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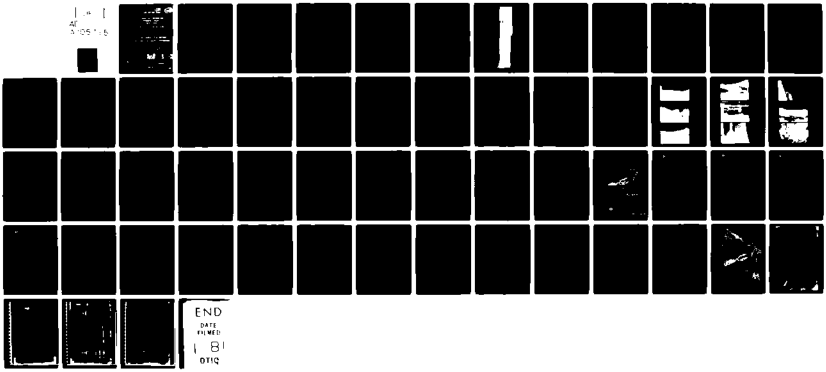

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COBBS HILL RESERVOIR
MONROE COUNTY
NEW YORK

INVENTORY No. NY1448

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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NEW YORK DISTRICT CORPS OF ENGINEERS

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

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Cobbs Hill Reservoir Dam
Monroe County
Lake Ontario Basin

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

This report provides information and analysis on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam by the performing organization.

The Phase I Inspection of the Cobbs Hill Reservoir Dam did not indicate conditions which would constitute an immediate hazard to human life or property.

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The hydrologic/hydraulic analysis indicates that the impoundment will contain the runoff from the PMP without overtopping the structure. Therefore, the spillway is assessed as adequate.

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PREFACE

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

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

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

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APPENDIX

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Cobbs Hill Reservoir Dam I.D. No. NY 1448
State Located:	New York
County:	Monroe
Watershed:	Lake Ontario Basin
Stream:	Not Applicable
Date of Inspection:	November 20, 1980

ASSESSMENT OF GENERAL CONDITIONS

The Phase I Inspection of the Cobbs Hill Reservoir Dam did not indicate conditions which would constitute an immediate hazard to human life or property.

The hydrologic/hydraulic analysis indicates that the impoundment will contain the runoff from the PMP without overtopping the structure. Therefore, the spillway is assessed as adequate.

The following remedial work should be undertaken during normal maintenance operations within one year:

1. Seepage near the toe of the northerly slope should be monitored and data recorded to detect any change in flow which might indicate changing conditions.

2. Seepage through the joints between monoliths 15 and 16 should be repaired.

3. General spalling of the concrete surfaces forming the inside slope of the impoundment was noted, with this spalling approaching a foot in depth in some areas. These areas of deteriorated concrete should be repaired to ensure the future integrity of the structure.

4. A flood warning and emergency evacuation system should be implemented to alert the public in the event conditions occur which could result in failure of the dam.

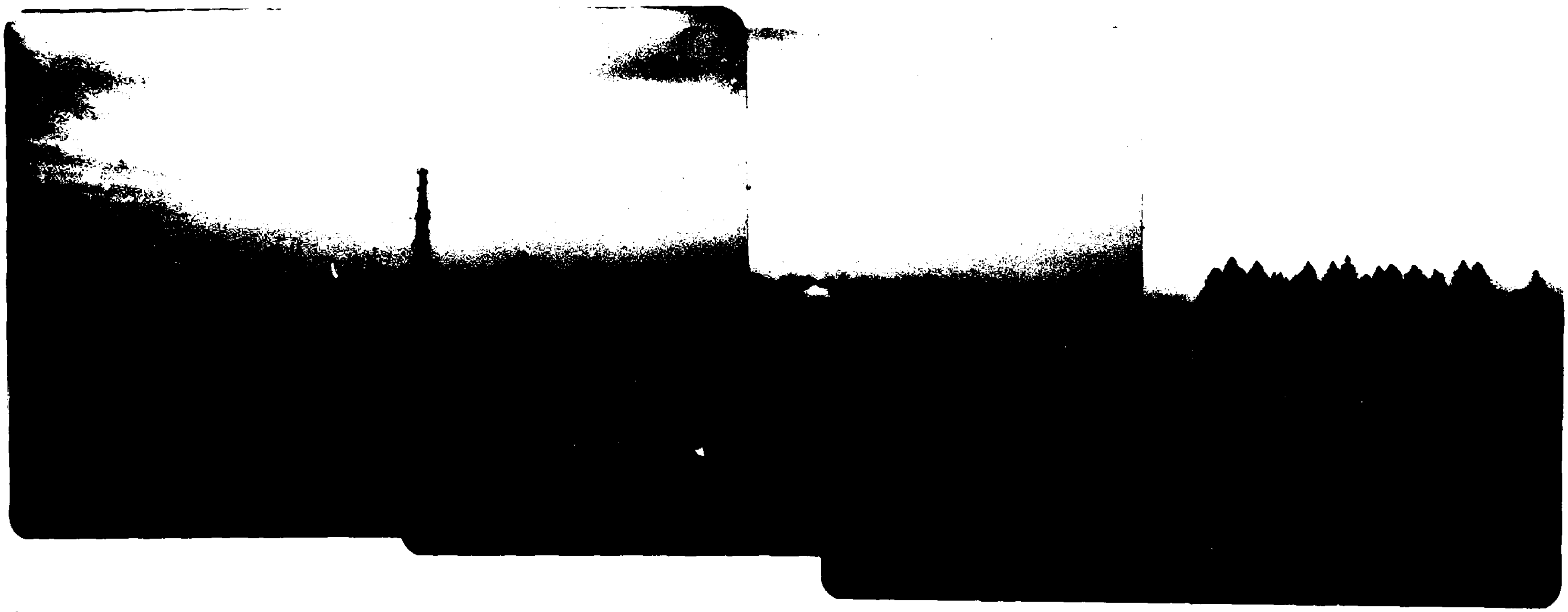
5. A formalized inspection system should be initiated to develop data on conditions and maintenance operations at the facility.

Dale Engineering Company

John B. Stetson, President

Approved By: Col. W. M. Smith, Jr.
New York District Engineer

Date: 30 JUN 1981



1. Overview of the reservoir.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
COBBS HILL RESERVOIR DAM I.D. NO. NY 1448
LAKE ONTARIO BASIN
MONROE COUNTY, NEW YORK

SECTION 1: PROJECT INFORMATION

1.1 GENERAL

a. Authority

Authority for this report is provided by the National Dam Inspection Act, Public Law 92-367 of 1972. It has been prepared in accordance with a contract for professional services between Dale Engineering Company and the U. S. Army Corps of Engineers.

b. Purpose of Inspection

The purpose of this inspection is to evaluate the existing condition of the Cobbs Hill Reservoir Dam and appurtenant structures, owned by the City of Rochester, Bureau of Water, Rochester, New York, and to determine if the dam constitutes a hazard to human life or property and to transmit findings to the U.S. Army Corps of Engineers.

This Phase I inspection report does not relieve an Owner or Operator of a dam of the legal duties, obligations or liabilities associated with the ownership or operation of the dam. In addition, due to the limited scope of services for these Phase I investigations, the investigators had to rely upon the data furnished to them. Therefore, this investigation is limited to visual inspection, review of data prepared by others, and simplified hydrologic, hydraulic and structural stability evaluations where appropriate. The investigators do not assume responsibility for defects or deficiencies in the dam or in the data provided.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

The Cobbs Hill Reservoir Dam is a water supply reservoir located within the City of Rochester, New York. The dam consists of a concrete retaining wall with compacted earth fill on the downstream face of the retaining wall. The floor of the reservoir is constructed of concrete. The structure is elliptical in shape with a length of 3560 feet and a maximum height of 25 feet. The retaining wall and earth fill backing completely encircles the impoundment. An inspection tunnel through the center of the concrete retaining wall extends around the entire perimeter of the impoundment. The reservoir is fed through a transmission line which is connected to the Bureau of Water supply source, Hemlock Lake. The water level in the impoundment is controlled by manipulating valves in the gatehouse situated at the westerly end of the impoundment.

b. Location

The reservoir is located in the City of Rochester, Monroe County, New York near its boundary with the Town of Brighton.

c. Size Classification

The maximum height of the dam is approximately 25 feet. The volume of the impoundment is approximately 442 acre feet. Therefore, the dam is in the small size classification as defined by the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification

The dam is located in a densely developed residential area of the City of Rochester. Therefore, the dam is in the high hazard classification as defined by the Recommended Guidelines for Safety Inspection of Dams.

e. Ownership

The dam is owned by the City of Rochester, Bureau of Water.

Contact: Roger McPherson, Director
Bureau of Water
10 Felix Street
Rochester, New York 14680
Telephone: (716) 428-7509

f. Purpose of the Dam

The dam is used as a water supply reservoir for the areas served by the Rochester Bureau of Water.

g. Design and Construction History

Plans for the Cobbs Hill Reservoir are dated 1907. The history of the Rochester Water Works indicates that the facility was constructed between 1905 and 1908. These plans substantially conform to the present configuration of the facility. No information is available regarding the design or construction history of this dam.

h. Normal Operational Procedures

Water level in the reservoir is monitored through a telemetering arrangement by the system's dispatcher who has 24-hour surveillance of the water elevations. Flow into the impoundment is controlled to maintain optimum water levels consistent with the operation of the system. Further surveillance is provided through the Superintendent of Upland Water Supply who dispatches personnel to personally inspect water levels at least twice a day.

