The contact of the embankment and abutments were sound and watertight. The downstream face of the dam is paved with native stone in the form of raised arch rings, within which are grassed areas properly mowed at the time of inspection, thus adding to the appearance of stability and of harmony with the natural setting. The exposed portion of the upstream riprap-protected slopes were also relatively uniform.

There were neither unusual visible movement at or beyond the toe of the embankment, nor surface cracks of the embankment. All drainage systems appear to be functioning properly.

3.1.3 Appurtenant Structures: There was some surface scaling and deposits on the reservoir side of the Upper Gate House. The conduits were full of water and could not be inspected. Repairs were being made to the gate hoist mechanisms in the Upper Gate House at the time of the inspection. According to a representative of the owner, the gates were operated after a thick layer of deposits had built up on the stems and resulted in some twisting-off of retaining brackets for the stem.

3.1.4 Reservoir Area: The reservoir rim near the dam appears to be quite stable. The slopes are densely wooded with large areas of exposed Highland Precambrian rocks.

3.1.5 Downstream Channel: The channel downstream of where the diversion tunnels entered the overflow channel was in good condition. The masonry walls along the downstream channel are in good condition, and there is a small local rock slide on the upper part of the channel wall along an access road due to severe weathering of the rock. The bottom of the downstream channel appears to be stable.

3.2 EVALUATION: Based on the results of the inspection, there were no visible signs of significant distress in the embankment and appurtenant structures.

3.3 ATTENDEES

North Jersey District Water Supply Commission
Mario Di Laura

New Jersey Dept. of Environmental Protection
Larry Woscyna

Gilbert Commonwealth Associates, Inc.
James A. Hagen
Rudolph J. Wahanik
Fine T. Hsu
Kenneth J. Miller (Electrical)

## 4.0 OPERATIONAL PROCEDURES

### 4.1 PROCEDURES

The water level in Wanaque Reservoir is governed by the Overflow Weir structure, several hundred feet away, to a pool elevation of 302.4 feet M.S.L. The high water elevation recorded since October 1950 was 303.93 feet with excess flow passing over the uncontrolled weir. The flow through the conduits passing through the dam is controlled by user demand and is pumped, when the reservoir is low, from the Pumping Station.

### 4.2 MAINTENANCE OF DAM

The maintenance has apparently been very good on this dam. Some of the maintenance contract numbers from records available at NJDWSC are given below:

| Contract No. | Item | Contractor |
|---|---|---|
| 29 | Reinforcement of Wanaque Tunnel and Approaches | Lock Joint Pipe Co. |
| 34 | Electrical Equipment | Watson-Flagg Engineering Co. |
| 48 | Paving of Top of Raymond Dam | United Construction Co. |

There is a maintenance equipment garage on the property.

### 4.3 MAINTENANCE OF OPERATING FACILITIES

Maintenance of the electrical equipment and gate operators is discussed in Appendix H.

### 4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

No automatic warning system exists at this dam. A daily patrol is made by the NJDWSC security guards equipped with radios. According to NJDWSC personnel, the guards are instructed to radio the guardhouse, or failing that, to directly radio the Wanaque police of any obvious, impending hazard to residents from the dams on the Wanaque Reservoir.

## 4.5 EVALUATION

For the intended purpose of the dam the past maintenance is generally adequate. However, the upper gates should be operated monthly to be sure they can close the conduits through the dam.

## 5.0 HYDRAULIC/HYDROLOGIC DESIGN

### 5.1 EVALUATION OF FEATURES

Other than the dam, there are no flood control facilities at this location. Reservoir overflow is provided by the Overflow Weir Structure, approximately 0.3 miles to the south. The intake structure built at this dam can draw water from three different reservoir elevations. The major supply steel conduits that convey water from the reservoir intake to the Wanaque Aqueduct are built inside the reinforced concrete diversion tunnels used during construction of the dam. The diversion tunnels are built at the bottom of the dam and cross the dam's concrete corewall. The diversion tunnels, therefore, are providing additional protection to the dam integrity in case of failure of the water supply conduits or any components of the flow control gate houses.

5.1.1 Design Data: The maximum pool elevation for the design discharge of 18,000 cfs is 304.3 feet. This is based on a spillway elevation of 300.3 feet plus a head of 4.0 feet, for the Overflow Weir. With the flashboards in place, the overflow becomes a sharp edged weir with an elevation of 302.4 feet, and a pool elevation of 306.6 feet with the design flow of 18,000 cfs.

5.1.2 Experience Data: The maximum recorded reservoir level is 303.9 feet (March 31, 1951, References 6 and 7), 11.1 feet lower than the top of the road built over the crest of Raymond Dam.

5.1.3 Visual Observations: There is no visual evidence to indicate the dam has ever been overtopped.

5.1.4 Overtopping Potential: The PMF, when developed as described in Appendix D and with the flashboards in place on the Overflow Weir, results in a reservoir elevation of 308.8 feet. One-half of the PMF results in a reservoir elevation of 306.0 feet, with the flashboards in place. As discussed in Section 7.0, the PMF and one-half the PMF reservoir levels are higher than the impermeable core of the dam.

Details on the methodology used and the hydraulic and hydrologic computations are presented in Appendix D.

5.1.5 Reservoir Drawdown: The existing emergency drawdown facilities installed in the several dams of the Wanaque Reservoir are not adequate to lower the water level of the reservoir in a short period of time. It is

recommended that the owner designs, and later constructs, water release structures that will allow the lowering of the water level in an acceptable period of time. A preliminary evaluation of the performance of the existing drawdown facilities is given in Appendix D. The time required to drawdown the Raymond Dam from elevation 302.4 (top of flashboards) to a water level of 222 feet using the existing facilities is:

| System in Use | Time in Days |
|---|---|
| Aerator System | 254* |
| 36-inch Diameter Blowoff | 323 |
| Aerator and Blowoff | 227 |

*Aerator alone can lower reservoir to elevation 240.5 feet in the given time.

## 6.0 DAM STABILITY

### 6.1 EVALUATION OF STRUCTURAL STABILITY

6.1.1 Visual Observations: There were no observed critical signs of distress or instability of the dam. The embankment has relatively uniform side slopes with adequate protection. The rocks exposed at both abutments are generally hard and essentially unweathered.

6.1.2 Design and Construction Data: Record drawings and published reports show the dam to be constructed primarily of sand and gravel, with water-tightness provided by a concrete corewall and adjoining impervious zone. Construction methods used as indicated in References 2 and 3 were of the state-of-the-art for the time of construction. This methodology included rolling the impervious zone soil in thin lifts which had been placed by trucks with restricted tailgate openings and moistened by adding water for proper consistency as needed. The sand and gravel was placed by dumping from conveyors without mechanical compaction; water was added at the conveyors to aid in placement. The corewall is seated deeply and bears on rock according to Reference 2 and 3 and the drawings and specifications. Based on the record of test borings, the foundation material underlying the earth embankment consists of sand, gravel and boulders with a few thin layers of hard pan (see Figure 9). There is no weak or highly compressible foundation soil indicated at this damsite. The upper portion of the corewall foundation rocks were extensively grouted. No data is available on grain size distribution, compaction properties, or other soil mechanics properties. No stability analysis of the dam exists.

The dam has existed for 50 years and apparently is still structurally stable.

6.1.3 Operation Records: Typically, the gates in the Upper Gate House are left open, and flow is controlled by valves in the Lower Gate House in response to municipal water demands.

The highest recorded reservoir level is elevation 303.93, well below the crest of the dam (elevation 310) and roadway (elevation 315), and 1 foot lower than the top of the corewall and impervious zone (elevation 305).

6.1.4 Post-Construction Changes: There are apparently no significant post-construction modifications to this dam.

6.1.5 Seismic Stability: The dam is located within Zone 1 on Algermissen's Seismic Risk Map of the United States (1969 edition). There

were no observed signs of static instability, and, therefore, in accordance with paragraph 3.6.4 of Reference 1, the dam may be assumed to present no hazard from earthquakes (under previously experienced loading).

## 7.0 ASSESSMENT/RECOMMENDATIONS/REMEDIAL MEASURES

The assessment and remedial measures contained herein are based on the provisions of Appendix I, Conditions.

### 7.1 DAM ASSESSMENT

7.1.1 Safety: No evidence was obtained to show that this dam, in its present condition, is structurally unsound. The inflow hydrograph for the probable maximum flood (PMF), as indicated by the Corps of Engineers, was routed through Wanaque Reservoir by means of the HEC-1 computer program (Reference 5). These results indicate that the crest of this dam will not be overtopped under PMF conditions. The records reviewed at NJDWSC-W indicate the reservoir level had never exceeded the top of impervious zone and concrete core of the dam. However, an undesirable condition which would occur under PMF or one-half PMF conditions would be the reservoir level higher than the top of both the impervious soil zone and the concrete core. This could result in a significant flow of water over the top of the impermeable materials and possible erosion or flooding. The gates at the Upper Gate House were not operable and were being repaired at the time of the inspection. The drawdown time is excessive based on the study included in Appendix D.

7.1.2 Adequacy of Information: The assessment is based primarily on the record drawings and the visual inspection of the dam. Further information which should be supplied to the Corps of Engineers by the owner in the near future includes a subsurface investigation on the gradation of embankment material, and horizontal and vertical permeability of the material.

### 7.2 RECOMMENDATIONS/REMEDIAL MEASURES

7.2.1 Alternatives: Detailed studies of embankment soils and phreatic conditions should be made, to determine the possibility of piping or erosion in the embankment when the reservoir level is above the top of the core. If remedial measures are found necessary, they should be performed soon. If there is a subsurface investigation program, piezometers should be installed in selected holes. In the near future, the owner should provide a water release facility that would allow the reservoir to be lowered in an acceptable period of time.

7.2.2 Operations and Maintenance Procedure: It is recommended that a monthly maintenance operating schedule be enacted soon to operate each of the four gates in the Upper Gate House through a complete close-open cycle.

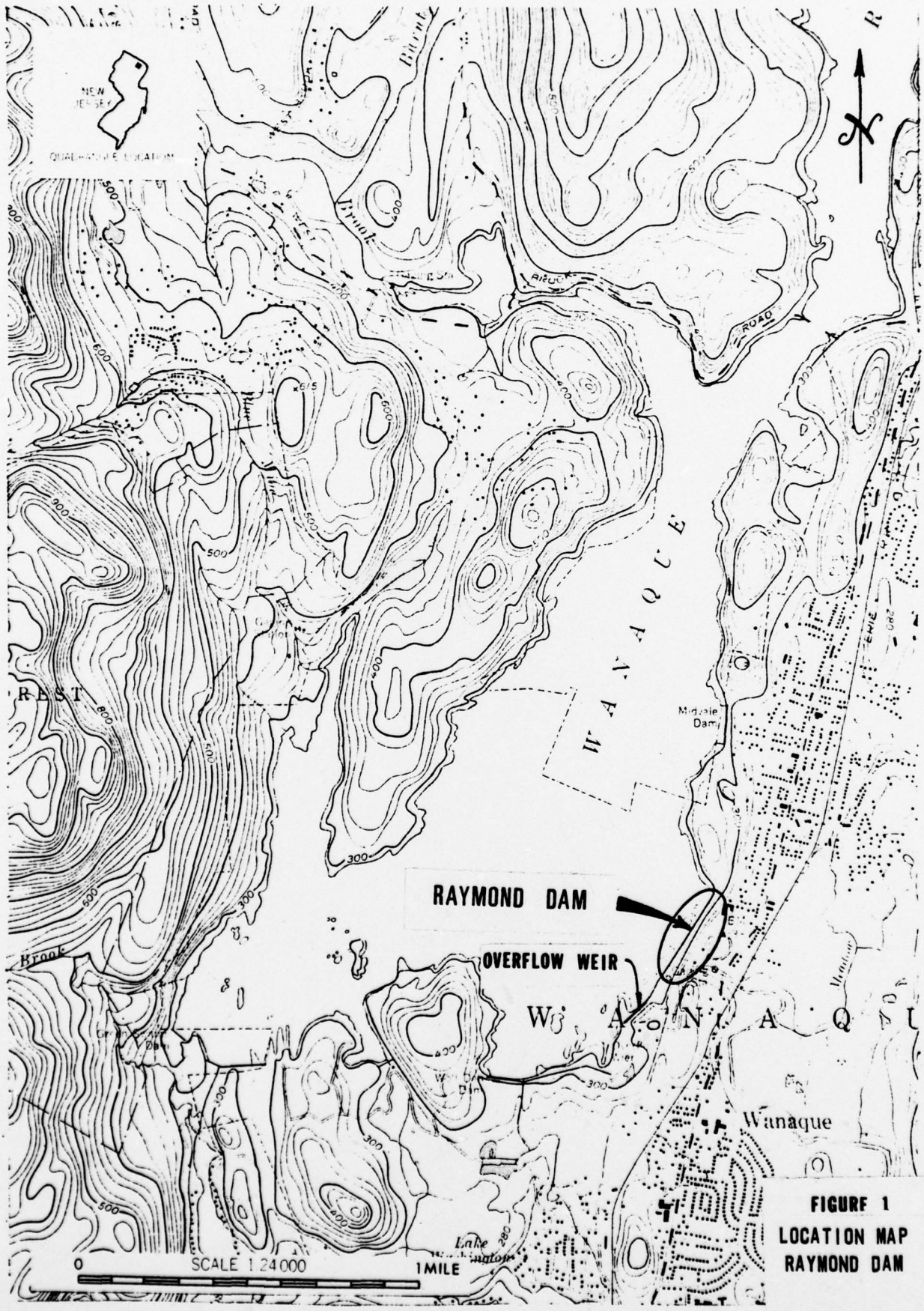
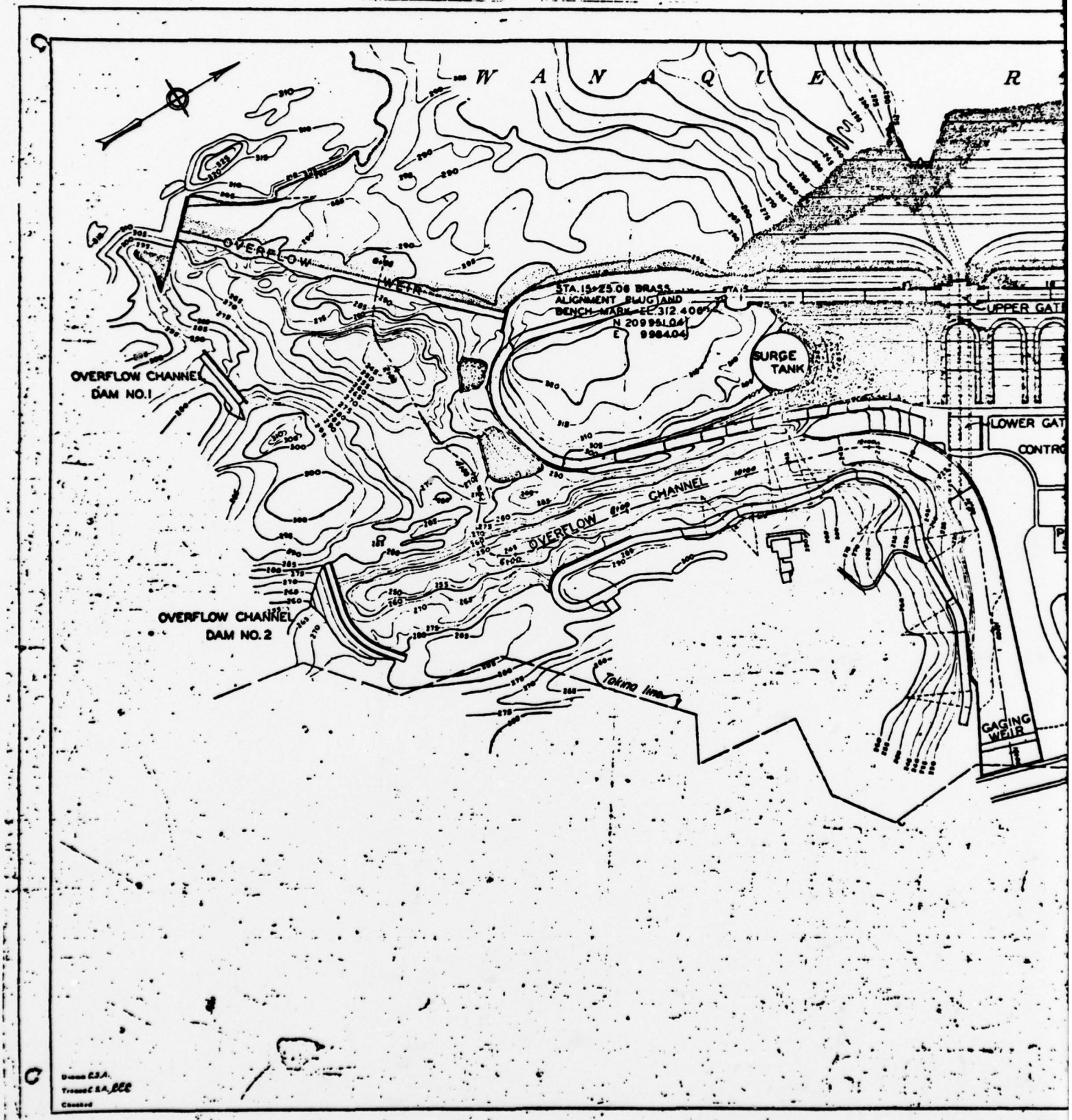
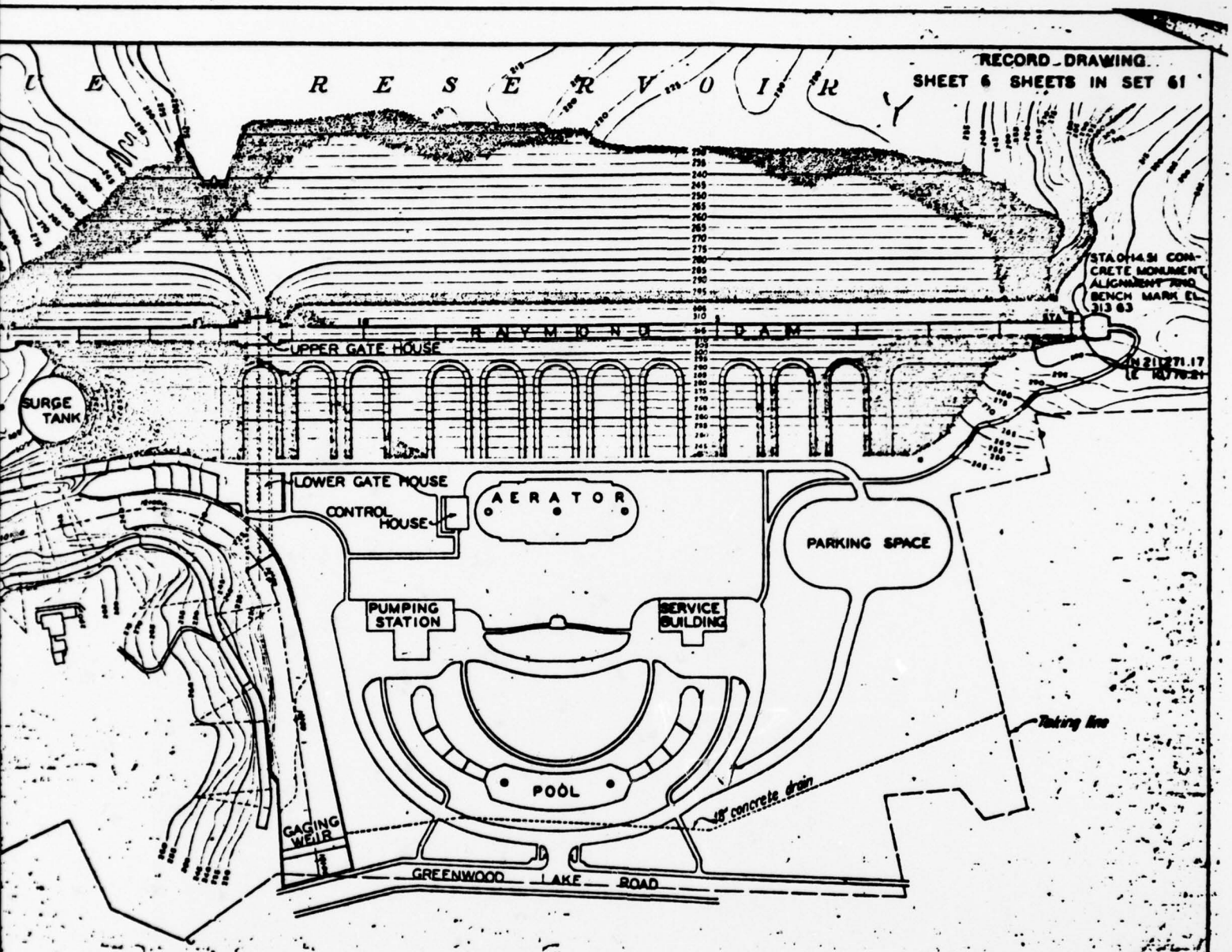



**FIGURE 1**
**LOCATION MAP**
**RAYMOND DAM**


W A N A Q U E
R
OVERFLOW WEIR
STA. 15+25.08 BRASS ALIGNMENT PLUG AND BENCH MARK EL. 312.406
N 209951.04
E 9984.04
SURGE TANK
UPPER GAT
LOWER GAT
CONTRO
OVERFLOW CHANNEL DAM NO.1
OVERFLOW CHANNEL
OVERFLOW CHANNEL DAM NO. 2
Tokino line
GAGING WEIR




NORTH JERSEY DISTRICT
WATER SUPPLY COMMISSION

# WANAQUE RESERVOIR
## RAYMOND DAM
## PLAN OF COMPLETED STRUCTURES

100 0 100 200ft

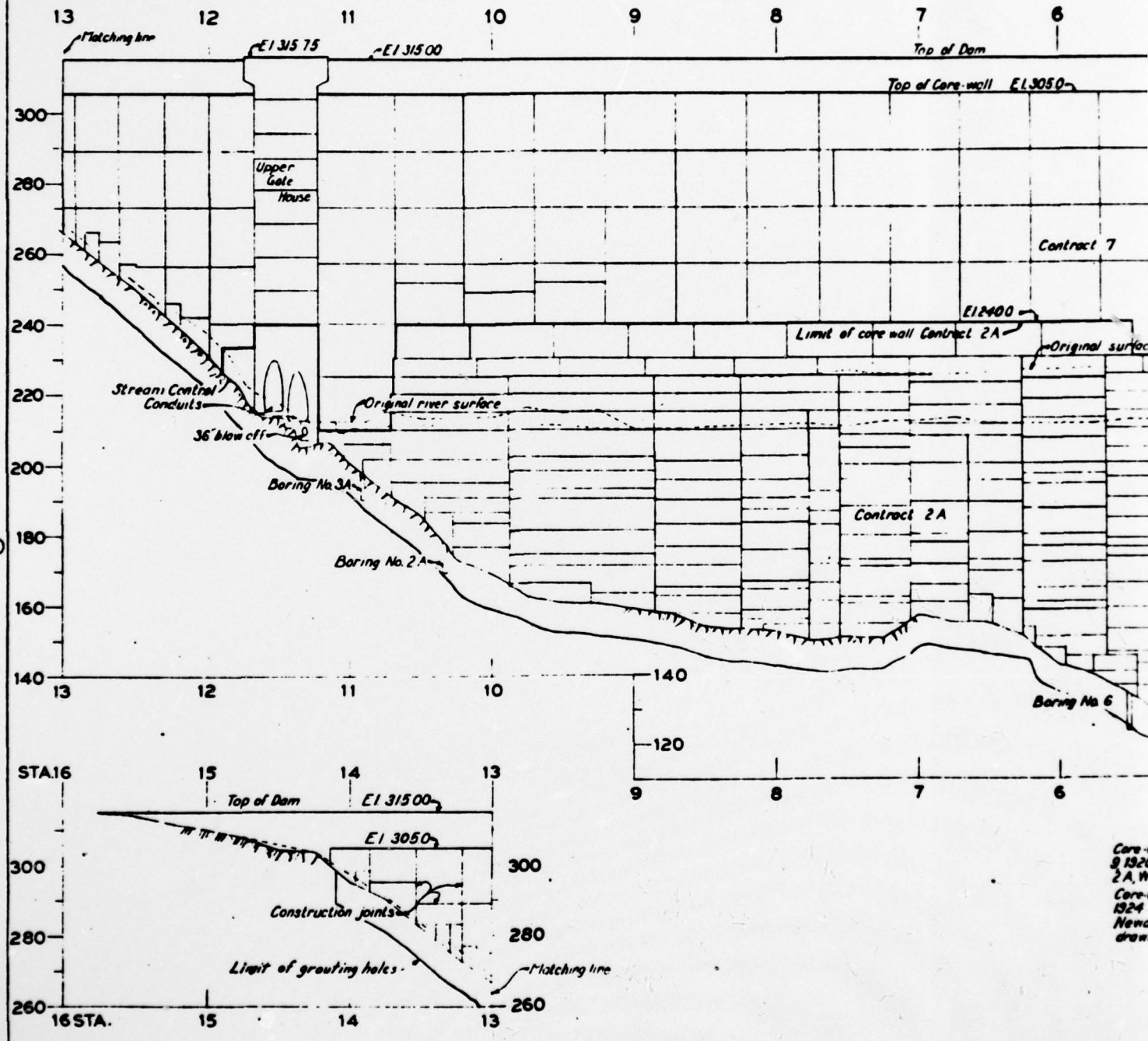
Neil C. Haldredge
Asst. Chief Engineer

APRIL 30, 1931

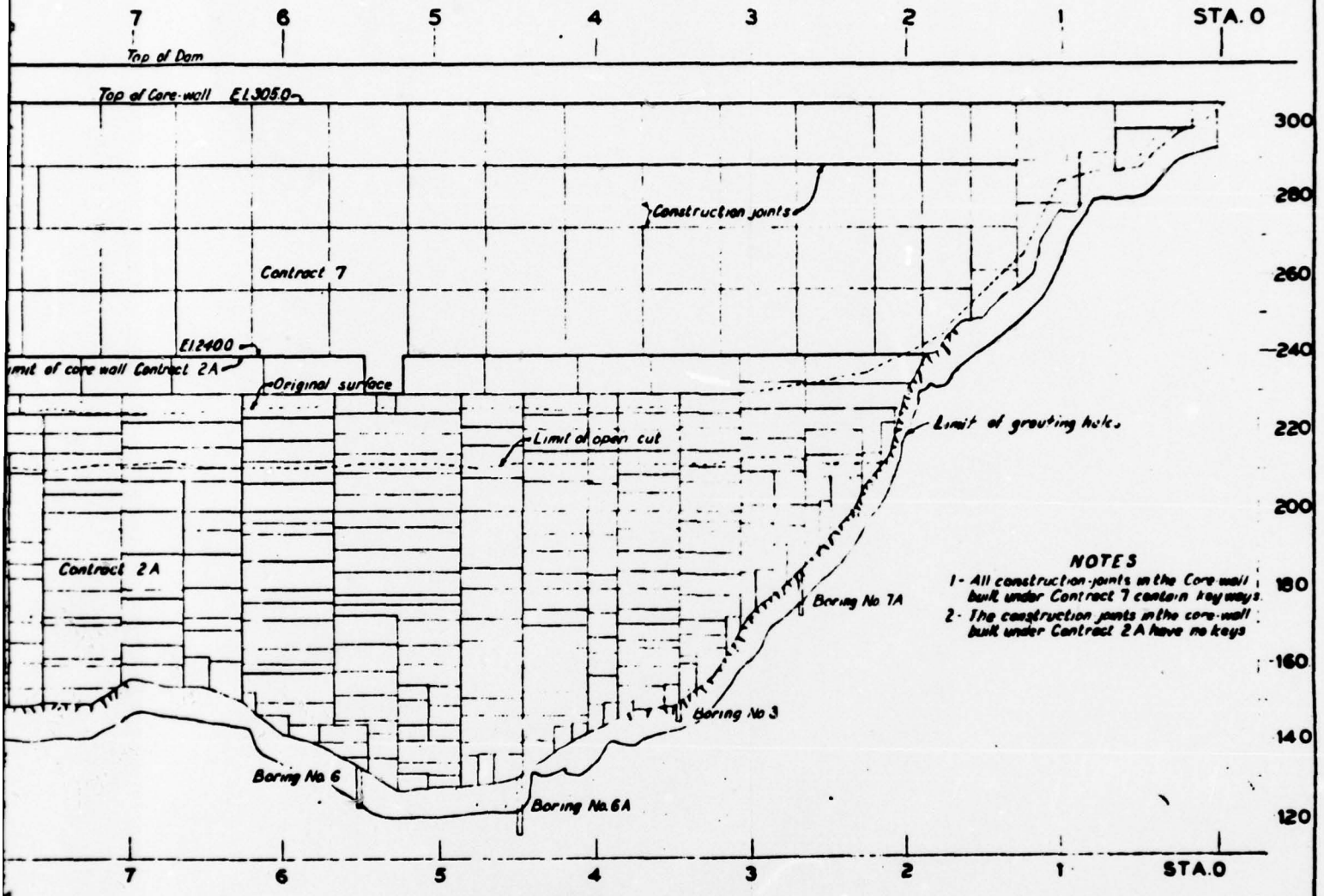
FIGURE 2

CASE C DR. 12 File-3.42W Acc. 3206

2


13
12
11
10
9
8
7
6
Matching line
El 315 75
El 315 00
Top of Dam
Top of Core wall El 3050
300
280
260
240
220
200
180
160
140
Upper Gate House
Contract 7
El 2400
Limit of core wall Contract 2A
Original surface
Stream Control Conduits
Original river surface
36" blow off
Boring No. 3A
Contract 2A
Boring No. 2A
Boring No. 6
120
STA. 16
15
14
13
Top of Dam
El 315 00
El 3050
Construction joints
Limit of grouting holes
Matching line
16 STA.