1.3 PERTINENT DATA

a. Drainage Area

The drainage area of Cobbs Hill Reservoir Dam is 19 acres.

b. Discharge at Dam Site

No discharge records are available for this site. The facility is a water supply reservoir which is used as local storage.

c. Elevation (feet above MSL)

Top of Dam	643
Normal Pool	638

d. Reservoir

Length of Normal Pool	1,422 ft.

e. Storage

Normal Pool	442 acre feet 144,000,000 gallons

f. Reservoir Area

Normal Pool	18.3 acres

g. Dam

Type - Concrete retaining wall with compacted earth fill backing. Concrete floor.
Length - 3560 ft.
Height - 25 ft.
Freeboard between Normal Reservoir and Top of Dam - 5 ft.
Top Width - 22 ft.
Side slopes- Interior: 1 horizontal:4 vertical (concrete)
Exterior: 2 horizontal:1 vertical (earth)
Zoning - "Rolled embankment" extends approximately 17 ft. from concrete section (see Figure 3)
Impervious Core - N/A
Grout Curtain - None

h. Overflow

Type - Broad crested weir overflow
Length - 12.5 ft.
Crest Elevation - 639
Discharge - Overflow pipe outlets into the storm drainage system of the City of Rochester.

i. Regulating Outlets

Water is discharged from the impoundment through the Rochester Water Works water distribution systems. Water levels are under 24-hour surveillance by the dispatcher.

SECTION 2: ENGINEERING DATA

2.1 GEOTECHNICAL DATA

a. Geology

Geologically, Cobbs Hill Reservoir is located in the Eastern Lake section of the Central Lowland Province which is part of the Interior Plains, the major physiographic division. Bedrock beneath the Reservoir are horizontally lying dolostones of the Lockport Group of Upper Silurian age. Depth to bedrock is unknown. The reservoir is sited on Cobbs Hill, a part of the Pinnacle Hills (or Pinnacle Range), an irregular but linear belt of kame deposits. These kames are ice-contact deposits laid down by streams discharging from the ice front into a glacial lake (Lake Dana). The Pinnacle Range is composed largely of stratified sand and gravel deposits which display abrupt changes both vertically and laterally. Glacial till (unsorted and unstratified), varying in thickness from 3 to 20 feet, overlies the sorted and stratified kame deposits. Kame deposits are generally regarded as being moderately to highly permeable.

b. Subsurface Investigations

No records of subsurface information were available concerning the foundation of the original facility.

2.2 DESIGN RECORDS

No reports were available from the original design of the dam. The available plans are included as Figures 2 through 5.

2.3 CONSTRUCTION RECORDS

No information was available concerning the original construction.

2.4 OPERATIONAL RECORDS

There are no operational records available for this dam. Water level records are maintained by the Bureau of Water.

2.5 EVALUATION OF DATA

The data presented in this report was obtained from the City of Rochester, Bureau of Water. The information available appears to be reliable and adequate for a Phase I inspection report.

SECTION 3: VISUAL INSPECTION

3.1 FINDINGS

a. General

The Cobbs Hill Reservoir Dam was inspected on November 20, 1980. The Dale Engineering Company Inspection Team was accompanied by Sanford Vreeland, Superintendent of Upland Water Supply; Russell Harding, P.E. Associate Engineer, Bureau of Water; Robert Weisenreider, Engineer, Bureau of Water; and Sam Coco, Foreman, City Reservoirs. During the inspection, the weather was fair with a light snow covering on the ground. The water level in the impoundment was 634.6.

b. Dam

Although the ground surface was partially obscured by a light snow cover, the conditions did not preclude an inspection of the surfaces of the embankment. The slopes of the earth fill section were uniform and no evidence of displacement was detected. The crest of the dam was at a uniform level. No evidence was detected in the field to suggest subsidence of the filled material. A small area of seepage was detected at the toe of the northerly slope of the embankment. This area was suspected to be a sanitary sewage outlet from the buildings directly up the hill from this area. An inspection of the interior of the concrete retaining wall which forms the inside slope of the impoundment was conducted. Minor seepage was detected at many of the joints between the monoliths of the retaining wall. Calcium deposits were also detected at many of these joints. However, in general seepage was very slight and could be termed insignificant. Flowing water seeping through the monolith joints between sections 15 and 16 was detected. This flow was in the magnitude of approximately 1 gallon per minute or less. Concrete surfaces within the inspection tunnel were in good condition. No significant spalling or cracking was detected in the gallery.

c. Spillway

The overflow spillway is located in the gatehouse at the top of a concrete wall forming the overflow chamber. The concrete surface of the spillway has experienced some spalling on the order of 1 to 1-1/2 inches, but retains its structural integrity.

d. Appurtenant Structures

The gatehouse at the westerly end of the impoundment is generaly in good condition. The valves and mechanical equipment are well maintained and in excellent operating condition. Some cracking of concrete was noted in the walls and struts in the intake valve room. The ceiling plaster in the gatehouse was cracked and the skylight was in poor condition. Some spalling of the exterior concrete of the gatehouse was noted, especially near the waterline.

e. Reservoir Area

The reservoir area covers approximately 18.3 acres. The impoundment is completely encircled by the dam structure. The inside slope of the impoundment is formed by the exposed face of the concrete retaining wall. The exposed surfaces of this concrete show general spalling throughout the perimeter of the impoundment especially near the waterline. This spalling approached a foot in depth in some areas and was more severe around the construction joints. The slope of the concrete was uniform and no signs of structural damage or displacement were detected during the inspection.

3.2 EVAULATION

The visual inspection revealed that the embankment is generally in good condition and well maintained.

The following specific items should be addressed by the Owner:

1. A small area of seepage was detected near the toe of the northerly slope. The area of seepage should be monitored to determine any change in flow which might indicate changing conditions. Testing should be conducted to determine if this seepage is from the reservoir or sanitary sewage from the nearby buildings.

2. The inspection through the tunnel in the concrete section of the dam indicates only minor seepage occuring through monolith joints. Seepage through the joint between monoliths 15 and 16 should be remedied by packing the joint through the chase provided for this purpose (~~see~~ Figure 3).

3. The concrete surface on the interior slope of the impoundment shows surface spalling but no indication of structural displacement or movement. These areas of deteriorated concrete should be repaired.

SECTION 4: OPERATION AND MAINTANENCE PROCEDURES

4.1 PROCEDURES

This reservoir is used to provide a local storage of potable water for use in the public water system served by the City of Rochester, Bureau of Water. Water levels in the impoundment are constantly monitored by a systems dispatcher and records are maintained of the water levels at all times. The reservoir is inspected daily by personnel from the Bureau of Water. There are no records of overflow of this system in the nearly 80 years of operation.

4.2 MAINTENANCE OF THE DAM

Maintenance and operation of the dam is controlled by the Bureau of Water. Daily visits are made to the site to check on conditions of the facilities. The water levels are held at optimum level consistent with water supply requirements. Conditions at the site indicate that the facility is generally well maintained.

4.3 MAINTENANCE OF OPERATION FACILITIES

The valves controlling flow into the impoundment are in operating condition and well maintained.

4.4 DESCRIPTION OF WARNING SYSTEM

No warning system is in effect at the present.

4.5 EVALUATION

The dam and appurtenances are normally inspected by personnel from the City of Rochester, Bureau of Water. The facility is presently in good condition and adequately maintained. Since this dam is in the high hazard classification, a warning system should be implemented to alert the public should conditions occur which could result in failure of the dam.

SECTION 5: HYDROLOGIC/HYDRAULIC

5.1 DRAINAGE AREA CHARACTERISTICS

The Cobbs Hill Reservoir is located in the southeastern fringe of the City of Rochester. The reservoir serves as a water supply holding area and is completely encircled by the embankment which is perched on a hill above the surrounding terrain. The only contributing runoff areas consist of the reservoir interior and the embankment crest, which constitutes a relatively small area in comparison to the reservoir area.

5.2 ANALYSIS CRITERIA

The purpose of this investigation is to evaluate the reservoir system's capacity to handle runoff from precipitation events. This has been assessed through the evaluation of the effects on the reservoir from the runoff produced by the Probable Maximum Precipitation (PMP).

The reservoir's capacity to handle the runoff produced by a precipitation event is a function of the available reservoir storage, outflow over the overflow weir, the measures taken to regulate the reservoir's supply and outlet conduits, and the volume of runoff.

Water is supplied to Cobbs Hill Reservoir by supply conduits from Hemlock Lake. The reservoir inflow and outflow is controlled by the valves in the gatehouse at the reservoir. The water level of the reservoir is monitored by a recording elevation gauge. This information is telemetered to the system's dispatch center which is staffed 24 hours a day. These reservoir levels are then radioed to Bureau of Water personnel.

The Probable Maximum Precipitation (PMP) is 21.5 inches according to Hydrometeorological Report (HMR #33) for a 24-hour duration storm, 200 square mile basin. Adjusting the rainfall to the lower limit of the areal adjustment graph (the drainage area is less than 10 square miles, the lower limit of the areal adjustment graph) resulted in an index PMP of 30.3 inches. Nearly 100% of the precipitation will result in runoff as the drainage area consists of the reservoir and concrete lined slopes.

5.3 SPILLWAY CAPACITY

The overflow spillway is an uncontrolled broad crested weir 12.5 feet long and 3 inches wide. The spillway crest is located at approximately elevation 639 and the top of the embankment at elevation 643. This results in a 4 feet height of flow that the spillway can accommodate before the earthen embankment is overtopped. A spillway coefficient of 3.32 was assigned for this height of flow. The discharge capacity of the spillway at the top of dam elevation is 330 cfs.

5.4 RESERVOIR CAPACITY

The reservoir storage capacity was estimated from the plan and cross section presented in Appendix F as Figures 2 and 3. The resulting estimates of the reservoir storage capacity are shown below:

Spillway Crest	460 acre feet
Top of Embankment	535 acre feet

5.5 OVERTOPPING POTENTIAL

The surcharge storage of 75 acre feet between the spillway and the top of the embankment is equivalent to 47 inches of runoff from the drainage area. Therefore, disregarding the spillway discharge and assuming the flow through the supply and outlet conduits to be equal throughout the PMP event, the reservoir has sufficient capacity above the spillway crest to store the PMP with over a foot of freeboard.

5.6 EVALUATION

Based on the information given by the operations staff, there will be more than sufficient operations freeboard within the reservoir to store the PMP without overtopping the embankment.

The reservoir has never been known to have been overtopped and the only way it would be overtopped would be due to an operator error on the supply end of the system. Since the reservoir levels are continuously monitored by a recording gauge that telemeters these levels to the system's dispatcher center which is staffed 24 hours a day and the reservoirs are inspected at least twice a day, the possibility of the reservoir being overtopped seems quite remote. Therefore, the spillway is assessed as adequate according to the Corps of Engineers' screening criteria.

SECTION 6: STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

Cobbs Hill Reservoir is constructed of a concrete retaining wall with a rolled earth backfill that completely encompasses the reservoir. The structure is perched on the top of a hill, above the surrounding terrain. The reservoir is somewhat kidney shaped some 1400 feet long with a maximum width of about 730 feet. The crest and interior of the reservoir are concrete, whereas the exterior earthen slopes are grassed. An inspection tunnel through the concrete retaining wall runs around the entire perimeter of the reservoir.

The exterior embankment appears to be adequately mowed and maintained. The slopes are generally uniform with no evidence of structural movement or cracking. Trees were observed on some portions of the embankment. Many of these areas appeared to be original ground. A rather small wet spot was detected near the toe of the northern embankment. This area was about a foot wide. The seepage was bubbling somewhat and measured to be flowing at the rate of about 0.3 gallons per minute. This portion of the embankment appears as though it could be the natural hillside. The seepage smelled like decaying vegetative matter. This seepage area is directly downhill from the radio station building and might even be sanitary sewage from this building.

The concrete reservoir retaining structure appeared to retain its proper alignment. Rather severe spalling of the exterior concrete surfaces of the reservoir retaining structure was observed. This spalling was mostly confined to the waterline area. The depth of this spalling approached one foot in areas and was most severe around the construction joints. The easterly side of the reservoir appeared to be more susceptible to this surface deterioration, probably due to the effect of the prevailing winds on the wave and ice action. Numerous cracks were observed in the shotcrete overlay on the slope between the crest and reservoir. The entire length of the tunnel through the retaining structure was inspected. The tunnel surfaces on the reservoir side showed more deterioration than the tunnel surface away from the reservoir. Some spalling of the concrete surface on the reservoir side was noted as was some leaching. Some minor seepage and calcium deposits were observed at the joints. Between monoliths 15 and 16, seepage on the order of 1 gallon per minute was observed. No flow was observed from the pressure relief drains that extend from underneath the reservoir slab into the inspection tunnel. These drains may well be inoperable at this time.

b. Design and Construction Data

No information regarding the structural stability of the structure was located.

The earliest available drawings are dated 1907. Information contained in the published history of the Rochester Water Works indicate the structure was constructed between 1905 and 1908.

Drawings included in Appendix F substantially conform to the present facility. The drawings indicate the concrete retaining wall to be 2 feet-9 inches at the top with a 1:4 (1 horizontal to 4 vertical) interior slope and 1:5 exterior slope (see Figure 3). These side slopes change at depth to 3.75:4 interior and 1:12 exterior to produce a width of about 14.5 feet at the bottom of the reservoir. A concrete slab varying in thickness from about 1-1/2 to 2 feet acts as the base for this retaining wall. The retaining wall is capped with 3 feet wide by 1 foot thick concrete cap blocks. Clay filled keyways (waterstops) are provided at the joints between monoliths of the wall to retard leakage from the reservoir. An inspection tunnel is located at the bottom of the retaining wall, approximately in the middle, and runs through the entire length of the wall. One inch galvanized iron pipes are shown to extend from underneath the outside edge of the reservoir up into the bottom of the inspection tunnel. These are probably intended to serve as pressure relief drains. The entire reservoir bottom appears to be lined with a concrete slab. The slope from the cap blocks to the crest is concrete lined as is the crest and the walkway that encircles the reservoir. A security fence runs along the crest, encompassing the entire reservoir. The compacted backfill for the retaining wall is comprised of earth, specified to be rolled in 4 inch layers. The exterior earthen slopes, extending beyond the rear angle of the embankment, scale to be at a 2:1 slope.

c. Operating Records

The only operating records available are those pertaining to reservoir water levels on file with the City of Rochester, Bureau of Water.

d. Post Construction Changes

There are no available documents or indications of significant post construction changes. It does appear that the slope between the crest and cap blocks as well as some of the cap blocks has been overlaid with a thin mortar layer.

e. Seismic Stability

No known faults or lineaments suggesting faults are present in the immediate area.

The area is located within Zone 2 of the Seismic Probability Map but is only 25 miles east of an active Zone 3, which has had earthquakes with intensities as great as VIII on the Modified Mercalli Scale. Only four earthquakes have been recorded in the vicinity of the reservoir and are tabulated below:

Date	Intensity Modified Mercalli	Location Relative to Dam
1931	I	5 miles NNW
1931	II	5 miles NNW
1944	II	2 miles NNW
1977	IV	9 miles SE

6.2 STRUCTURAL STABILITY ANALYSIS

The concrete retaining structure as well as the earthen embankment backfill appeared to be generally uniform in section with no signs of structural instability in evidence. The area of leakage between monoliths 15 and 16 should be repaired. The wet area near the toe of the north embankment should be tested to determine if it might be due to leakage from the reservoir. Flow from this area should be monitored as part of a formalized inspection program.

The entire structure, as well as areas beyond the toe of the slope, should be regularly inspected as part of a formalized inspection program to detect deficiencies. Any deficiencies and the remedial measures undertaken to correct these deficiencies should be well documented to provide historical background on which future evaluations may be based.

SECTION 7: ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety

The Phase I Inspection of the Cobbs Hill Reservoir Dam did not indicate conditions which would constitute an immediate hazard to human life or property.

The hydrologic/hydraulic analysis indicates that the impoundment will contain the runoff from the Probable Maximum Precipitation (PMP) without overtopping the structure.

The visual inspection did not reveal conditions that would indicate evidence of structural displacement or instability.

The following specific safety assessments are based on the Phase I visual examination and analysis of hydrology and hydraulics, and structural stability.

1. Seepage was detected near the toe of slope of the northerly embankment. This seepage is immediately downhill from the radio station buildings situated near the hilltop.
2. Seepage was detected in the inspection tunnel through the joint between monoliths 15 and 16.
3. General spalling of the concrete surfaces forming the inside slope of the impoundment was noted, with this spalling approaching a depth of a foot in areas.
4. No warning system is presently in effect to alert the public should conditions occur which could result in failure of the dam.
5. No formalized inspection system is in effect at the facility.

b. Adequacy of Information

The information available is adequate for this Phase I investigation.

c. Urgency

Items 1-4 of the safety assessment should be addressed by the Owner and appropriate actions taken within one year of this notification.

d. Need for Additional Investigation

This Phase I inspection has not revealed the need for additional investigations regarding this structure.

7.2 RECOMMENDED MEASURES

The following is a list of recommended measures to be undertaken to insure safety of the facility.

1. Seepage near the toe of the northerly slope should be monitored and data recorded to detect any change in flow which might indicate changing conditions.

2. Seepage through the joints between monoliths 15 and 16 should be repaired.

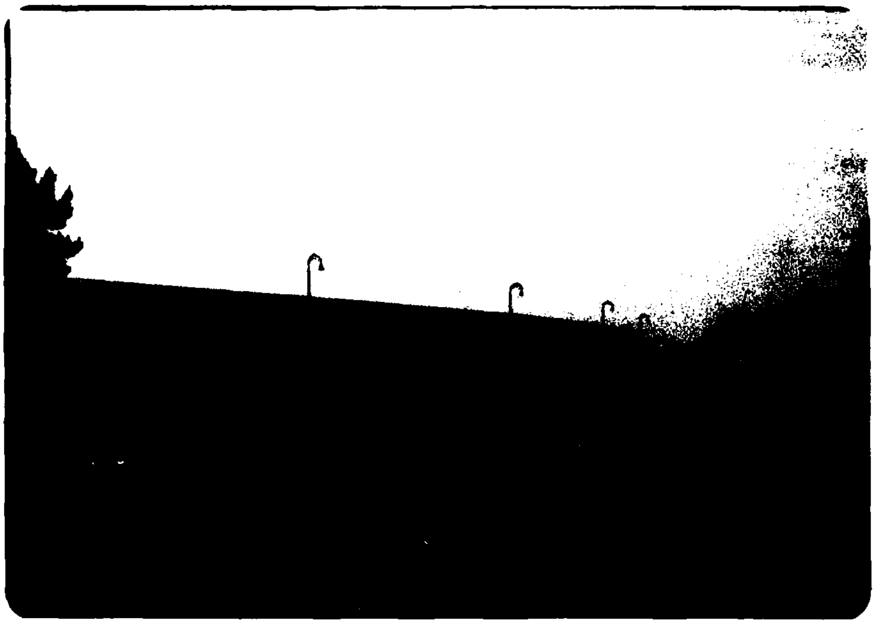
3. The deteriorated areas of the concrete surfaces of the inside slope of the impoundment should be repaired.