RECORD DRAWING
SHEET 7 SHEETS IN SET 61




NOTES

1 - All construction-joints in the Core-wall built under Contract 7 contain key ways.
2 - The construction joints in the core-wall built under Contract 2A have no keys

CONSTRUCTION RECORD

Core-wall below Elevation 240 built November 9, 1920 to February 29, 1924, under Contract 2A, W.H. Gahagan, Inc., Brooklyn, N.Y., Contractor.

Core-wall above Elevation 240 built March 10, 1924 to July 14, 1928, Clifford F. MacEvoy Co. Newark, Contractor, as shown on this record drawing.

Engineer in charge

Neil C. Macdrady
Asst. Chief Engineer

NORTH JERSEY DISTRICT
WATER SUPPLY COMMISSION

# WANAQUE RESERVOIR

## RAYMOND DAM

## PROFILE

APRIL 30, 1931

FIGURE 3

CASE — DR. 1 — File-3.42W — Acc. 3207

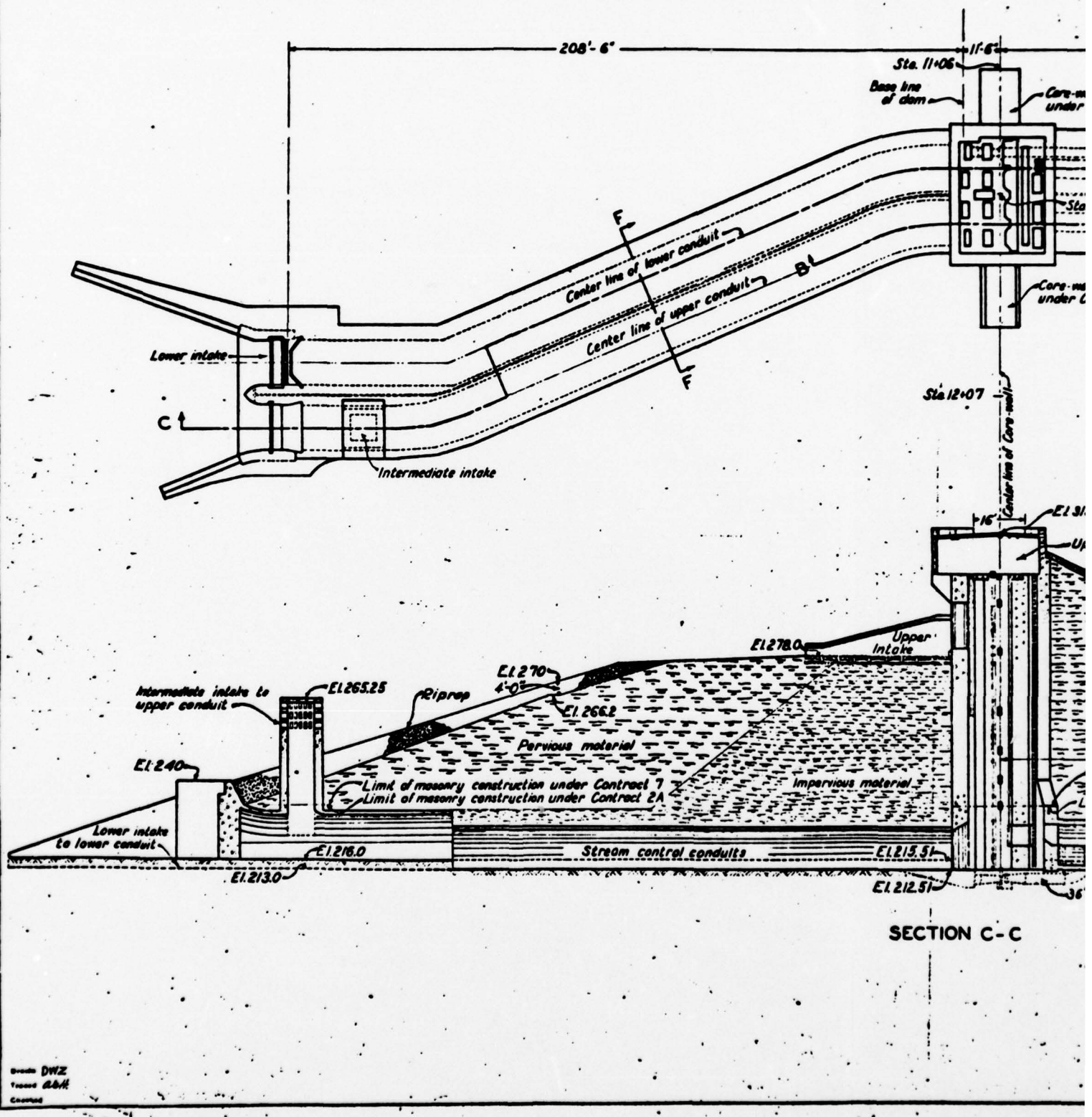
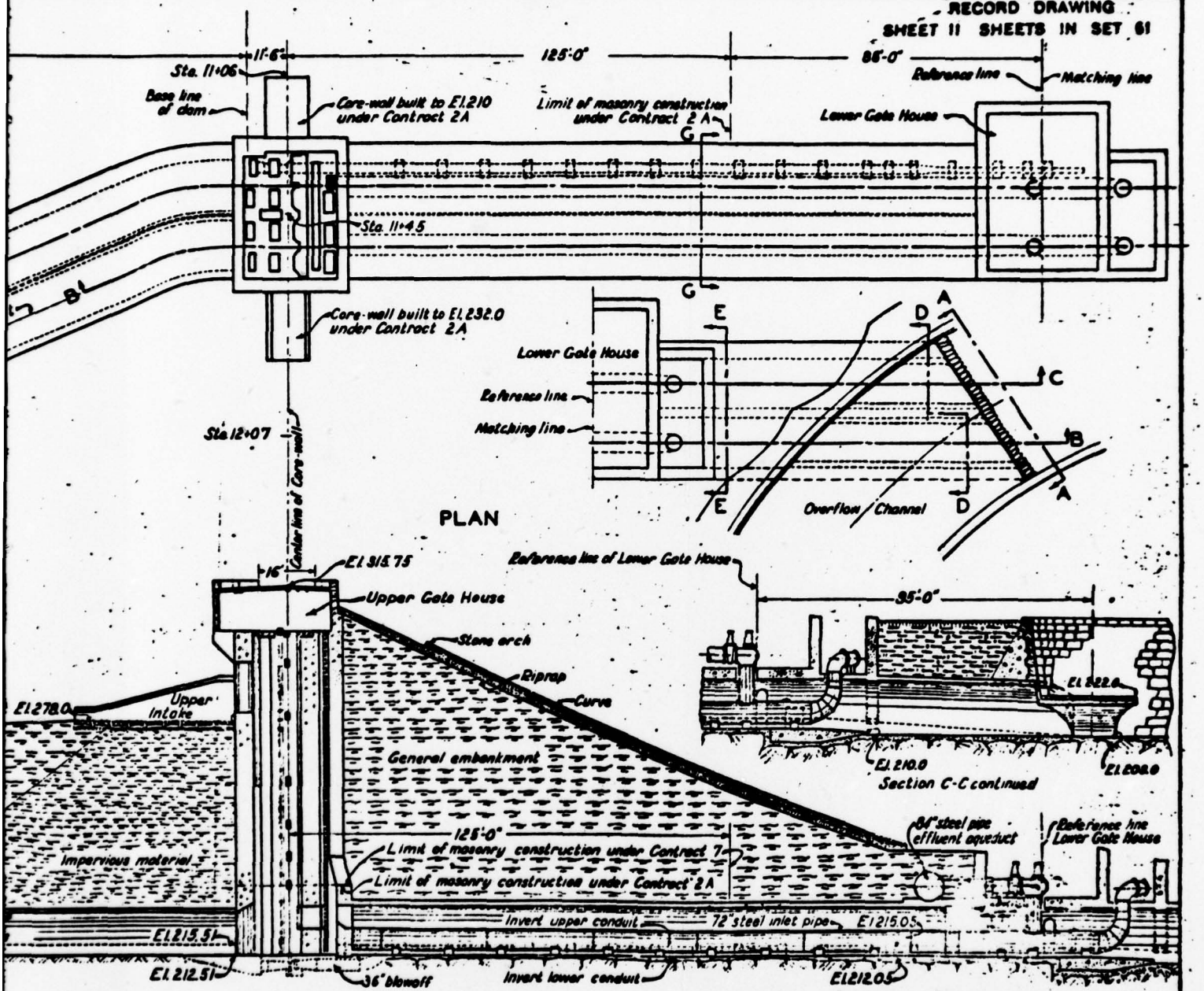

208'-6"
11'-6"
Sta. 11+06
Base line of dam
Core-wall under
Center line of lower conduit
Center line of upper conduit
F
F
BL
Lower intake
C
Intermediate intake
Sta 12+07
Center line of Core-wall
16'
El 31
Upper Intake
El 278.0
El 270
4'-0"
El 266.2
Intermediate intake to upper conduit
El 265.25
Riprap
Pervious material
El 240
Limit of masonry construction under Contract 7
Limit of masonry construction under Contract 2A
Impervious material
Lower intake to lower conduit
El 216.0
Stream control conduits
El 215.5
El 213.0
El 212.5
36'
SECTION C-C

Figure 3

RECORD DRAWING
SHEET 11 SHEETS IN SET 61




SECTION C-C

REFERENCES

1. For Section A-A see Sheet 43, Acc 3243.
2. For Sections B-B, D-D, E-E, F-F, and G-G and part of C-C to a larger scale see Sheet 12, Acc 3212.

Neil C. Haldrady
Asst. Chief Engineer

NORTH JERSEY DISTRICT
WATER SUPPLY COMMISSION

# WANAQUE RESERVOIR
## RAYMOND DAM
## STREAM CONTROL CONDUITS

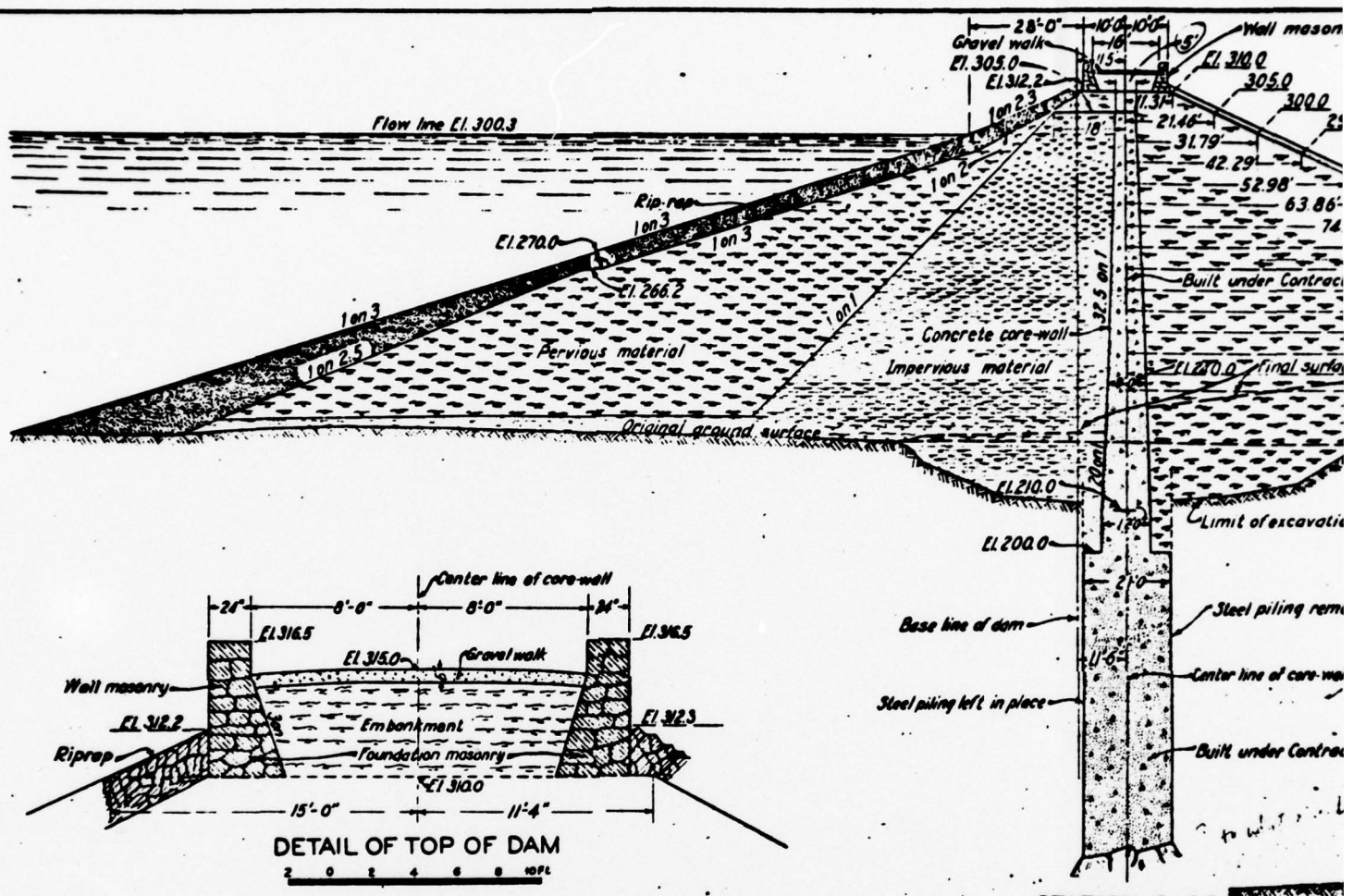
20 0 20 40 FT.