4. A flood warning and emergency evacuation system should be implemented to alert the public in the event conditions occur which could result in failure of the dam.

5. A formalized inspection system should be initiated to develop data on conditions and maintenance operations at the facility.

APPENDIX A

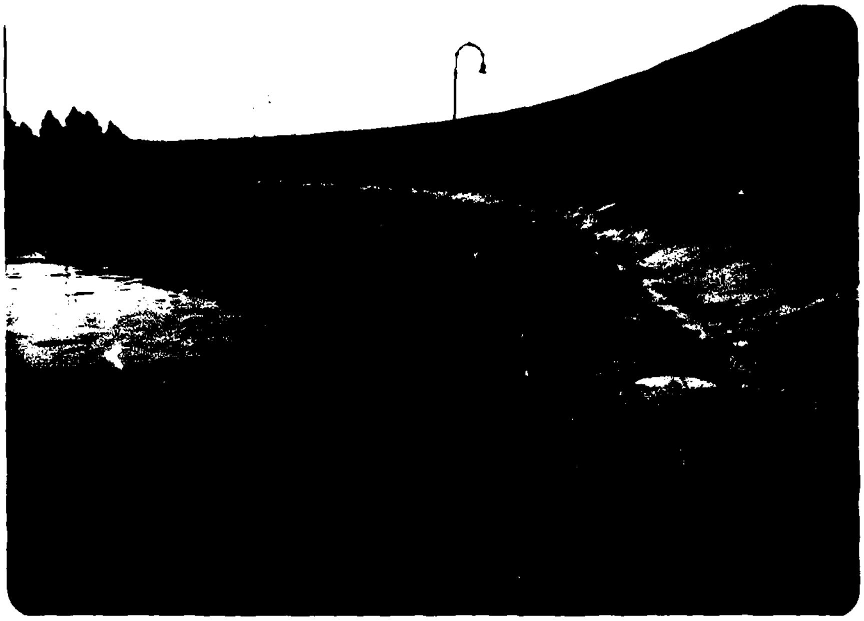
PHOTOGRAPHS



2. Exterior slope of reservoir, gatehouse in background.

3. Slope of southerly earth embankment.

4. Slope of easterly earth embankment.



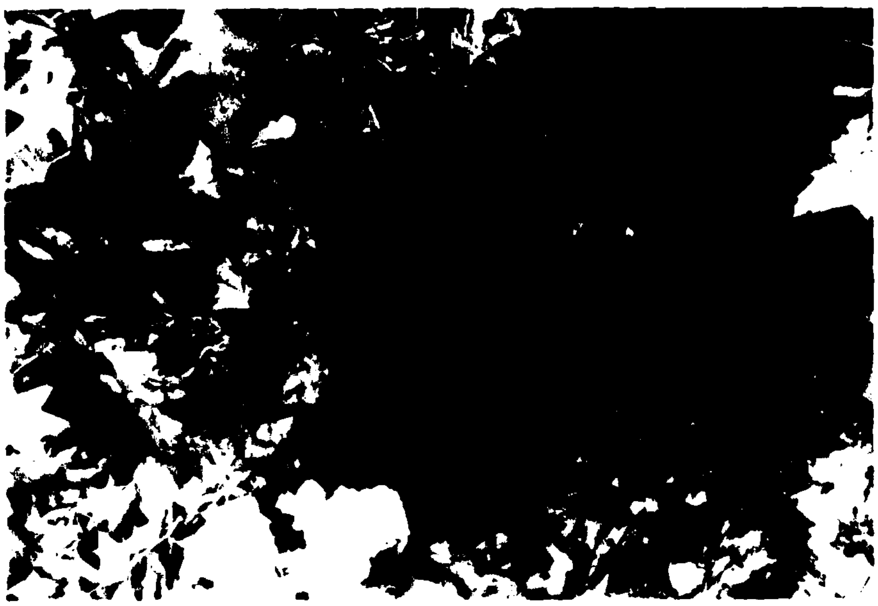
5. Interior face of concrete retaining wall showing surface cracking and spalling. Photo is typical of conditions.

6. Concrete foundation of gatehouse showing spalled concrete.

7. Valve room in gatehouse.

8. Typical monolith joint in inspection tunnel showing calcium deposits.

9. View of "downstream" hazard.



10. Area of seepage at toe of northerly slope.

APPENDIX B

VISUAL INSPECTION CHECKLIST

93-15-3(9/80)

VISUAL INSPECTION CHECKLIST

1) Basic Data

a. General

Name of Dam COBBS HILL RESERVOIR DAM

Fed. I.D. # NY 1448 DEC Dam No. ______

River Basin LAKE ONTARIO BASIN

Location: Town CITY OF ROCHESTER County MONROE

Stream Name N/A

Tributary of N/A

Latitude (N) 43 - 08.3 Longitude (W) 77 - 32.4

Type of Dam CONCRETE RETAINING WALL W/ EARTH FILL BACK UP.

Hazard Category HIGH

Date(s) of Inspection NOV. 20, 1980

Weather Conditions FAIR

Reservoir Level at Time of Inspection 634.6

b. Inspection Personnel F.W. BYSZEWSKI, J.A. GOMEZ, B. COLWELL
H. MUSKATT - DALE Engr. • S. VREELAND, R. HARDING, S. COCO,
R. WEISENREIDER - ROCHESTER BUREAU OF WATER

c. Persons Contacted (Including Address & Phone No.)

SANFORD VREELAND - SUPT. UPLAND WATER SUPPLY
10 FELIX ST. 716-334-4594 (RUSH RESERVOIR)
ROCHESTER N.Y. 14608

d. History:

Date Constructed 1905 - 1908 Date(s) Reconstructed ——

Designer UNKNOWN

Constructed By UNKNOWN

Owner CITY OF ROCHESTER BUREAU OF WATER.

93-15-3(9/80)

2) Embankment

a. Characteristics

(1) Embankment Material UNKNOWN

(2) Cutoff Type NONE

(3) Impervious Core NONE

(4) Internal Drainage System NONE

(5) Miscellaneous THE IMPOUNDING STRUCTURE CONSISTS OF A CONCRETE RETAINING WALL STRUCTURE WITH AN EARTH FILL BACKUP SECTION. THE FLOOR OF THE RESERVOIR IS CONCRETE

b. Crest

(1) Vertical Alignment NO MISALIGNMENT OBSERVED

(2) Horizontal Alignment NO MISALIGNMENT OBSERVED

(3) Surface Cracks NONE OBSERVED (LIGHT SNOW COVER AT TIME OF INSPECTION)

(4) Miscellaneous CONCRETE WALKWAY AROUND ENTIRE PERIMETER OF RESERVOIR

c. Upstream Slope

(1) Slope (Estimate) (V:H) 4:1 CONCRETE

(2) Undesirable Growth or Debris, Animal Burrows N/A

(3) Sloughing, Subsidence or Depressions WALL SHOWS NO SIGN OF DISPLACEMENT CONCRETE SURFACE SPALLING THROUGHOUT. MODERATE.

(1) Erosion at Contact N/A

(2) Seepage Along Contact N/A.

3) Drainage System

a. Description of System

Pipes extend from underneath Reservoir slab up into inspection tunnel

b. Condition of System Unknown. Apparently not operating at time of inspection.

c. Discharge from Drainage System None at time of inspection.

4) Instrumentation (Momumentation/Surveys, Observation Wells, Weirs, Piezometers, Etc.) NONE

93-15-3(9/80)

5) Reservoir

a. Slopes N/A - DESCRIBED IN 2.)

b. Sedimentation INSIGNIFICANT - POTABLE WATER

c. Unusual Conditions Which Affect Dam NONE NOTED

6) Area Downstream of Dam

a. Downstream Hazard (No. of Homes, Highways, etc.) THE DAM IS LOCATED IN A DENSELY DEVELOPED RESIDENTIAL AREA INSIDE THE CITY OF ROCHESTER

b. Seepage, Unusual Growth ONE SMALL AREA OF SEEPAGE AT TOE OF NORTHERLY SLOPE. (SUSPECTED TO BE SANITARY SEWAGE FROM NEARBY BUILDING.)

c. Evidence of Movement Beyond Toe of Dam NONE OBSERVED

d. Condition of Downstream Channel N/A

7) Spillway(s) (Including Discharge Conveyance Channel)

OVERFLOW WEIR IN GATEHOUSE CONNECTS FLOW TO AN OVERFLOW LINE TO THE CITY STORM DRAIN SYSTEM.

a. General ↗

b. Condition of Service Spillway SYSTEM IS IN GOOD CONDITION, WELL MAINTAINED.

93-15-3(9/80)

c. Condition of Auxiliary Spillway N/A

d. Condition of Discharge Conveyance Channel N/A

8) Reservoir Drain/Outlet

Type: Pipe 16" Conduit ______ Other ______

Material: Concrete ______ Metal CAST IRON Other ______

Size: 16" Length 530 + 230 + 330 = 1090 ft.

Invert Elevations: Entrance 609.83 Exit 524.18

Physical Condition (Describe): Unobservable ✓

Material: CAST IRON

Joints: — Alignment —

Structural Integrity: REPUTED TO BE OPERATING SATISFACTORILY

Hydraulic Capability: ______

Means of Control: Gate ✓ Valve ______ Uncontrolled ______

Operation: Operable ✓ Inoperable ______ Other ______

Present Condition (Describe): WELL MAINTAINED.

93-15-3(9/80)

9) Structural

a. Concrete Surfaces Exposed surfaces on interior slope of reservoir are spalled and show signs of surface cracking. Spalling is mostly confined to waterline area, with some spalled areas to 1 foot deep. Surfaces inside tunnel generally in good condition. Reservoir side of interior showed more signs of deterioration than side away from reservoir

b. Structural Cracking Shotcrete patching of slope to reservoir showed signs of cracking. None observed in inspection tunnel.

c. Movement - Horizontal & Vertical Alignment (Settlement) No apparent movement noted

d. Junctions with Abutments or Embankments N/A

e. Drains - Foundation, Joint, Face N/A

f. Water Passages, Conduits, Sluices N/A

g. Seepage or Leakage No leakage or seepage except at joints. Only significant leakage between monoliths 15&16 inside inspection tunnel (see next page)

h. Joints - Construction, etc. SOME MINOR LEAKAGE IN CONSTRUCTION JOINTS IN INSPECTION TUNNEL, CALCIUM DEPOSITS FOUND AT MOST JOINTS. FLOWING LEAKAGE AT JOINT BETWEEN MONOLITHS 15 & 16. MODERATE AMOUNT, 1 GAL/MIN MAXIMUM

i. Foundation N/A.

j. Abutments N/A

k. Control Gates ALL IN OPERATING CONDITION

l. Approach & Outlet Channels N/A

m. Energy Dissipators (Plunge Pool, etc.) N/A.

n. Intake Structures CONCRETE SPALLED AT WATER LINE OF GATEHOUSE.

o. Stability NO SIGNS OF INSTABILITY WERE OBSERVED.

p. Miscellaneous N/A

10) Appurtenant Structures (Power House, Lock, Gatehouse, Other)

a. Description and Condition

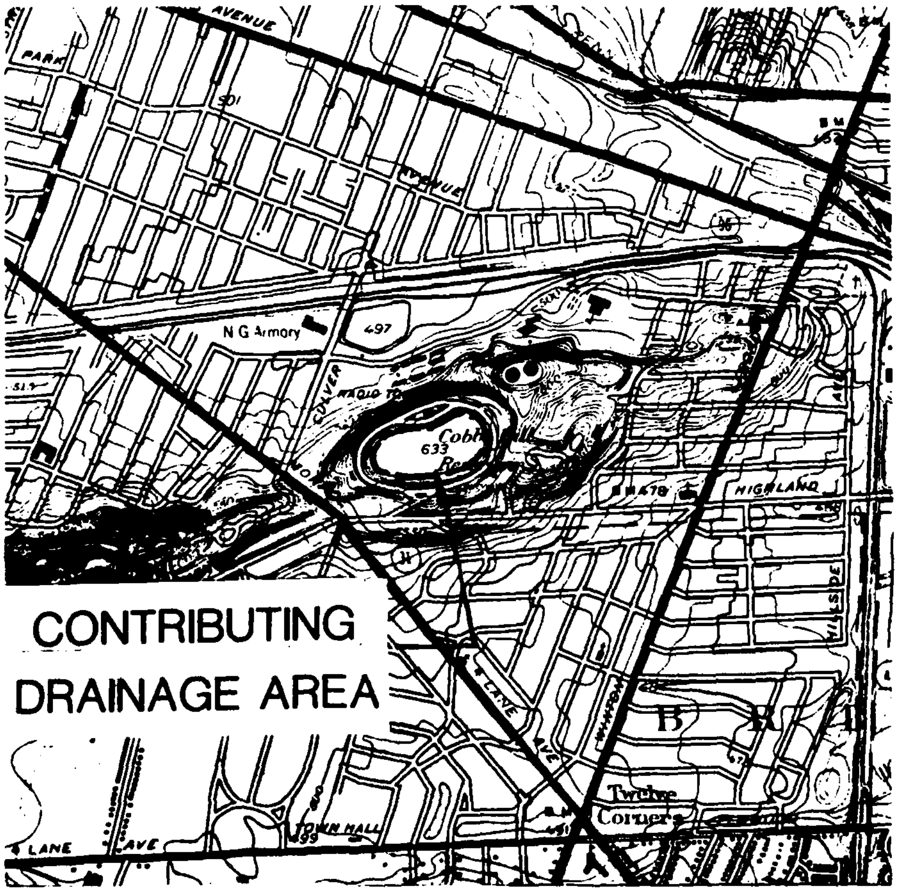
MINOR CRACKING OF WALLS AND STRUTS IN INTAKE VALVE ROOM. SOME CRACKING OF CEILING PLASTER. SKYLIGHT IN POOR CONDITION

11) Operation Procedures (Lake Level Regulation):

WATER IS FED INTO THE RESERVOIR FROM THE SOURCE AT HEMLOCK LAKE. WATER LEVELS ARE MONITORED ON A 24 HOUR BASIS BY THE SYSTEM DISPATCHER THROUGH TELEMETERED LEVEL RECORDERS. IMMEDIATE ACTION IS TAKEN TO AVOID DISCHARGE FROM OVERFLOW WEIRS. ON SITE INSPECTION OF WATER LEVEL IS PROVIDED TWICE DAILY. NO EMERGENCY WARNING OR EVACUATION PLAN IS IN EFFECT.

APPENDIX C

HYDROLOGIC/HYDRAULIC, ENGINEERING DATA AND COMPUTATIONS



LEGEND

— — — WATERSHED AREA
— — — SUB AREA

SCALE: 1" = 2000'

DRAINAGE BASIN

STETSON • DALE BANKERS TRUST BUILDING UTICA • NEW YORK • 13501 TEL 315-797-5800 **DESIGN BRIEF**

PROJECT NAME N.Y.S. Dam Inspections 1981 DATE 12-19-80

SUBJECT Cobbs Hill Reservoir Dam, ID # 1448 PROJECT NO. 2520

Depth-Area-Duration DRAWN BY JAG

PMP from HMR # 33
for Lat. ~ 43°08' Long. ~ 77° 34'
Index Rainfall = 21.5" for 200 mi², 24 hr
Zone 2

Duration	% Index*	Depth
6 hrs.	117	25.2"
12 hrs.	127	27.3
24 hrs	141	30.3
48 hrs	151	32.5

* Adjusted for site area (these are adjusted for 10 mi², the lower limit of the areal adjustment graph)

STETSON • DALE BANKERS TRUST BUILDING UTICA • NEW YORK • 13501 TEL 315-797-5800 **DESIGN BRIEF**

PROJECT NAME N.Y.S. Dam Inspections 1981 DATE [illegible] 81

SUBJECT Cobbs Hill Reservoir PROJECT NO. 2520

Overflow Spillway Capacity DRAWN BY JAG

Spillway Length = 12.5'
Spillway Width = 3" Broad crested weir

Crest Elevation = 639
Top of Embankment @ Elev. 643
Freeboard @ Spillway Pool = 4'

From King & Brater - "Handbook of Hydraulics"
Table 5-3
C = 3.32 for H = 4'

$$Q = C L H^{3/2}$$

for H = 4'