APRIL 30, 1931

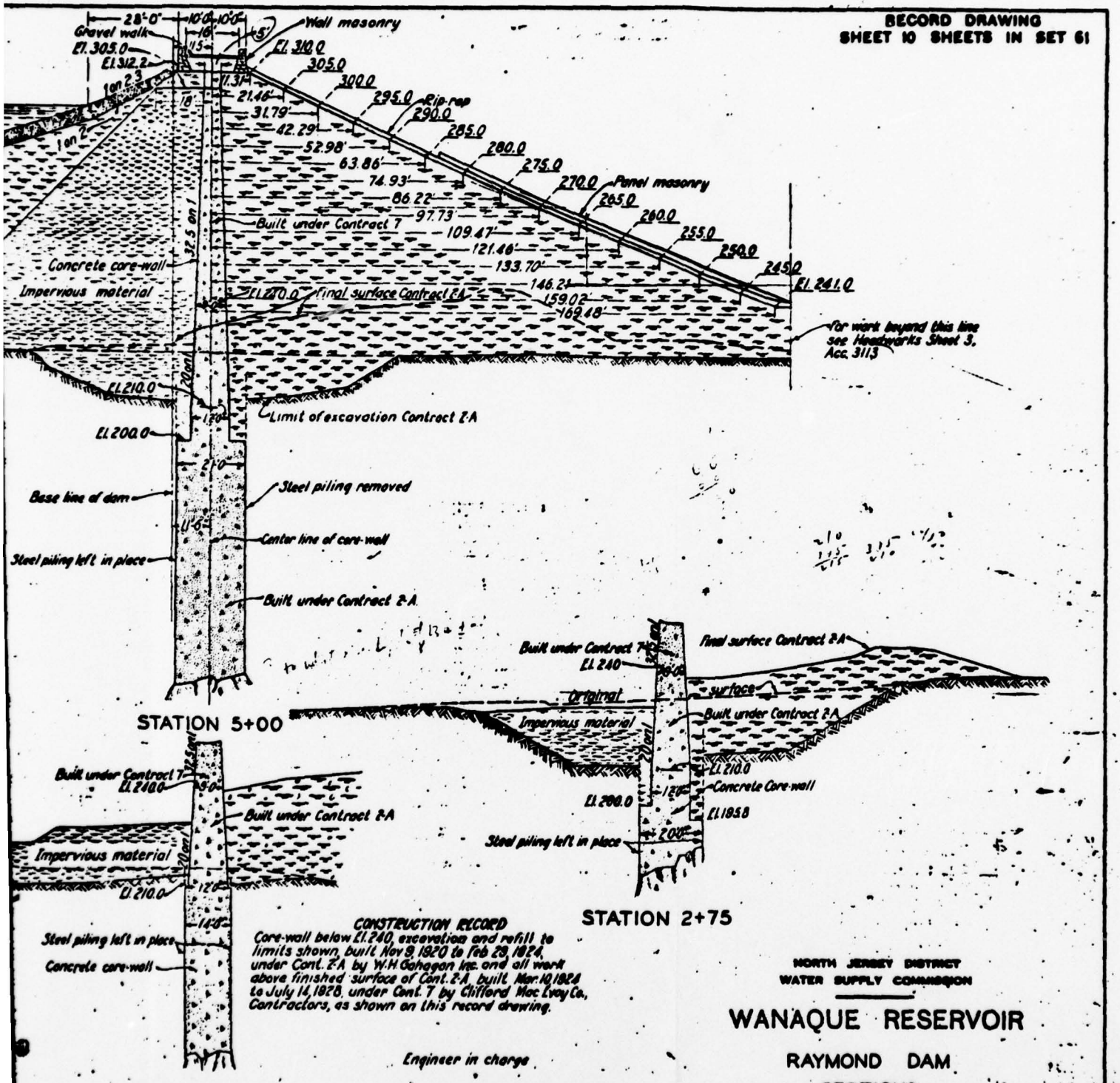
FIGURE 4

CASE C DR. File-3.42W Acc. 3211

556


Flow line El. 300.3
El. 270.0
El. 266.2
Rip-rap
1 on 3
1 on 2.5
Pervious material
Original ground surface
Concrete core-wall
Impervious material
Gravel walk
El. 305.0
El. 312.2
28'-0"
10'-0"
10'-0"
Wall masonry
El. 310.0
305.0
300.0
21.46'
31.79'
42.29'
52.98'
63.86'
Built under Contract
El. 280.0
final surface
El. 210.0
El. 200.0
Limit of excavation
Base line of dam
Steel piling left in place
Steel piling removed
Center line of core-wall
Built under Contract
STATION 5+00
Center line of core-wall
24"
8'-0"
8'-0"
24"
El. 316.5
El. 315.0
Gravel walk
Wall masonry
El. 312.2
Embankment
Riprap
Foundation masonry
El. 312.3
El. 310.0
15'-0"
11'-4"
DETAIL OF TOP OF DAM
2 0 2 4 6 8 10 Ft
Built under Contract
El. 240.0
Final surface Contract 2A
Original surface
Impervious material
El. 210.0
Steel piling left in place
Concrete core-wall
Core-wall below El. 24
limits shown, built
under Cont. 2A by
above finished surf
to July 14, 1978, unde
Contractors, as sho
STATION 9+25

RECORD DRAWING
SHEET 10 SHEETS IN SET 61




CONSTRUCTION RECORD

Core-wall below El. 240, excavation and refill to limits shown, built Nov 9, 1920 to Feb 28, 1924, under Cont. 2-A by W.H. Gahagan Inc. and all work above finished surface of Cont. 2-A, built Mar. 10, 1924 to July 14, 1928, under Cont. 7 by Clifford Mac Evoy Co., Contractors, as shown on this record drawing.

Engineer in charge

Neil C. Headrick
Asst. Chief Engineer

NORTH JERSEY DISTRICT
WATER SUPPLY COMMISSION

# WANAQUE RESERVOIR

## RAYMOND DAM

## SECTIONS

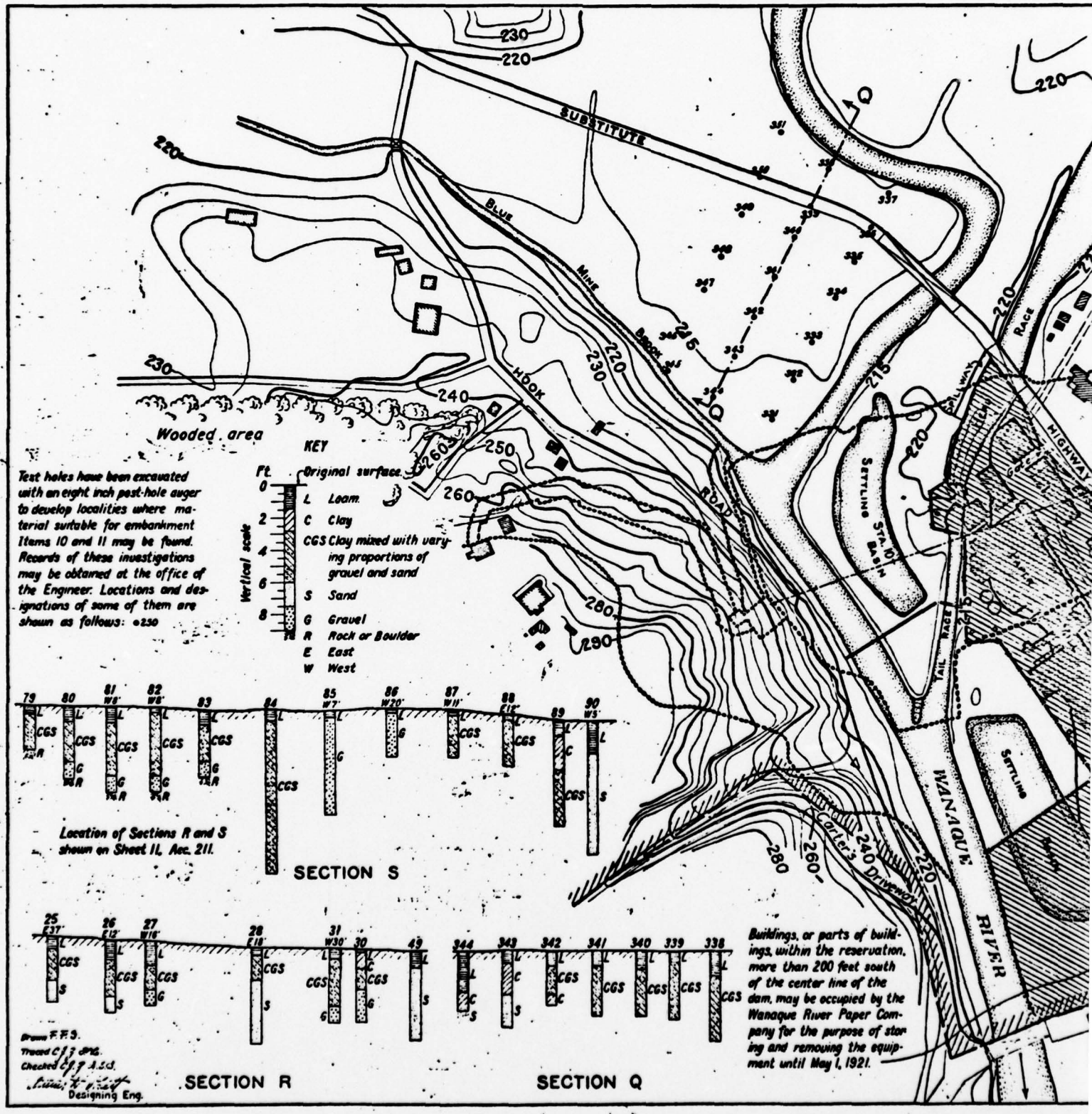
30 0 30 60

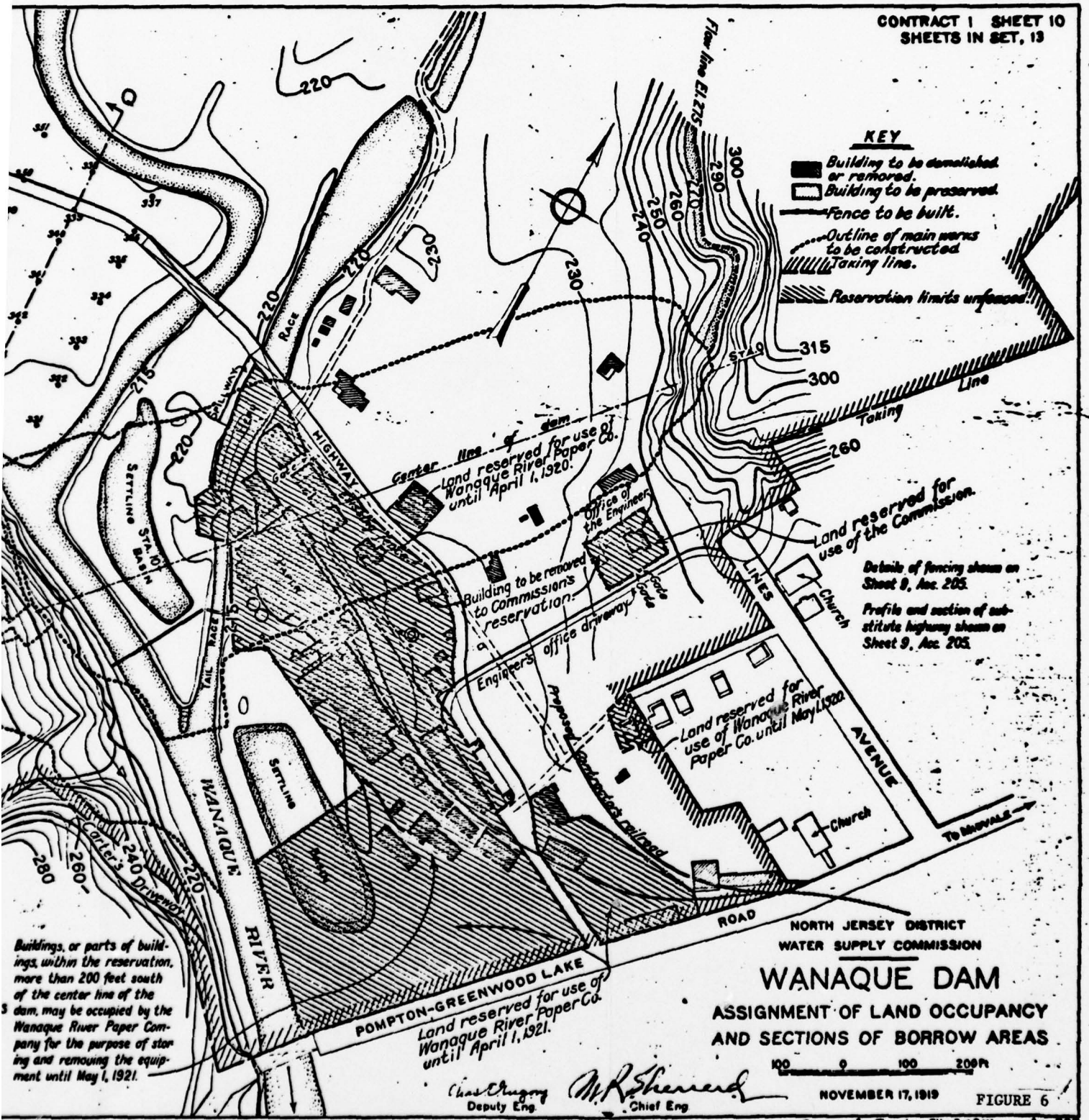
APRIL 30, 1931

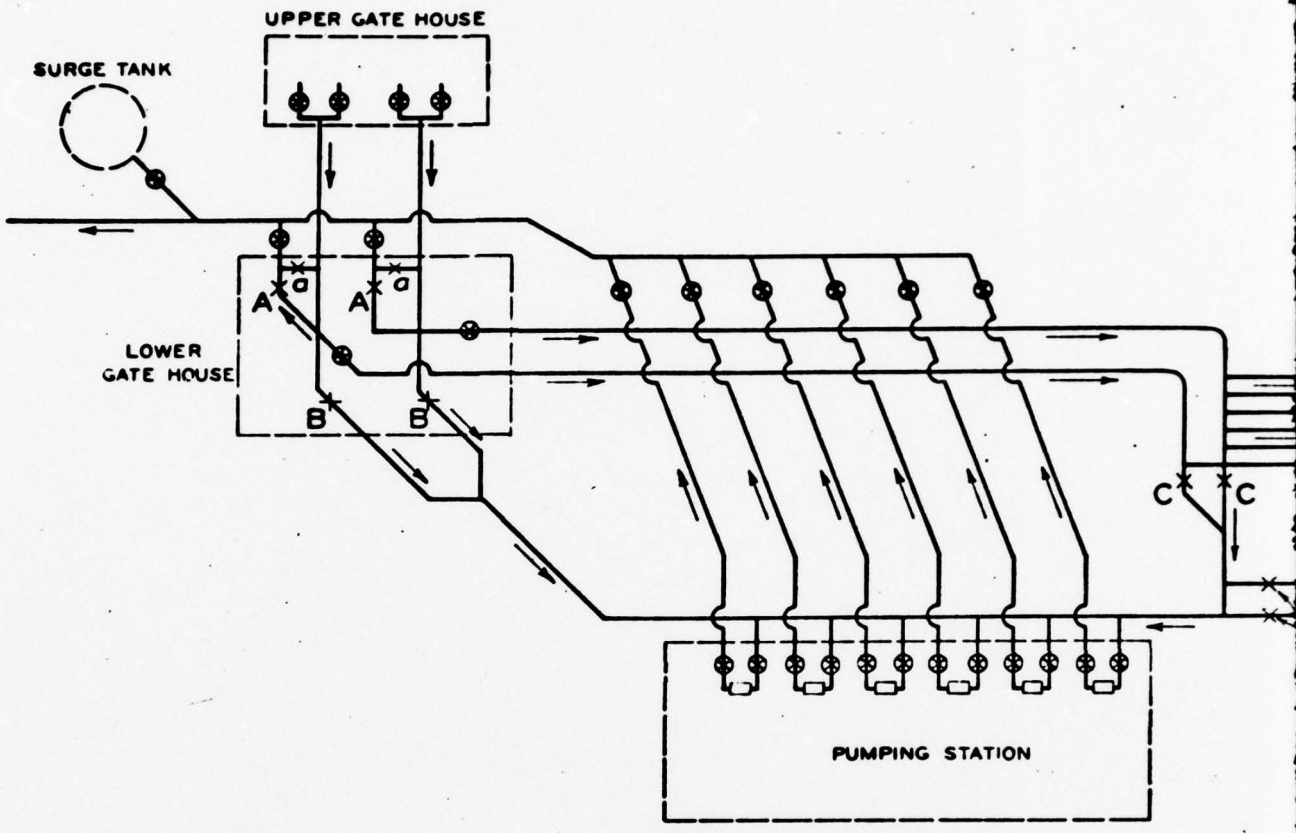
FIGURE 5

CASE C DR. 12 File-3.42 W Acc. 3210

2


SUBSTITUTE
BLUE
MINE
BROOK
HOOK
ROAD
Wooded area
KEY
Ft.
Original surface
L Loam
C Clay
CGS Clay mixed with varying proportions of gravel and sand
S Sand
G Gravel
R Rock or Boulder
E East
W West
Vertical scale
Test holes have been excavated with an eight inch post-hole auger to develop localities where material suitable for embankment Items 10 and 11 may be found. Records of these investigations may be obtained at the office of the Engineer. Locations and designations of some of them are shown as follows: ●250
Location of Sections R and S shown on Sheet 11, Acc. 211.
SECTION S
SECTION R
SECTION Q
Buildings, or parts of buildings, within the reservation, more than 200 feet south of the center line of the dam, may be occupied by the Wanaque River Paper Company for the purpose of storing and removing the equipment until May 1, 1921.
Drawn F.F.S.
Traced C.J.J. 3rd.
Checked C.J.J. A.S.C.
Designing Eng.
RACE
TAIL RACE
SETTLING BASIN
WANAQUE RIVER
Carter's
Driveway


CONTRACT 1 SHEET 10
SHEETS IN SET, 13
KEY
Building to be demolished or removed.
Building to be preserved.
Fence to be built.
Outline of main works to be constructed.
Taking line.
Reservation limits unfenced.
Flow line El 275
Center line of dam
Land reserved for use of Wanaque River Paper Co. until April 1, 1920.
Office of the Engineer
Building to be removed to Commissions reservation.
Engineer's office driveway
Land reserved for use of the Commission.
Details of fencing shown on Sheet 9, Acc. 205.
Profile and section of substitute highway shown on Sheet 9, Acc. 205.
Land reserved for use of Wanaque River Paper Co. until May 1, 1920.
Church
Church
AVENUE
TO MIDVALE
ROAD
POMPTON-GREENWOOD LAKE
Land reserved for use of Wanaque River Paper Co. until April 1, 1921.
WANAQUE RIVER
Carter's Driveway
Proposed Susquehanna railroad
HIGHWAY
RACE
TAIL RACE
SETTLING BASIN
SETTLING
Buildings, or parts of buildings, within the reservation, more than 200 feet south of the center line of the dam, may be occupied by the Wanaque River Paper Company for the purpose of storing and removing the equipment until May 1, 1921.
NORTH JERSEY DISTRICT
WATER SUPPLY COMMISSION
WANAQUE DAM
ASSIGNMENT OF LAND OCCUPANCY AND SECTIONS OF BORROW AREAS
100 0 100 200 Ft
NOVEMBER 17, 1919
Deputy Eng.
Chief Eng.
FIGURE 6
Case 2 Dr. 1 File 3.42W Acc 227




**NOTE:**

VALVES SHOWN THUS ⊗ ARE GUARD VALVES
NORMALLY LEFT OPEN

## TO START AERATOR AND PUMPS WHEN AQUEDUCT IS BEING SUPPLIED BY GRAVITY

All valves except "D" and "E" are open.

1. Open valves "D" and "E" allowing aerator pool to fill and overflow and at same time test action of aerator control valves "D" Due to increased draft from reservoir slight drop in aqueduct pressure will occur meanwhile.
2. Close valves "B."
3. Start pumps, making sure that total delivery is somewhat greater than the rate of draft on the aqueduct.
4. Close valves "A" and "a" allowing surge tank to overflow if necessary.
5. Gradually close valves "C."
6. If necessary, cut off part of aerator sections with valves "E" so as to get sufficient aeration head.

## TO STOP AERATOR AND PUMPS

1. Open valves "a" and then "A"
2. Close valves "D" and "E."
3. Stop pumps
4. Open valves "C" and "B."

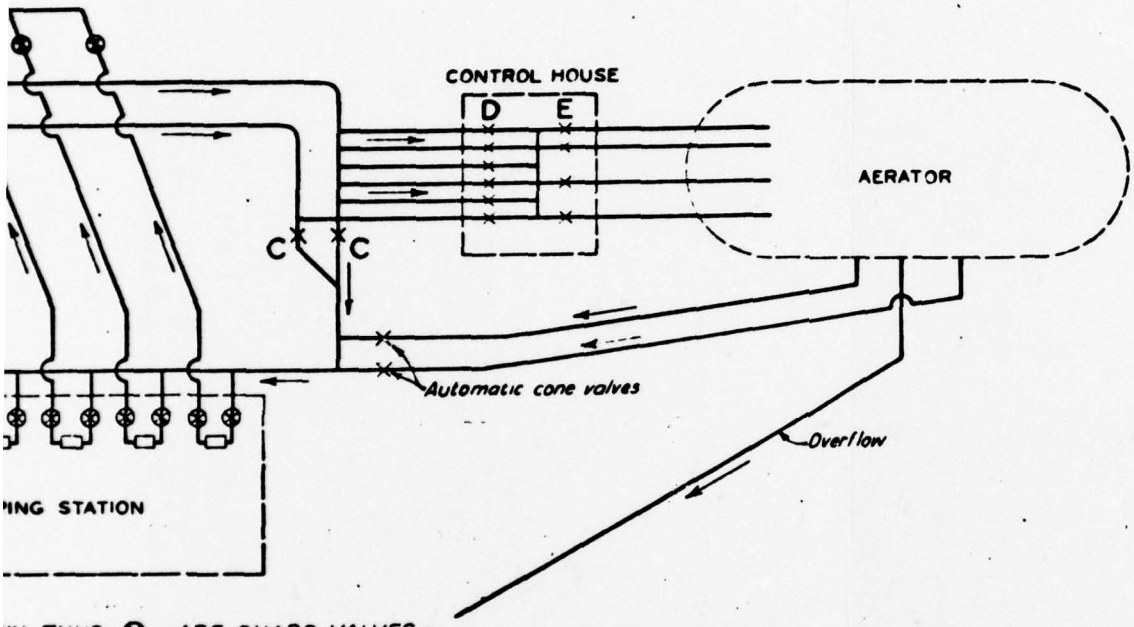
## TO START PUMPS WITHOUT

All valves except "D" and "E" are

1. Start pumps making sure t delivery is somewhat greate the rate of draft on the aq
2. Close "A" and "a."
3. Adjust pumping rate to eq demand with the head in t tank at approximately the level to maintain El 237 at

Drawn 8 J.
Traced 8-16 J.
Checked J.

Fuller & Mc
Engineers Wanaque Aqu




N THUS ⊗ ARE GUARD VALVES,-
LEFT OPEN

S

TO START PUMPS WITHOUT AERATOR

All valves except "D" and "E" are open

1. Start pumps making sure that total delivery is somewhat greater than the rate of draft on the aqueduct.
2. Close "A" and "a"
3. Adjust pumping rate to equal the demand with the head in the surge tank at approximately the correct level to maintain El 237 at Belleville.

TO CONTROL FLOW THRU AERATOR TO RIVER WHEN NOT AERATING

Valves "D" and "E" are closed.