$$Q = 3.32 (12.5') (4')^{3/2}$$

$$\underline{\underline{Q = 330 \text{ cfs}}}$$

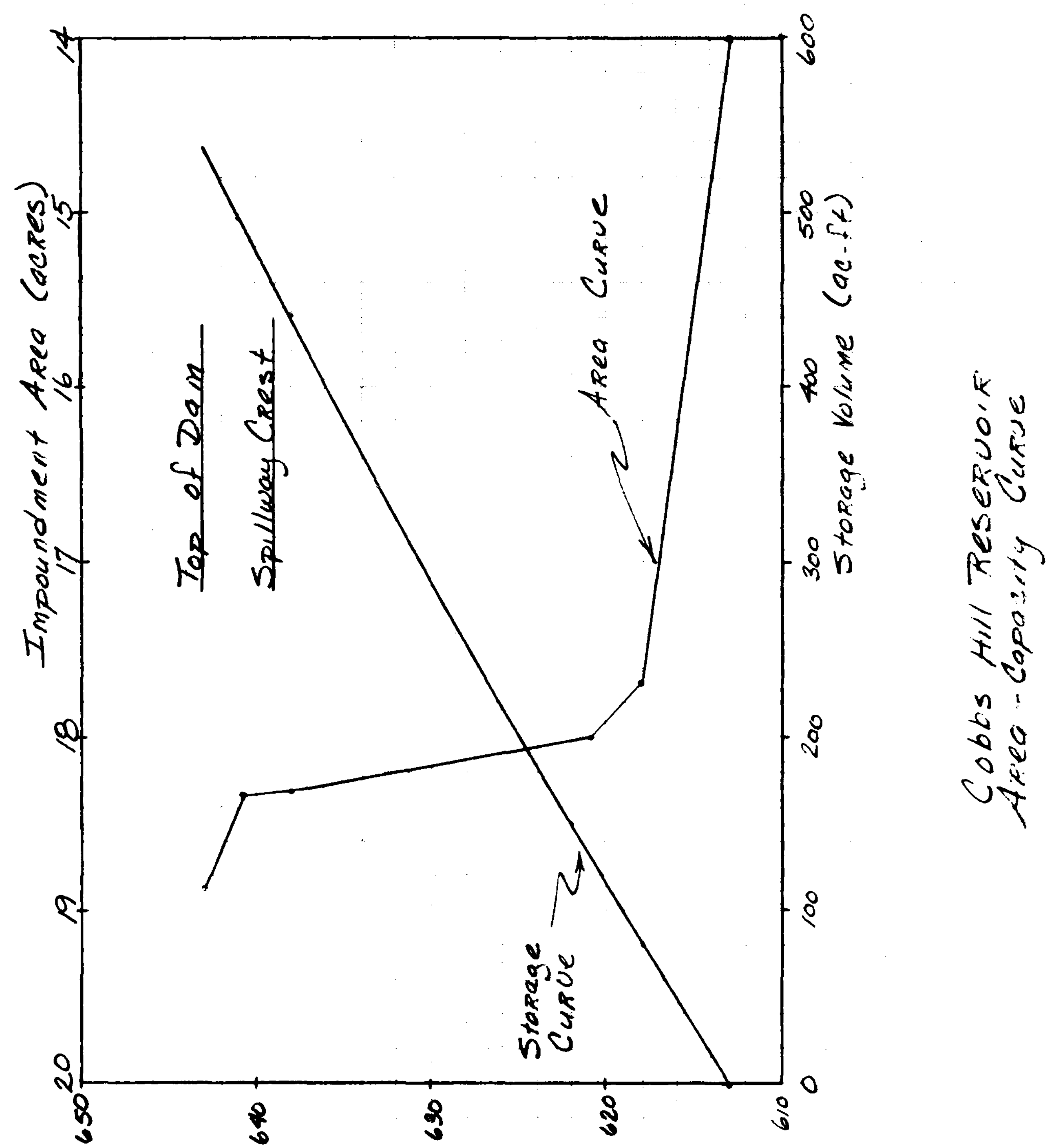
STETSON • DALE BANKERS TRUST BUILDING UTICA • NEW YORK • 13501 TEL 315•797•5800

DESIGN BRIEF

PROJECT NAME N. Y. S. Dam Inspections DATE 1-15-81

SUBJECT Cobbs Hill Reservoir PROJECT NO.

Area - Capacity Curve DRAWN BY



STETSON • DALE BANKERS TRUST BUILDING UTICA • NEW YORK • 13501 TEL 315-797-5800 DESIGN BRIEF

PROJECT NAME N.Y.S. Dam Inspections 1981 DATE 1-15-81
SUBJECT Cobbs Hill Reservoir PROJECT NO.
DRAWN BY

Drainage Area = 19.0 acres

Storage Volume @ 639 (spillway crest) = 460 ac-ft
Storage Volume @ 643 (Top of Embankment) = 535 ac-ft

Surcharge Storage = 75 ac-ft

Equivalent Runoff = $\frac{75 \text{ ac-ft}}{19 \text{ ac}}$ = 3.94' = 47"

COBBS MILL RESERVOIR
NY # 1448

CHECK LIST FOR DAMS
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

AREA-CAPACITY DATA:

	Elevation (ft.)	Surface Area (acres)	Storage Capacity (acre-ft.)
1) Top of Dam	643	—	535
2) ~~Design High Water~~ (~~Max. Design Pool~~) Normal Pool	638	18.3	442
3) Auxiliary Spillway Crest	N/A		
4) Pool Level with Flashboards	N/A		
5) Service Spillway Crest	639	—	460

DISCHARGES

	Volume (cfs)
1) Average Daily	20 MGD
2) Spillway @ Maximum High Water	330
3) Spillway @ Design High Water	N/A
4) Spillway @ Auxiliary Spillway Crest Elevation	N/A
5) Low Level Outlet	Through water supply transmission lines
6) Total (of all facilities) @ Maximum High Water	Unknown
7) Maximum Known Flood	Unknown
8) At Time of Inspection	Unknown

CREST: ELEVATION: 643

Type: Concrete retaining wall with earth backfill

Width: 22' Length: 3560

Spillover N/A

Location ______

SPILLWAY:

PRINCIPAL		EMERGENCY
N/A	Elevation	639
	Type	Broad crested weir
	Width	12.5'
	Type of Control	
	Uncontrolled	✓
	Controlled:	
	Type (Flashboards; gate)	(provision for stop log, but not used)
	Number	
	Size/Length	
	Invert Material	
	Anticipated Length of operating service	
	Chute Length	
	Height Between Spillway Crest & Approach Channel Invert (Weir Flow)	

HYDROMETEROLOGICAL GAGES:

Type : Water level gage

Location: Gate house

Records:

Date -

Max. Reading - Unknown - Never Known to top Reservoir embankment

FLOOD WATER CONTROL SYSTEM:

Warning System: Water level readings are taken on a 24 hr. basis and monitored by the system dispatcher through telemetered level indicators and Recorders.

Method of Controlled Releases (mechanisms):

Through the water supply system.

DRAINAGE AREA: 19 acres

DRAINAGE BASIN RUNOFF CHARACTERISTICS:

Land Use - Type: Interior slopes of Reservoir

Terrain - Relief: fairly steep

Surface - Soil: concrete lined to the crest

Runoff Potential (existing or planned extensive alterations to existing (surface or subsurface conditions)

High Runoff Potential

Potential Sedimentation problem areas (natural or man-made; present or future)

None Known

Potential Backwater problem areas for levels at maximum storage capacity including surcharge storage:

N/A

Dikes - Floodwalls (overflow & non-overflow) - Low reaches along the Reservoir perimeter:

Location: no low areas

Elevation:

Reservoir:

Length @ Maximum Pool 0.27± (Miles)

Length of Shoreline (@ Spillway Crest) 0.7± (Miles)

APPENDIX D

REFERENCES

APPENDIX

REFERENCES

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7. J.T. Riedel, J.F. Appleby and R.W. Schloemer: Hydrometeorological Report No. 33, U.S. Department of Commerce, U.S. Department of Army, Corps of Engineers, Washington, D.C., April 1956. Available from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C.

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12. C.A. Hartnagel, 1907, Geologic Map of the Rochester and Ontario Beach Quadrangles, New York State Museum Bulletin 114.

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APPENDIX E

PREVIOUS INSPECTION REPORTS/AVAILABLE DOCUMENTS

THE HISTORY OF THE ROCHESTER WATER WORKS

Prior to its incorporation in 1834 as a City, and for 40 years thereafter, Rochester, New York obtained its water supply from private wells and cisterns. A number of attempts were made during that time to organize and construct a unified public supply. The first water company was incorporated in 1835, only one year after the City had been created. This company expired a year later without having accomplished any construction. A second water company was incorporated in 1852. This company created considerable controversy by a proposal for the City to be a stockholder. After a number of attempts, the City finally withdrew.

The company struggled for twenty years. During this time, the City Council appointed a committee to study the various possible sources of water for a public supply. Eleven sources were evaluated. It is interesting to note that in comparison with Upland sources such as Hemlock Lake, Lake Ontario was not chosen, not so much because of the quality of the water, but because of the cost of pumping from Lake Ontario elevation to the City which was some 200 feet higher in elevation and the fact that the technology of the day for intake construction required a tunnel, which in turn required a rock formation under the lake which was not available very close to Rochester. Apparently, technology for laying a pipe intake on the lake bottom was not sufficiently developed at that time. After a number of delays, this company did commence construction on July 2, 1867. Prior to going bankrupt in 1872, this company laid approximately 8 and 1/2 miles of pipe within the City, ranging in size from 16 inch to 6 inch. It also installed 33 hydrants. These facilities were acquired by the City and incorporated into the City's water system in 1882; therefore, part of the existing system may be well over 100 years old. This company had planned on using Hemlock Lake as a source of supply. It did construct a reservoir which can still be seen on the West side of Route 15A, just south of the New York thruway. It also constructed the wood stave pipe from this reservoir to the City line. Thru an oversight, no air release valves were installed on this wood stave pipe and when an attempt was made to fill it, the air pockets in the high points made the line inoperable. The leakage was so great from this wood stave pipe that it was not deemed worthwhile to install the air release valves. The failure of this transmission line probably became a large factor in the company's ultimate bankruptcy. A third water company was planned in 1872, but failed in organization.