1. Lock valves "D" open with hand control and open such "E" valves as necessary to maintain proper flow in river.

Fuller & Mc Clintock
Engineers Wanaque Aqueduct

NORTH JERSEY DISTRICT
WATER SUPPLY COMMISSION

# WANAQUE AQUEDUCT

## HEADWORKS

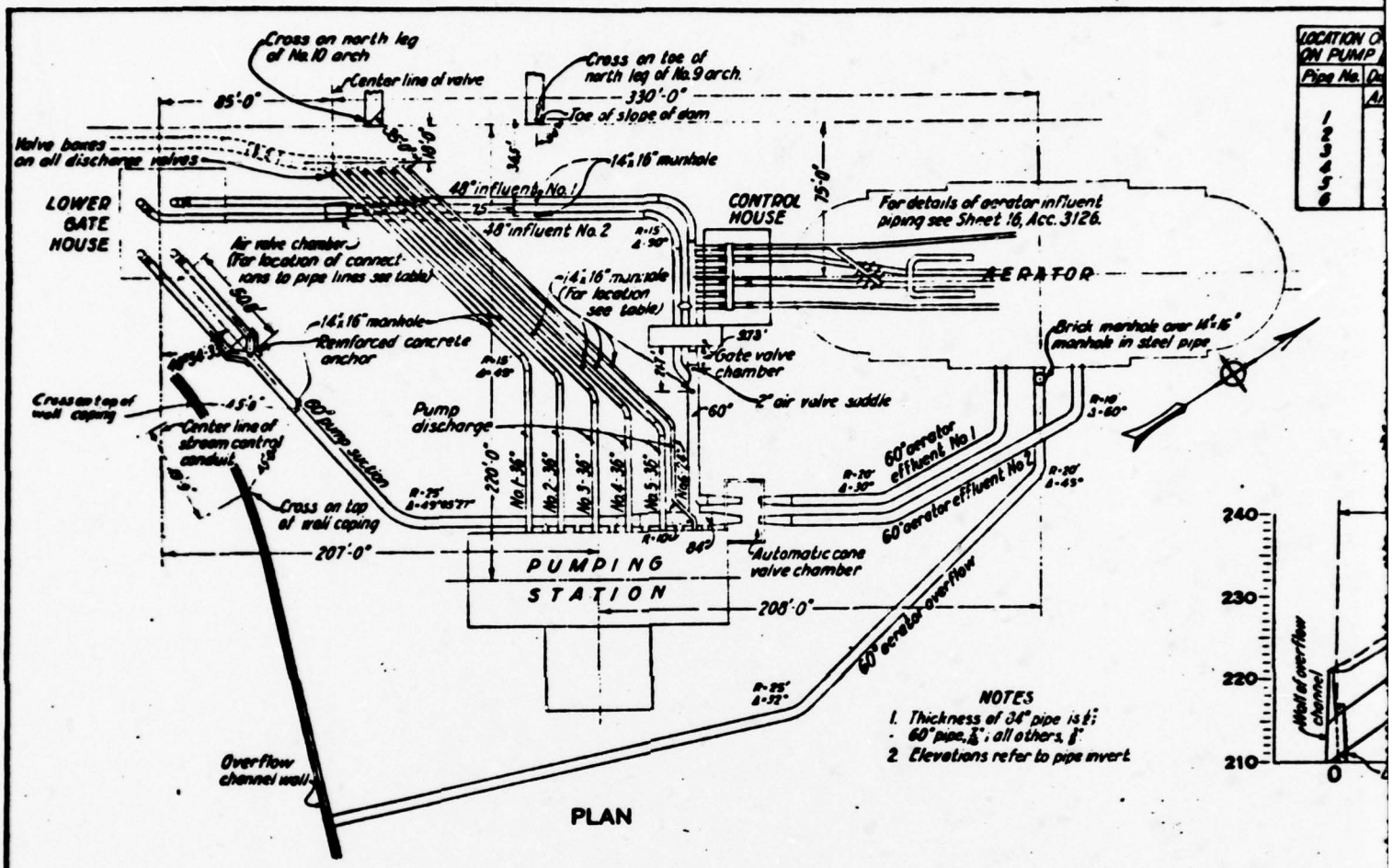
## PROCEDURE FOR VALVE OPERATION

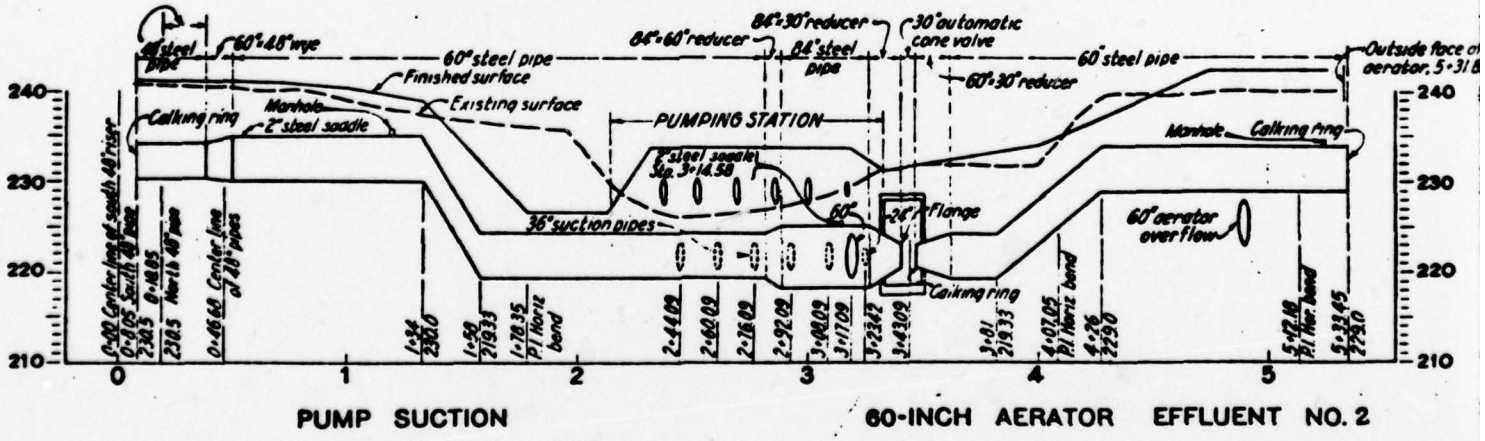
NO SCALE

DECEMBER 15, 1930 FIGURE 7

File-32.0 Acc. 2967

2



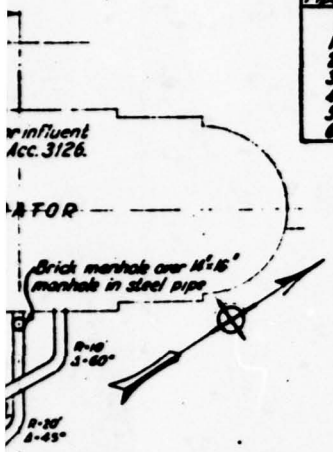

PUMP SUCTION

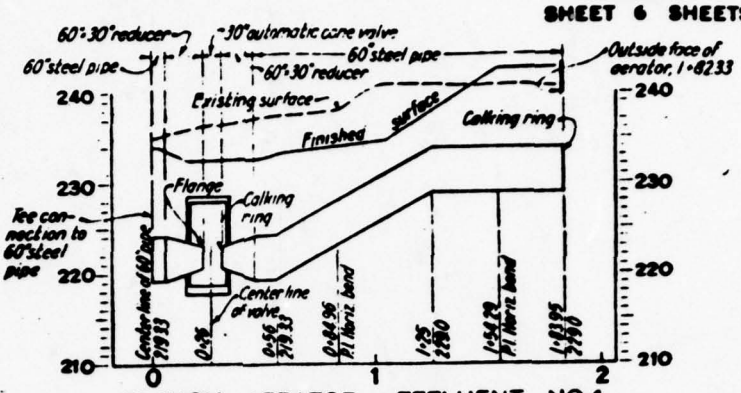
60-INCH AERATOR EFFLUENT NO. 2

Section Engineer

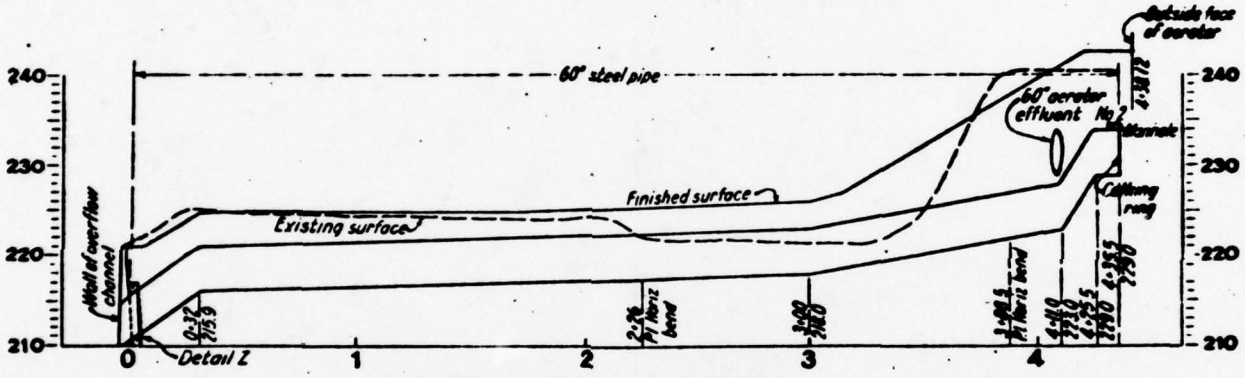
RECORD DRAWING
SHEET 6 SHEETS IN SET 76

| LOCATION OF APPURTENANCES ON PUMP DISCHARGE LINES | | |
|---|---|---|
| Pipe No. | Distance from ℄ of valve | |
| | Air valve | Manhole |
| 1 | 25.0 | 105.0 |
| 2 | 25.0 | 101.5 |
| 3 | 25.0 | 112.5 |
| 4 | 26.1 | 134.8 |
| 5 | 26.1 | 134.5 |
| 6 | 21.1 | 135.7 |

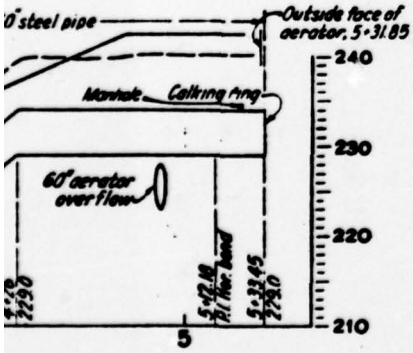


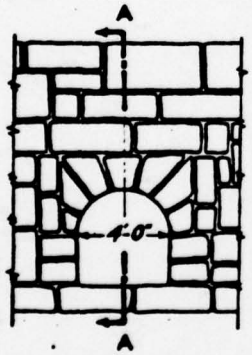

60-INCH AERATOR EFFLUENT NO.1



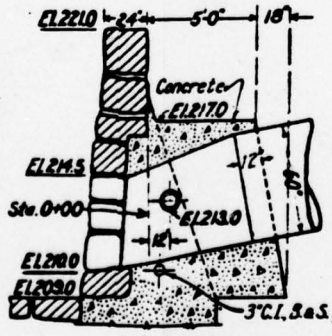

60-INCH AERATOR OVERFLOW



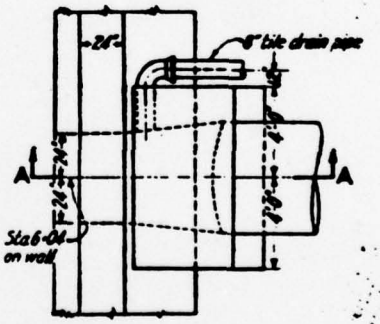

60-INCH AERATOR EFFLUENT NO. 2




ELEVATION




SECTION A-A




PLAN

DETAIL Z

REFERENCE
For remaining pipe profiles see Sheet 7, Acc. 3117.

NORTH JERSEY DISTRICT
WATER SUPPLY COMMISSION

# WANAQUE AQUEDUCT

## HEADWORKS

## STEEL PIPE

## PLAN AND PROFILES

APRIL 30, 1931

FIGURE 8

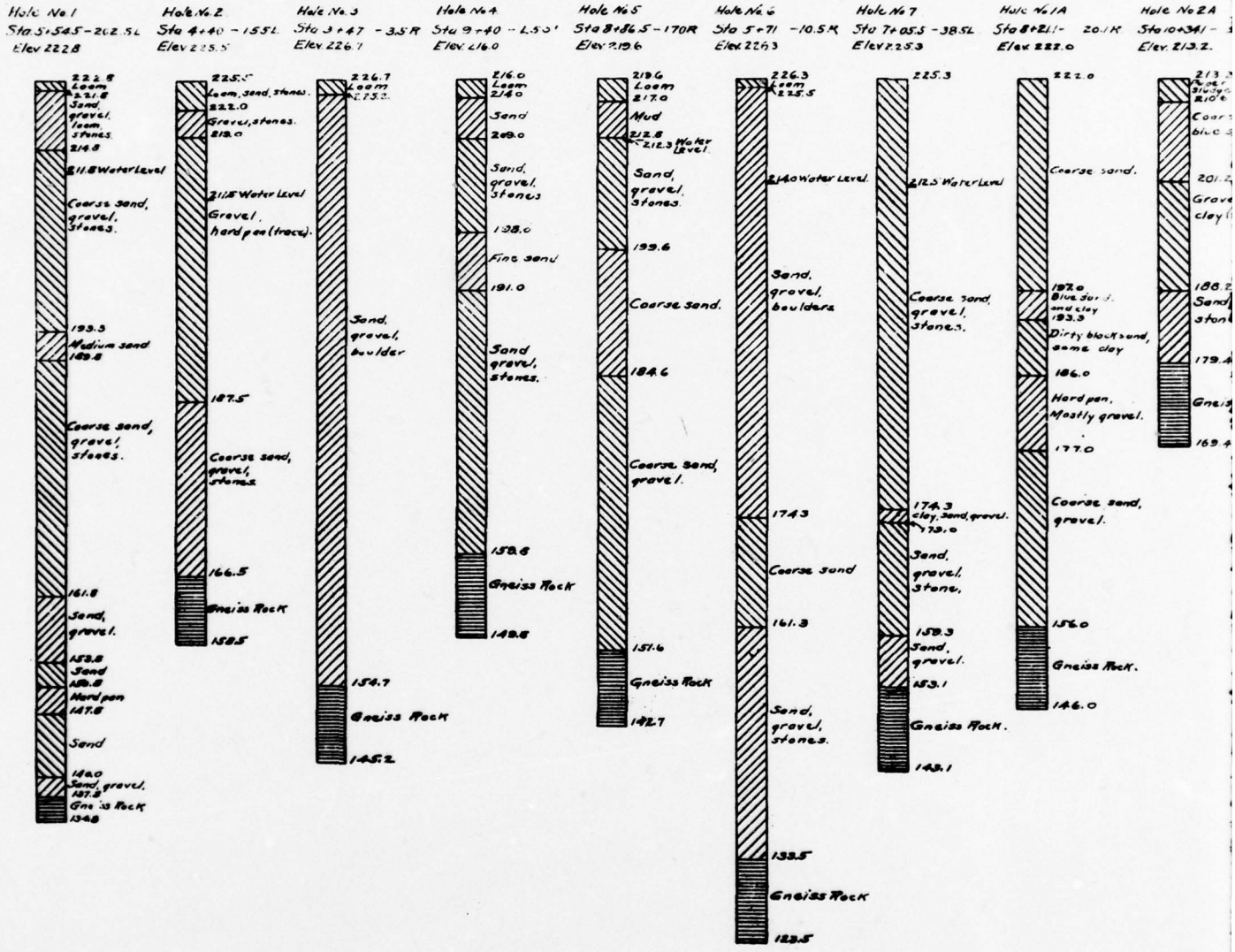
Neil C. Headrick
Asst. Chief Engineer

F. W. Howes.
for Fuller & McClintock,
Engineers Wanaque Aqueduct

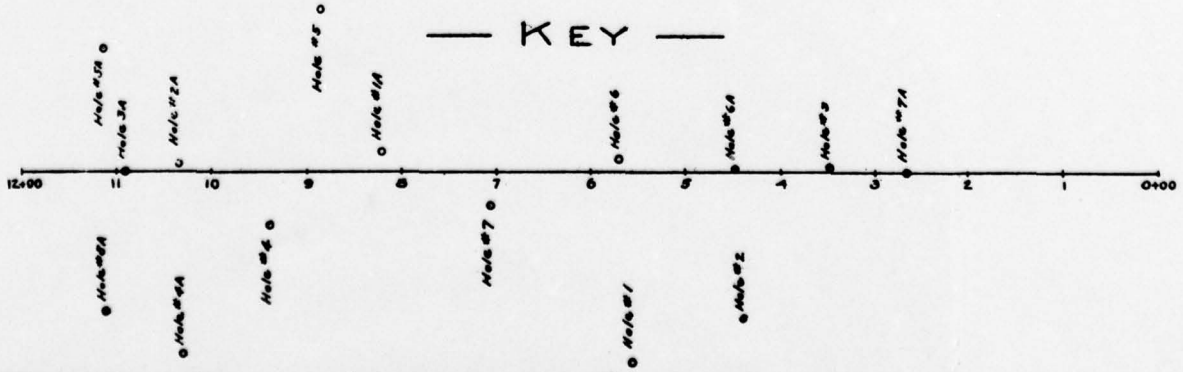
CASE D DR. File-50W Acc. 3116

2

## Cross Section of Borin

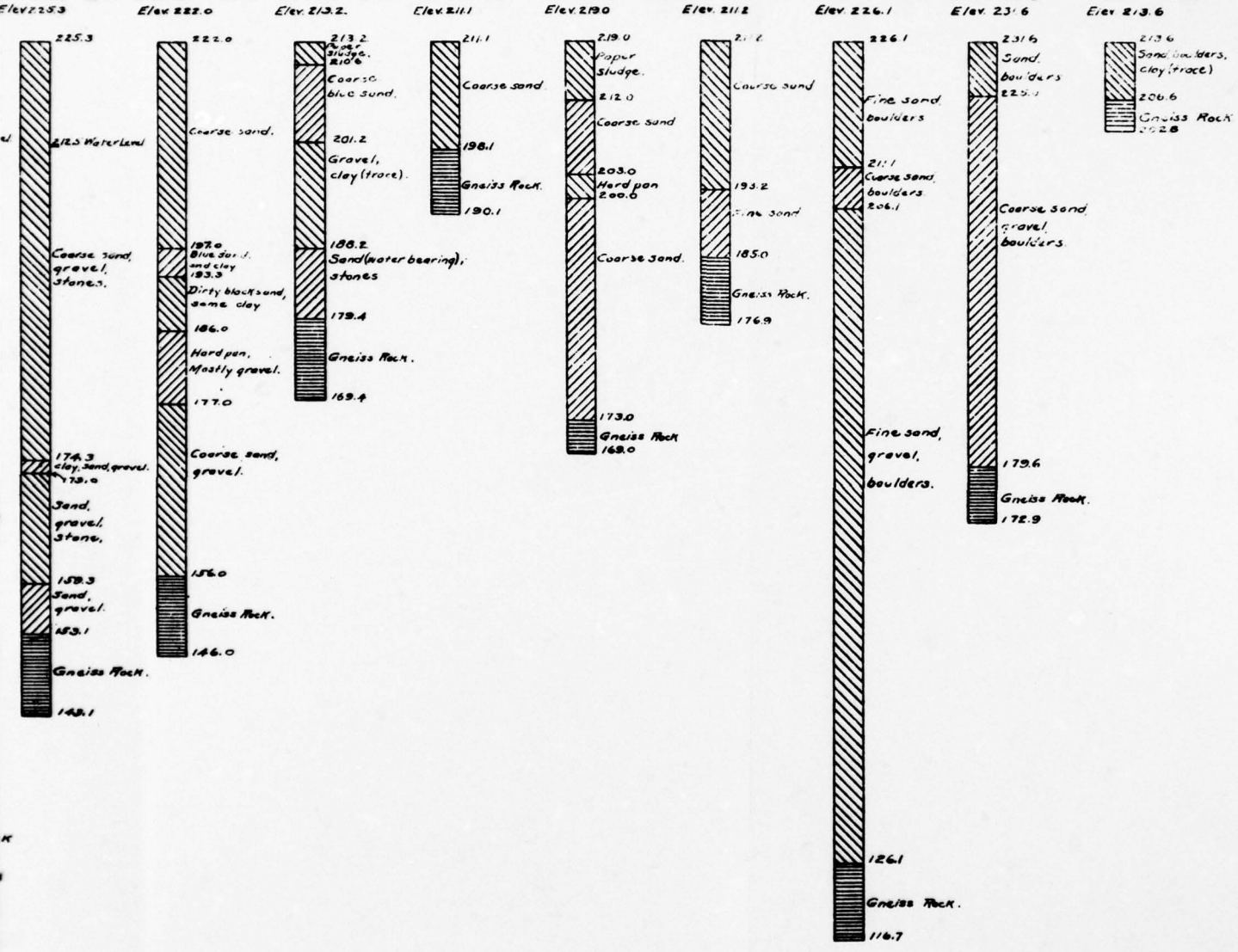



## Key




Drawn H.C.H.
Traced W.W.S.
Checked W.W.S.

# oss Section of Borings




NORTH JERSEY DISTRICT
WATER SUPPLY COMMISSION

# WANAQUE DAM

## RECORD OF BORINGS

MARCH 22, 1920.

Case A Dr. [illegible] File 342K, Sec. 8 M;

FIGURE 9

# APPENDIX A

# VISUAL CHECKLIST

## APPENDIX A - VISUAL INSPECTION CHECK LIST

### PHASE 1

Name Dam: Raymond County: Passaic State: New Jersey Coordinators: Philadelphia District-Corps of Engineers

Date(s) Inspection: 8-10 May, 1978 Weather: Cloudy Temperature: 60°

Pool Elevation at Time of Inspection: 301.5 M.S.L. Tailwater at Time of Inspection: N.A.

Gilbert Associates, Inc.
Inspection Personnel:

Fine T. Hsu
James A. Hagen
Rudloph J. Wahanik

Also Present:

Mario DiLaura (NJDWSC)
Larry Woscyna (NJDEP)

James A. Hagen - Recorder

CONCRETE/MASONRY DAMS
(Raymond Dam is Earthfill)

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|---|---|---|
| SEEPAGE OR LEAKAGE | Not Applicable (N.A.) | |
| STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS | N.A. | |
| DRAINS | N.A. | |
| WATER PASSAGES | N.A. | |
| FOUNDATION | N.A. | |

## CONCRETE/MASONRY DAMS

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|---|---|---|
| SURFACE CRACKS CONCRETE SURFACES | N.A. | |
| STRUCTURAL CRACKING | N.A. | |
| VERTICAL AND HORIZONTAL ALIGNMENT | N.A. | |
| MONOLITH JOINTS | N.A. | |
| CONSTRUCTION JOINTS | N.A. | |

## EMBANKMENT

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|---|---|---|
| SURFACE CRACKS | Surface cracks on the crest and side slopes were not evident except for a few minor cracks of the asphalt paving along the dam crest. | None |
| UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE | None observed. | |
| SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES | None observed. | |
| VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST | Appears to be good. | |
| RIPRAP FAILURES | None observed. | |

## EMBANKMENT

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|---|---|---|
| JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM | The contact between the embankment and abutment appears to be in good condition and watertight. | |
| ANY NOTICEABLE SEEPAGE | There was no seepage evident downstream of the embankment. | |
| STAFF GAGE AND RECORDER | The staff gage is located at Raymond Dam and is read and recorded manually everyday. | |
| DRAINS | The drains at the toe of the dam were dry when inspected. The owner's representative reported that the main use for them is to collect excess water from the sprinkler system installed for the grassed areas on the lower portion of the dam. | None |

## OUTLET WORKS

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|---|---|---|
| CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT | None was observed. | |
| INTAKE STRUCTURE | Submerged and not visible at the time of the inspection. | |
| OUTLET STRUCTURE | The downstream portal of the construction stream control conduit appears to be in good condition. | |
| OUTLET CHANNEL | The channel bottom below the stream control conduit is paved with stones in a bed of mortar and appears to be in good condition. The masonry walls of the channel are also in good condition. There is a small local rock slide on the upper part of channel wall along an access road due to severe weathering. | The slide should not significantly affect the safety of the dam. |
| EMERGENCY GATE | The Upper Gate House had some mineral deposition at the junction with the masonry wall and minor spalling at the normal water line but was basically sound. The Upper Gates were inoperable and being repaired at the time of the inspection. | The upper gates should be operated regularly thru a cycle of full closure and opening. |

UNGATED SPILLWAY - (NONE WAS OBSERVED)

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|---|---|---|
| CONCRETE WEIR | N.A. | |
| APPROACH CHANNEL | N.A. | |
| DISCHARGE CHANNEL | N.A. | |
| BRIDGE AND PIERS | N.A. | |

## GATED SPILLWAY - (NONE WAS OBSERVED)

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|---|---|---|
| CONCRETE SILL | N.A. | |
| APPROACH CHANNEL | N.A. | |
| DISCHARGE CHANNEL | N.A. | |
| BRIDGE AND PIERS | N.A. | |
| GATES AND OPERATION EQUIPMENT | N.A. | |

## INSTRUMENTATION

| VISUAL EXAMINATION | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|---|---|---|
| MONUMENTATION/SURVEYS | The bench mark shown at station 0 + 00 on the drawings was observed to exist in the field as a disc inside a metal covered box flush with the paving on the crest of the dam. | None |
| OBSERVATION WELLS | N.A. | |
| WEIRS | N.A. | |
| PIEZOMETERS | N.A. | |
| OTHER | N.A. | |

## RESERVOIR

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|---|---|---|
| SLOPES | A continuous exposure of bedrock along the reservoir near the dike has maintained quite stable slopes. This was found to be the case around the major portion of the reservoir which was observed. | None |
| SEDIMENTATION | At the time of the inspection, the reservoir bottom could be seen within approximately seven feet on the water surface. A boat trip around the majority of the reservoir perimeter indicated no excessive sediment deposits but there were several swampy areas where some sediment may enter. Because of thin to non-existent soil cover and the presence of dense vegetative cover, the overall amount and rate of sediment deposition in the reservoir is believed to be low. | None |

# APPENDIX B

# ENGINEERING DATA CHECKLIST

# APPENDIX B
## CHECK LIST
## ENGINEERING DATA
## DESIGN, CONSTRUCTION, OPERATION

| ITEM | REMARKS |
|---|---|
| PLAN OF DAM | A tracing of the record drawing is available at the NJDWSC office in Wanaque, N.J. (hereafter referred to as NJDWSC-W). Also see the attached Figures in this report. |
| REGIONAL VICINITY MAP | The USGS Wanaque, N.J. 7-1/2 min. quadrangle map is available. |
| CONSTRUCTION HISTORY | The 1925 Commissioner's Report (Reference 3) is available at NJDWSC-W. There is also a 1931 Commissioner's report at NJDWSC-W, an article on the construction was printed in the N.E.W.W.A. Journal (Reference 2) during construction. Some photos are available in the NJDWSC-W and the N.J. Dept. of Environmental Protection offices in Trenton, N.J. (DEP). |
| TYPICAL SECTIONS OF DAM | A section through the dam is shown on record drawing No. 10 of 61 which is available at NJDWSC-W and is included in Figure 5. |
| HYDROLOGIC/HYDRAULIC DATA | Records are available at NJDWSC-W and some are printed in USGS reports. |
| OUTLETS - PLAN<br>- DETAILS<br>- CONSTRAINTS<br>- DISCHARGE RATINGS | See Figures 2 and 4 attached to this report. The outlet is neither intended nor used to assist with storm surges in the reservoir. |
| RAINFALL/RESERVOIR RECORDS | Excellent records are available from the USGS and NJDWSC from the time of construction of this dam. |

## APPENDIX B - CONT'D

| ITEM | REMARKS |
|---|---|
| DESIGN REPORTS | Bid specifications are available at NJDWSC-W. Some design calculations are available in File #32 of the New Jersey Dept. of Environmental Protection offices in Trenton, N.J. (DEP). See also pages 34-44 of Reference 3, the 1925 Commissioner's Report. |
| GEOLOGY REPORTS | Permanent geologic notes with respect to this dam site were made by Dr. Henry B. Kummel, former N.J. State Geologist, on March 31, 1921 and by others on May 3, 1922. These notes are on file at the N.J. Geological Society (NJGS). A report of the site by Dr. Charles P. Berkey on October 18, 1927 is available at the NJGS. A report of the excavation for the core wall foundation was reported in pages 104 to 106 of Reference 3, the 1925 Commissioner's Report. |
| DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES | Design calculations, dam stability, or seepage studies were not available at NJDWSC-W. Design calculations for this dam do not appear to be in the DEP files. |
| MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD | Impervious borrow materials for the project were investigated with the results indicated on contract drawings: Contract 7, Sh. 3, Contract 1, Sh. 10, 11, and 12, and Contract 2A, Sh. 7, including test boring data. Test borings at the foundation area of this dam are shown on Contract 1, Sh. 3. Foundation grouting records are shown on record drawing Sh. 9. All these drawings are available at NJDWSC-W. |
| POST-CONSTRUCTION SURVEYS OF DAM | It appears that post construction survey information was used in preparing the record drawing. |

APPENDIX B - CONT'D

| ITEM | REMARKS |
|---|---|
| BORROW SOURCES | Locations and logs of borrow areas are shown on contract drawings available at NJDWSC-W. Much of the impervious borrow material used for the core was located on a tract of land lying below the dam and east of the Erie R.R. The remainder came from lands within the reservoir. There was an adequate local supply of gravel used for building the downstream shell of the dam. |
| SPILLWAY PLAN | N.A. (Spillway is separate dam 0.3 miles south) |
| SECTIONS | |
| DETAILS | |
| OPERATION EQUIPMENT PLANS & DETAILS | Record drawings of the operational equipment are available at NJDWSC-W although equipment details are lacking in some instances. |
| MONITORING SYSTEMS | None observed. |
| MODIFICATIONS | No significant modifications from the design of the dam were observed. |
| HIGH POOL RECORDS | Records exist at the NJDWSC-W and in USGS publications. |
| POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS | Annual reports for certain years are in dam file No. 32 of DEP and in Commissioner Reports for 1928, 1930, and 1931 in addition to the 1925 Report in reference 3. |
| PRIOR ACCIDENTS OF FAILURE OF DAM DESCRIPTION REPORTS | None reported since original construction |
| MAINTENANCE OPERATION RECORDS | Operational levels of the reservoir are available from NJDWSC-W. |

## CHECK LIST
## ENGINEERING DATA
## HYDROLOGIC AND HYDRAULIC DATA

DRAINAGE AREA CHARACTERISTICS: Densely forrested, few homes, very hilly with minimal cover on bedrock.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 302.4 ft (89151 Acre-ft)

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

ELEVATION MAXIMUM SPILLWAY DESIGN FLOOD POOL: 308.8 ft

ELEVATION TOP DAM: 310.00 ft (Top of roadway built on top of dam crest 315.0 ft, top of thin masonry wall 316.5) ft

CREST: Paved roadway

a. Elevation: 315.0 ft
b. Type: Non-overflow
c. Width: 20 feett
d. Length: 1603 feet
e. Location Spillover: Not Applicable
f. Number and Type of Gates: Not Applicable

OUTLET WORKS:

a. Type: Two cast-in-place concrete arch tunnels feeding steel pipes.
b. Location: Lower right abutment - See Figures
c. Entrance inverts: Sill upper intake 278.00 ft
Sill intermediate intake 256.00 ft
Sill lower intake 222.00 ft
d. Exit inverts: 209.0 (both)
e. Emergency drawdown facilities: The Wanaque Aquaduct
The existing aerator
The 36 inch diameter blowoff pipeline.

HYDROMETEOROLOGICAL GAGES:

a. Type: Rainfall recording chart, 24-hour precipitation can, and maximum and minimum temperature recorder. Float type continuous stream level recorder with drum chart.

b. Location: Raymond Dam in Wanaque, New Jersey.

c. Records: Weather data published as Climatological Data-Wanaque-Raymond Dam by the National Oceanic and Atmospheric Administration. Streamflow data is recorded by the U.S.G.S.

MAXIMUM NON-DAMAGING DISCHARGE: Non-overflow dam.