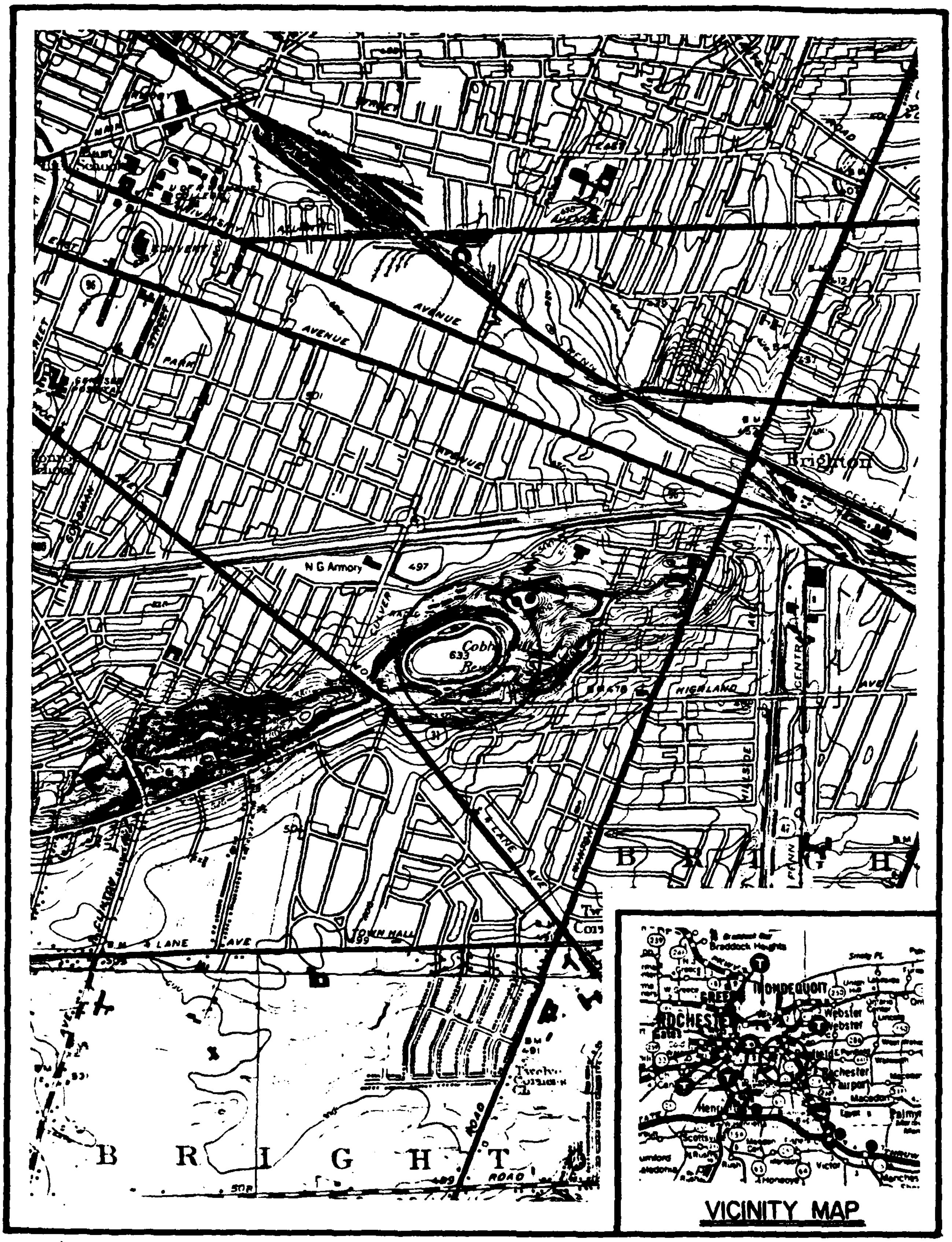
The State Legislature finally resolved the problem of a water supply, by an act which required the Mayor to appoint a water commission, which in turn was required to provide a plan and estimate to the Mayor. When approved by the Mayor, the commissioners were then directed to proceed with their plans and were impowered to borrow the necessary money for the work. City Council was ignored, except that it was ordered to pay all expenses incurred by the commissioners. This disregard for the City Council obviously led to considerable dispute and hostility toward water works commissioners. In spite of the debates and opposition, the commission did persist and succeeded in creating the original Rochester Water Works System. They proceeded to employ J. Nelson Tubbs as Chief Engineer. Tubbs was described in the following manner, "While thoroughly versed in the science of his profession, he never hesitated to set formulas, and formulated methods at defiance when his own genious has dictated a better way or a larger result." He was described in 1876 by the commissioners as genial in intercourse, patient under trials and disappointments, cool and undaunted in the presence of difficulties, clear in judgment, accurate in detail, rarely mistaken in his estimate of results, of strict integrity, firm in purpose, and of remarkable executive ability. A few years later, in 1890, Mr. Tubbs was requested to resign because the conduit from Hemlock Lake was not delivering as muchwateras someone thought it should. Mr. Tubbs employed Emil Kuichlin as an assistant engineer. Mr. Kuichling was a graduate of the University of Rochester with degrees in arts and engineering. He later graduated from the Polytechnic School at Carlsruhe, Germany with a degree in Civil Engineering. His attitude was considered to be less in defiance of set formulas and formulated methods. On July 15, 1872, the Mayor approved plans submitted by Tubbs and Kuichling. These called for two water systems instead of one. A fire-fighting system with a separate distribution grid would take its supply from the Genesee River. The other system, for domestic and industrial purposes, would take its supply from Hemlock Lake. A contract for pumping equipment for the fire-fighting system included water turbines and steam engines and was awarded to the Holly Manufacturing Company of Lockport on February 27, 1873. This water system became known as the Holly System, a title which has survived to this date. Work on the Holly and domestic systems proceeded simultaneously. The Holly Pump Station was constructed rapidly and on February 18, 1874, Tubbs demonstrated the capabilities of the Holly System in a most spectacular manner which was befitting his personality. One phase of the test consisted in operating fourteen fire streams at once, while changing the pumps from water power to steam without noticeable affect. The heights of these streams varied from 131 to 152 feet. Another phase demonstrated the simultaneous discharge of 30 fire streams. The pump pressure was 135 psi and the total discharge rate was 8,220 gallons per minute. Another phase demonstrated a four inch vertical stream to a height of almost 295 feet. This discharged 4,938 gallons per minute at a pump pressure of 175 psi. Another phase demonstrated a five inch vertical stream to an elevation of 257 feet, at a discharge rate of 6,463 gallons per minute, with a pump pressure of 140 psi. This demonstration delighted the spectators, and any doubt as to the wisdom of a public water supply was instantly dispelled. The original domestic system consisted of an intake facility at Hemlock Lake and a conduit from the lake to the City. This conduit consisted in part of 36 inch riveted wrought iron and, closer to the City, of 24 inch cast iron pipe. This was a considerable project. It required a ditch about 5 feet wide and 6 to 15 feet deep and 26 miles long. This had to be constructed without power equipment. It is said that the work force consisted of 700 to 900 men quartered in field camps and laboring for two years. An equalizing reservoir was constructed at Rush, New York with a capacity of 63 million gallons. A distribution reservoir was also constructed in Highland Park, then known as Mt. Hope, with a capacity of 26 million gallons. Hemlock Lake's elevation was 905, Rush 751, and Highland 638 feet U.S.G.S. This provided adequate head for gravity flows. The capacity of the original system completed in 1874 was soon inadequate, due to increased consumption within the City and some deterioration of the flow capacity of the conduit system. Therefore, a new conduit was authorized and construction began in 1894. This included a new intake and Gate House and a 6 foot brick tunnel from the Gate House to a point about 13,000 feet towards the City. The original intake in Conduit I from the lake to the northern terminus of this tunnel have since been abandoned. The Cobbs Hill Reservoir, with a capacity of 144 million gallons at the same elevation as Highland Reservoir was constructed between 1905 and 1908. These three reservoirs therefore provide a capacity of 234 million gallons of storage. This is a very generous supply, compared with our average day use of approximately 52 million gallons. In 1914, a third conduit was required. This paralleled Conduit II. Whereas Conduit II had been constructed of riveted steel and cast iron in a 38 inch diameter, Conduit III was 37 inches in diameter, partly steel and partly cast iron. Canadice Lake, at elevation 1,099 U.S.G.S., with 2 billion gallons usable capacity, was added to the system in 1919. This water is released into Hemlock Lake, as required. The conduit system that resulted was fairly complex. The three conduits were interconnected in a number of places and valves could isolate sections and direct the flow between the conduits. After the tunnel was completed to the north of Hemlock Lake and after Conduit I was abandoned in the same area, there was only one facility to supply water from Hemlock to the end of the tunnel, known as overflow number one. This was used continuously from 1894 until 1965. At this time, a pump station and 36 inch bypass line were constructed, so that the tunnel could be inspected and so that there would be an alternate supply in case of a failure of the tunnel. Upon inspection, the tunnel was found to be in excellent conditions.

As early as 1926, it became apparent that an additional supply would soon be needed. Various sources were evaluated. The urgency waxed and waned. A number of schemes were developed for increasing the supply from Upland sources. There was a very strong public resistance to using Lake Ontario. Representatives of the State Health Department finally resolved the controversies. They pointed out that their approval would be necessary before any additional construction could begin and that their evaluation would include the adequacy of supply, as well as the quality, and it was evident that difficulties would arise in providing a supply from Upland sources that would be adequate for any lengthy period of time in the future. Finally, construction began in 1952 on a treatment plant at Lake Ontario, in a booster station on Mt. Read Blvd. near Ridge Road, designed to provide an additional supply of 36 million gallons a day. Raw water was obtained from Lake Ontario thru Eastman Kodak's intake line. This system was completed in 1955. The Monroe County Water Authority constructed a new intake line in 1963. At that time, the City contracted with them for a joint ownership so that the City is entitled to 40 million gallons a day from this intake line. A low lift pump station was later constructed adjacent to the intake, and in 1965 our pumps were removed from the Kodak intake and our supply line was reconnected to our new low lift pump station and our Lake Ontario supply system was complete. The original Holly Pump Station was electrified and remodeled. However, it is now obsolete and in need of extensive repair work. Construction of a new modern Holly Pump Station has now been authorized and the design is under way.