# APPENDIX C

# PHOTOGRAPHS



May 1978

MOWING OF GRASS NEAR LEFT ABUTMENT BY RESIDENT MAINTENANCE CREW



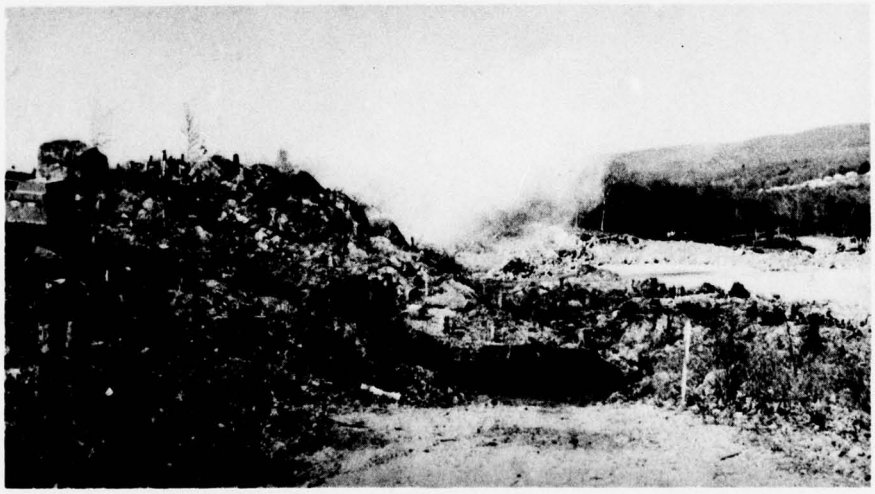
May 1978

DETAIL OF DOWNSTREAM RIPRAP AND PANEL MASONRY



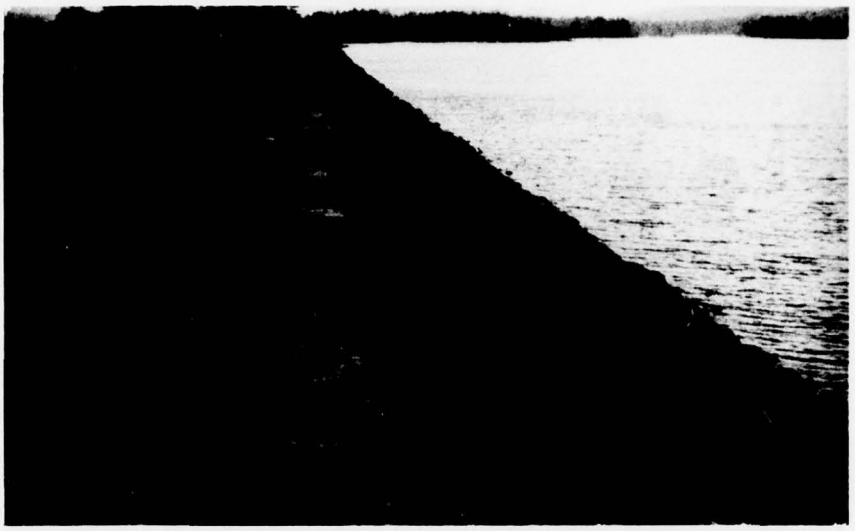
May 1978

VIEW OF OPEN TOP SURGE TANK - ACCESS ROAD ON RIGHT



May 1978

DUST FROM BLASTING AT NEW FILTRATION PLANT SITE 0.3 MILES SOUTHWEST OF DAM - VIEW LOOKING NORTHEAST



May 1978

NOTE UNIFORMITY OF RIPRAP AND HORIZONTAL ALIGNMENT



May 1978

RIGHT ABUTMENT - NOTE OVERFLOW WEIR IS IN CENTER BACKGROUND



May 1978

VIEW OF UPSTREAM FACE OF DAM AND ROCK ABUTMENTS



May 1978

SURFACE DETERIORATION AT UPPER GATE HOUSE



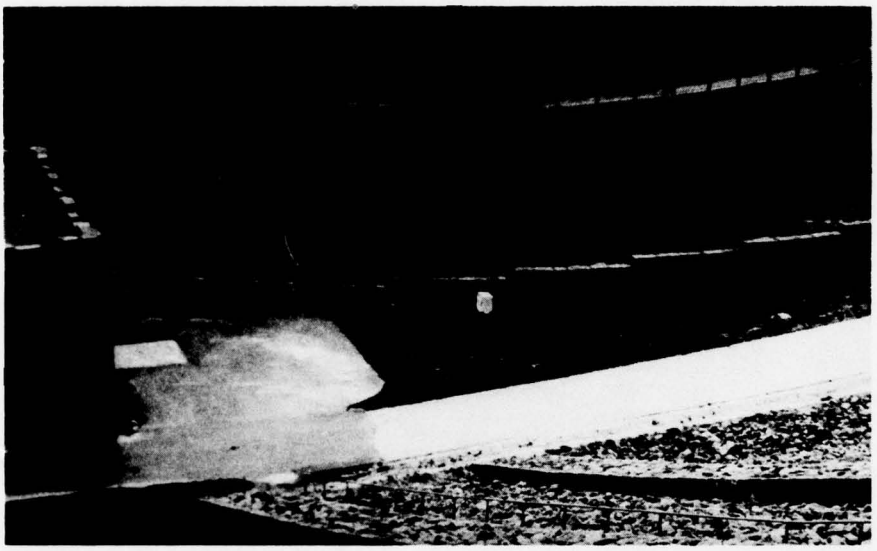
May 1978

LEFT DOWNSTREAM ABUTMENT AREA



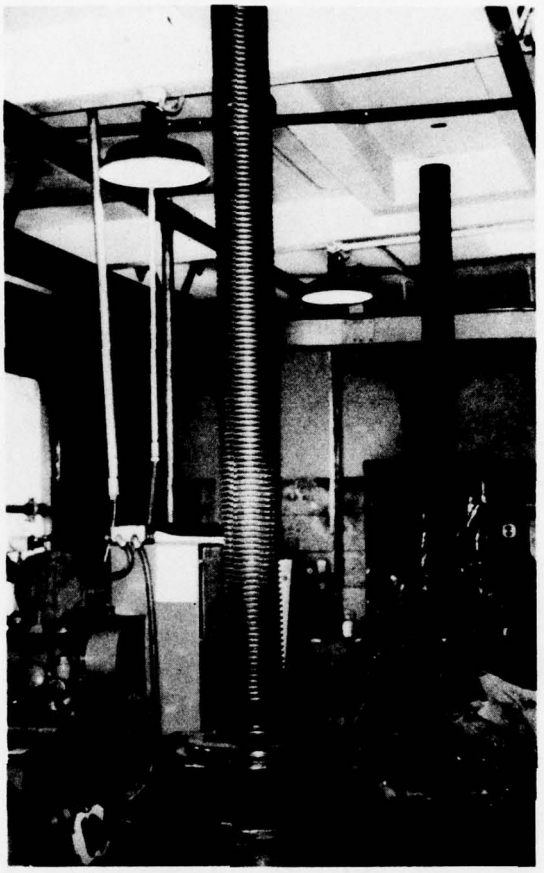
May 1978

RESERVOIR SHORELINE TO LEFT OF DAM



May 1978

METEOROLOGICAL GAUGES TO RIGHT OF LOWER GATE HOUSE



May 1978

UPPER GATE HOUSE - TWO GATE
OPERATORS ON RIGHT



May 1978

GATE OPERATORS - PUSHBUTTON CONTROLS

# APPENDIX D

# HYDRAULIC AND HYDROLOGIC COMPUTATIONS

Complete Hydraulic & Hydrologic Computations are on file in the U. S. Army Engineer District, Philadelphia Office. Copies of the computations will be made available when typing, drafting and reproduction are completed.

# APPENDIX E

# PREVIOUS INSPECTION REPORTS

NORTH JERSEY DISTRICT WATER SUPPLY COMMISSION

M E M O R A N D U M

TO: Dam Inspection File

FROM: Joseph Foley, Engineer

DATE: April 5, 1977

On March 31, 1977 Roscoe Jennings, Doug De Lorie and I inspected the dams at the Wanaque Reservoir; the following is a report on their conditions and recommendations on maintenance of same.

FURNACE ROAD DAM

Condition: There are trees and brush on the wet and dry sides of the dam and also a small swamp of apparently trapped water behind the dam.

Recommendations: The trees should be killed and removed using poison suitable for potable water.

MIDVALE DAM

Condition: Some trees are growing on the wet and dry sides of the dam. There is a small spring flowing from the foot of the dam at the north end. Wet spots and soft wet sand are also apparent at the foot of the dam. No sink holes or other indications of dam failure were apparent at this location. A sample of water from this spring and a sample from the reservoir were taken and anlyzed, the results are as follows:

| | | |
|---|---|---|
| Spring Water: | Specific conductivity | 68 |
| | pH | 6.3 |
| Reservoir Water: | Specific conductivity | 102 |
| | pH | 6.9 |

The results indicate that this water is more likely to be ground water than reservoir water. (For additional information, please refer to a memo from Bob Wieland to George Destito dated May 3, 1976).

Recommendations: The trees on the dam should be killed and removed. The dam should also be checked periodically to be sure the spring is not a leak in the dam.

RAYMOND DAM

Condition: Excellent

SPILLWAY

Condition: Good, except that it was indicated by Ernie Restaino that there is a small leak in the spillway. I did not observe it because of the overflow. I will check it again when the reservoir goes down.

Recommendations: The leak in the spillway should be fixed when the reservoir goes down.

WOLF DEN DAM

Condition: There are trees and shrubs on both the wet and dry sides. There are small springs flowing from the low sections behind the dam. Some samples were also taken here and the results were that the water had a specific conductivity of 90 and a pH of 6.3, so this water is most likely ground water also.

Recommendations: I recommend that the trees and shrubs be removed.

GREEN SWAMP

#4 Dam

Condition: The general condition of the dam is good, although sections of the gunite surfacing are cracked and have fallen off (especially near the expansion joints), due to moisture that found its way under the guite. There was water running out of the drain but this flow was not excessive.

Recommendations: The cracked and loose gunite should be chipped away and replaced and at the expansion joints, the gunite should be chipped and tar poured in to allow expansion of the concrete.

#3 and #2A Dams

Condition: Both small dams are heavily wooded and there is a small swamp behind the #3 dam.

Recommendations: The only recommendation for these dams is that the trees be removed from both sides of the dams.

#2 Dam

Condition: This dam is in excellent condition, except around the expansion joints where the gunite is cracked due to the fact that no allowance was made for expansion when the guite was applied to the dam. There is also a swamp behind this dam, but this looks like a natural swamp.

Recommendations: The gunite at the expansion joints should be chipped away and tar poured in to allow expansion and any other cracks in the gunite should be chipped and repaired.

#1 Dam

Condition: There are trees and shrubs on both wet and dry sides of this dam. There is also a swamp behind the dam.

Recommendations: The dam should be cleared of trees and shrubs.

As a result of my research, so far on dam inspection, I received a booklet, "Supervision of Dams by State Authorities" published by the United States Committee on large dams, July 1966. This publication had little information on the actual inspection of dams but it did have some useful information such as: the function of dam supervision in New Jersey is performed by the Chief Engineer, Division of Water Policy and Supply, Department of Conservation and Economic development. Inspection of dams is done by the State at the State's own expense on the complaint of potential failure.

Additional information on dam inspection is also coming from the Corps of Engineers and the United States Committee on Large Dams.

JF:lk

cc: Dean C. Noll
Robert G. Wieland

Report on Dam Inspection

WANAQUE PROJECT

Application No. 32.

Location 23.31.5.4.8 and nearby.

On March 23, 1928, the gates in the main dam were closed except for the passage of 27 m. g. d. through the blow-off, and on March 29, 1928, the water in the reservoir had risen 7 feet.

On March 29, 1928, in company with Mr. H. T. Critchlow, inspection was made of all of the dams in the Wanaque project.

Furnace Road dam was found to be about 50 per cent complete.

Post Brook Diversion dam, weir and control house were complete except for closing a small breach which was left in the dam for stream control, and installation of recording gage in the control house.

Wanaque Main dam. (Raymond Dam)

Midvale Dam.

Overflow Weir.

Wolf Den Dam, and

Green Swamp Dams Nos. 1, 2, 3 and 4 were complete and were given final inspection.

The construction of all dams has been done in accordance with the approved plans and in a thoroughly workmanlike and satisfactory manner.

John K. Brooks

John K. Brooks
Hydraulic Engineer.

3/31/28

Trenton, N. J.

March 30, 1928.

(New Jersey - Dept. of Environmental Protection)

# APPENDIX F

# GEOLOGIC MAP


RAYMOND DAM
OAKLAND




## LEGEND

### TRIASSIC

| | |
|---|---|
| Trb | BRUNSWICK FORMATION |
| Trbs | BASALT FLOWS |

### PRECAMBRIAN

| | |
|---|---|
| gh | MOSTLY HORNBLENDE GRANITE AND GRANITE GNEISS |
| am | AMPHIBOLITE |
| pqo | PYROXENE GNEISS; MAINLY QUARTZ-OLIGOCLASE - CLINOPYROXENE GNEISS |
| hqa | PYROXENE GNEISS; MAINLY QUARTZ-ANDESINE GNEISS WITH BOTH ORTHO-AND CLINOPYROXENE |
| qo | QUARTZ-OLIGOCLASE-GNEISS |
| qob | QUARTZ-OLIGOCLASE-BIOTITE GNEISS |
| qs | SILLIMANITE GNEISS |
| msk | MARBLE AND SKARN |

——— CONTACT LINE

——— FAULT LINE

NOTES:

1. THE PRECAMBRIAN MAP UNITS REPRESENT GENERALIZED GROUPINGS OF ROCK TYPES BASED MAINLY ON MINERAL COMPOSITION. THERE IS MUCH LOCAL VARIATION IN THE MINERAL COMPOSITION.
2. THE CONTACT LINES AND FAULT LINE SHOWN ON THE DRAWING ARE DASHED WHERE INFERRED.

SOURCE:

NEW JERSEY GEOLOGICAL SURVEY TOPOGRAPHIC SERIES AND GEOLOGIC OVERLAY SHEETS 23.

1 0 1 2

SCALE IN MILES

# APPENDIX F
# REGIONAL GEOLOGIC MAP SHOWING DAM LOCATION

# APPENDIX G

# REFERENCES

## APPENDIX G

## REFERENCES


1. Recommended Guidelines for Safety Inspection of Dams, (Washington, D.C., Department of the Army, Office of the Chief of Engineers).

2. Public Works, Vol. 54, No. 5, May 1923.

3. North Jersey District Water Supply Commission - Report 1925, (Newark, N.J., Office of the Commission), 1925.

4. Water Resources Data for New Jersey, Part 1, Surface Water Records, United States Department of the Interior, Geologic Survey.

5. HEC-1 Flood Hydrograph Package, Hydrologic Engineering Center, Corps of Engineers, January, 1973.

6. Daily Reservoir Water Level and Discharge Record Files from October 1950 to date owned by the NJDWSC.

7. Water Resources Data for New Jersey, Part 1, Surface Water Records, USGS, Department of the Interior.

8. Passaic River Basin - New Jersey and New York Survey Report for Water Resources, New York District Corps of Engineers, June 1972.

# APPENDIX H

# ELECTRICAL REPORT

## APPENDIX H

## RAYMOND DAM

## UPPER GATE HOUSE ELECTRICAL INSPECTION

The Upper Gate House has four electrically operated sluice gates. All gates operators receive power from a recently installed Square D Co. 250 V, 3 PH, AC, 400A molded case breaker power panel. If this source of power fails, the gates must be manually operated with the hand wheel provided at each station. The electrical gate operating equipment is in good condition even though it has been in service for approximately 50 years. Each gate operator consists of a 30 HP, 220 V, 3 PH, 60 HZ General Electric Co. induction motor, size #4 full voltage reversing Westinghouse Electric Co. starter, close, stop, open pushbutton station complete with indicating lights and a gate position including limit switch directly below the pushbutton station.

At the time of the inspection, 5/11/78, all four gates were inoperable due to corrosion in the stem guide at each gate. Two of the gates were in the process of having their corroded brass stem guides replaced with stainless steel. The remaining two gates are scheduled to have their guide replaced after completion of the work on the first two.

A gate operating procedure has been established for the operators. This procedure consists of observing the indicating limit switch and stopping the gate before the end of the travel is reached. The hand wheel is then used to drive the gate to the full closed or open position.

An indicating light and lens is missing on one of the valve operator pushbutton stations. This does not affect the operation of the gate controller. Because of the age of the equipment, replacement parts are difficult to obtain and may have to be custom made or replaced with similar equipment.

It is recommended that a monthly maintenance operating schedule be installed to operate each of the four sluice gates through a complete close open cycle. This will show that all electrical, mechanical and hydraulic components of the gate system are in operating condition.

A request was made to see the operating or maintenance log record on the Upper Gate House electrical equipment. The reply was that this type of record did not exist.

In the inspection of the Upper Gate House electrical system there was nothing observed that would indicate the presence of an imminent hazard.

## APPENDIX H

## RAYMOND DAM

## LOWER GATE HOUSE ELECTRICAL INSPECTION

The Lower Gate House has eight electrically operated valves and one chlorination standby pump. Six of the valves are main 48-inch valves. One 24 inch and one 30 inch bypass valve complete the installation. All eight electrically operated valves and the one chlorination pump receive power from a new Square D Co. 250 V 3-PH, AC 400A molded case breaker power panel. In the event of a power failure at the power panel the valves can be operated with a hand wheel or a portable gasoline engine driven operator. The hand wheel is removed on the valve operator and the portable gas engine drive is attached to the top of the hand wheel shaft.

This arrangement will open and close the valves with the same speed as the electric motor.

All valve operators are in good electrical operating condition even though they have been in service for approximately 50 years. The 48-inch valve operators are driven by a 8.4 HP, 220 V, 3 PH, 60 HZ General Electric Co. induction motor and the two bypass valves are operated by 4 HP, 220 V, 3 PH, 60 HZ General Electric Co. motor. Each valve operator is equipped with a three position open, stop, close pushbutton station, General Electric Co. size #2 reversing starter and valve position indicating limit switch.

The same valve operating procedure as used in the Upper Gate House is used in the Lower Gate House. This consists of completing the last part of the close or open valve travel under manual hand wheel control.

Operating and maintenance log records were not kept for the Lower Gate House electrical equipment.

During this inspection of the Lower Gate House electrical system there was nothing observed that would indicate the presence of an imminent hazard.

# APPENDIX I

# CONDITIONS

# APPENDIX I

## CONDITIONS

This report is based on a visual inspection of the dam, a review of available engineering data and a hydrologic analysis performed during Phase I Investigation as set forth in the Recommended Guidelines for Safety Inspection of Dams, as modified by the contract between the U.S. Corps of Engineers and Gilbert Associates, Inc., Contract No. DACW61-78-C-0114.

The foregoing review, inspection, and analysis are by their nature limited in scope. It is possible that hazardous conditions exist and that conditions exist which with time might develop into safety hazards and that these conditions are not detectable by means of the aforesaid review, inspection, and analysis. Accordingly Gilbert Associates, Inc. cannot and does not warrant or represent that conditions which are hazardous do not exist, or that conditions do not exist which with time might develop into safety hazards.

As required by the Corps of Engineers the terms "good", "fair", "poor", "condition" have been used in this Report to characterize the information obtained from the aforesaid review, inspection, and analysis. The definitions of these terms as used are:

"good condition" - minor studies or remedial measures are required.

"fair condition" - sizeable studies or remedial measures are required due to deficiencies which could be hazardous depending on conditions. Immediate attention is required.

"poor condition" - major studies or remedial measures are required due to deficiencies which could be hazardous depending on conditions. Immediate studies or corrective action is required.