The Rochester Water Works has a heritage of good design and construction. It now consists of about 690 miles of pipe, 7,000 hydrants, 25,000 valves, and 60,000 meters. Incidentally, it is interesting to note that the City was 100 percent metered by 1926. The Hemlock system provides a peak capacity of 48 million gallons a day and an average capacity of 31 million gallons a day. This combined with the Lake Ontario supply of 36 million gallons a day, provides an adequate reserve. We are justly proud of this enviable water system which will soon be 100 years old.

APPENDIX F

DRAWINGS



LOCATION PLAN

FIGURE 1

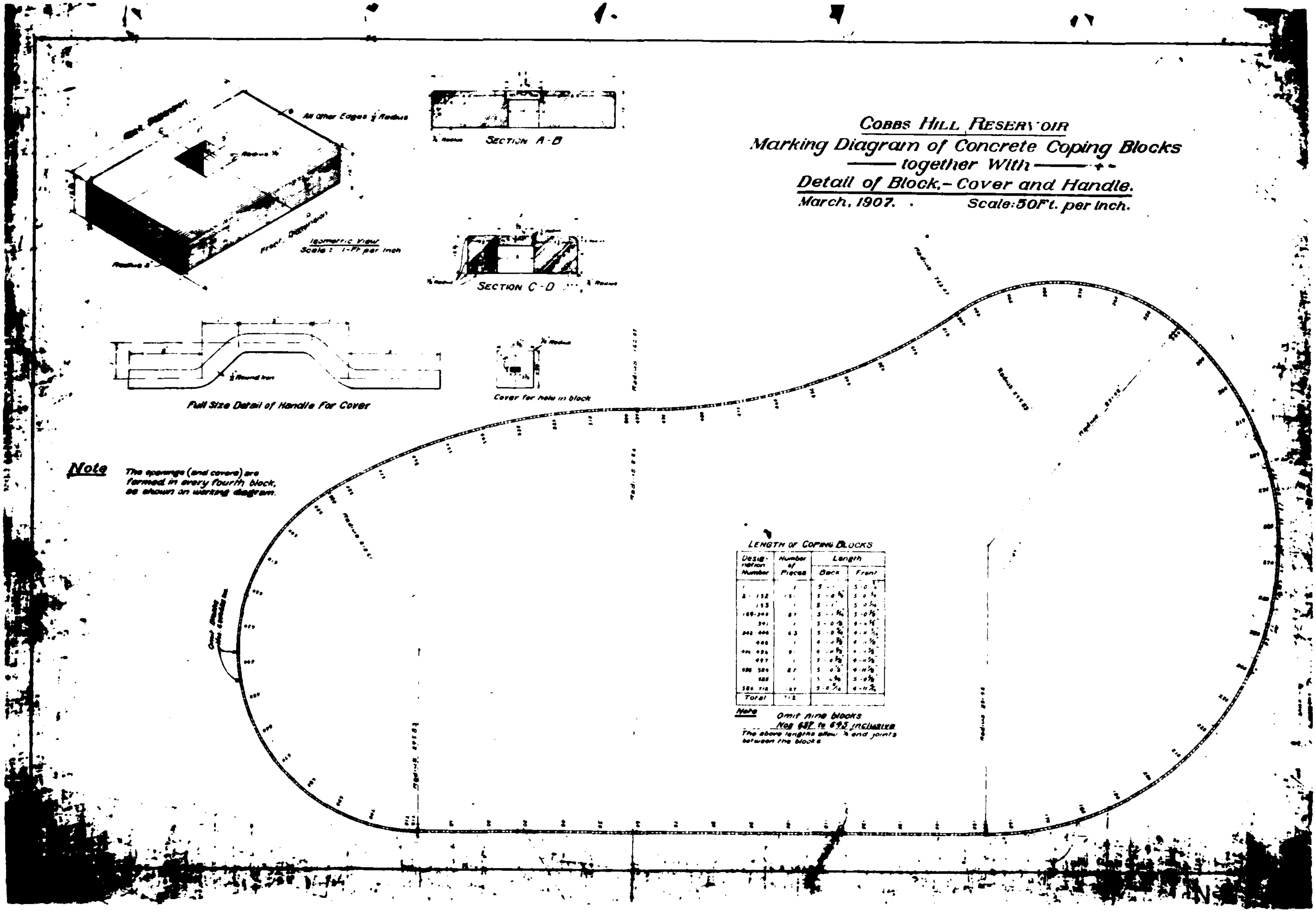

Cobbs Hill Reservoir
Marking Diagram of Concrete Coping Blocks
together With
Detail of Block,- Cover and Handle.
March, 1907.
Scale: 50 Ft. per inch.
All other Edges ½ Radius
Isometric View
Section A-B
Section C-D
Full Size Detail of Handle For Cover
Cover for hole in block
Note
The openings (and covers) are formed in every fourth block, as shown on working diagram.
Length of Coping Blocks
Omit nine blocks
Nos 687 to 695 inclusive
The above lengths allow ¼ end joints between the blocks

FIGURE 2

CITY OF ROCHESTER
DEPARTMENT OF ENGINEERING
COBBS HILL RESERVOIR
Section Exhibiting Construction of Embankment, Retaining Wall, and Lining of Bottom.
October 1910. Scale: 2 Ft. per In.

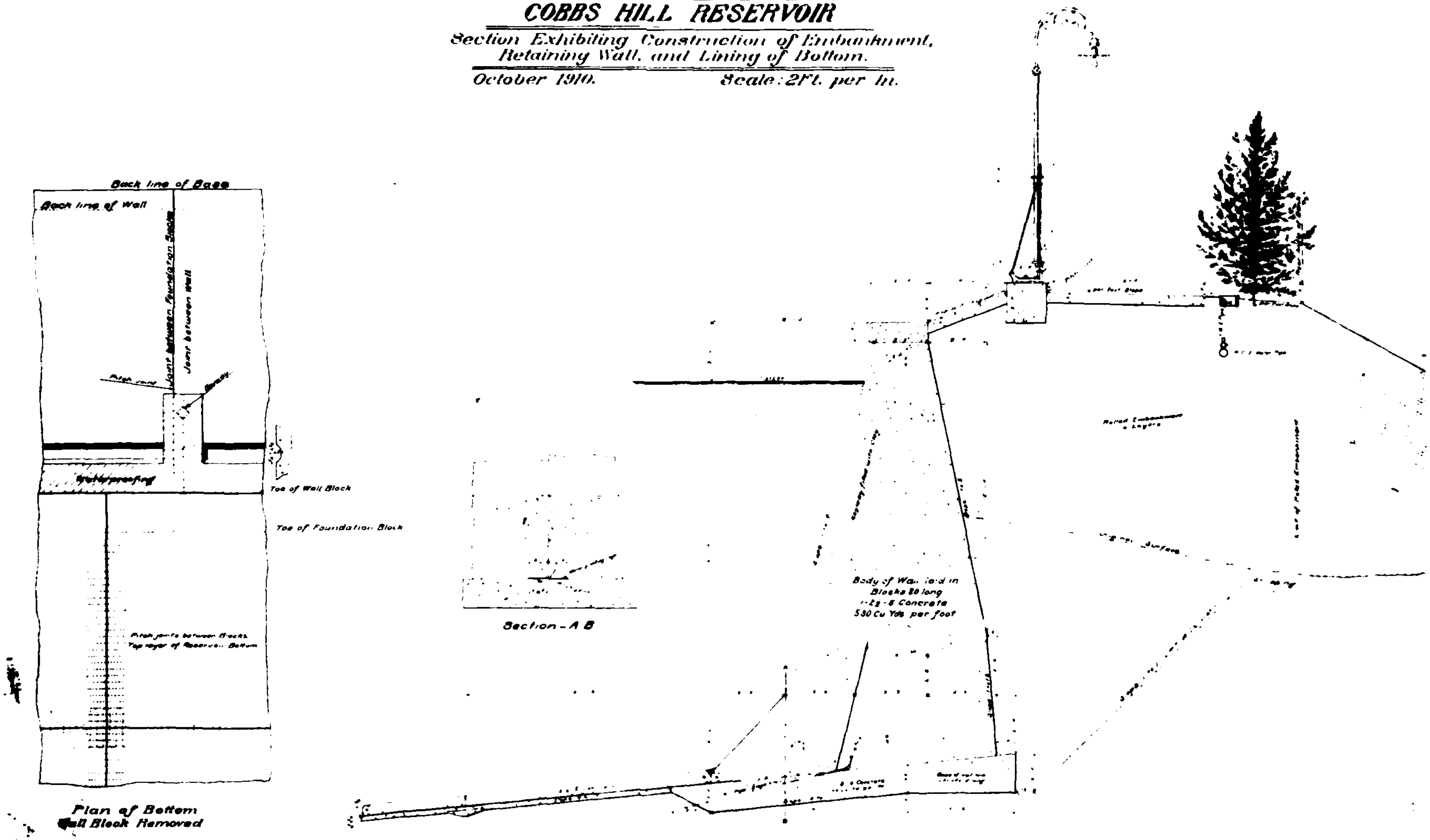


FIGURE 3

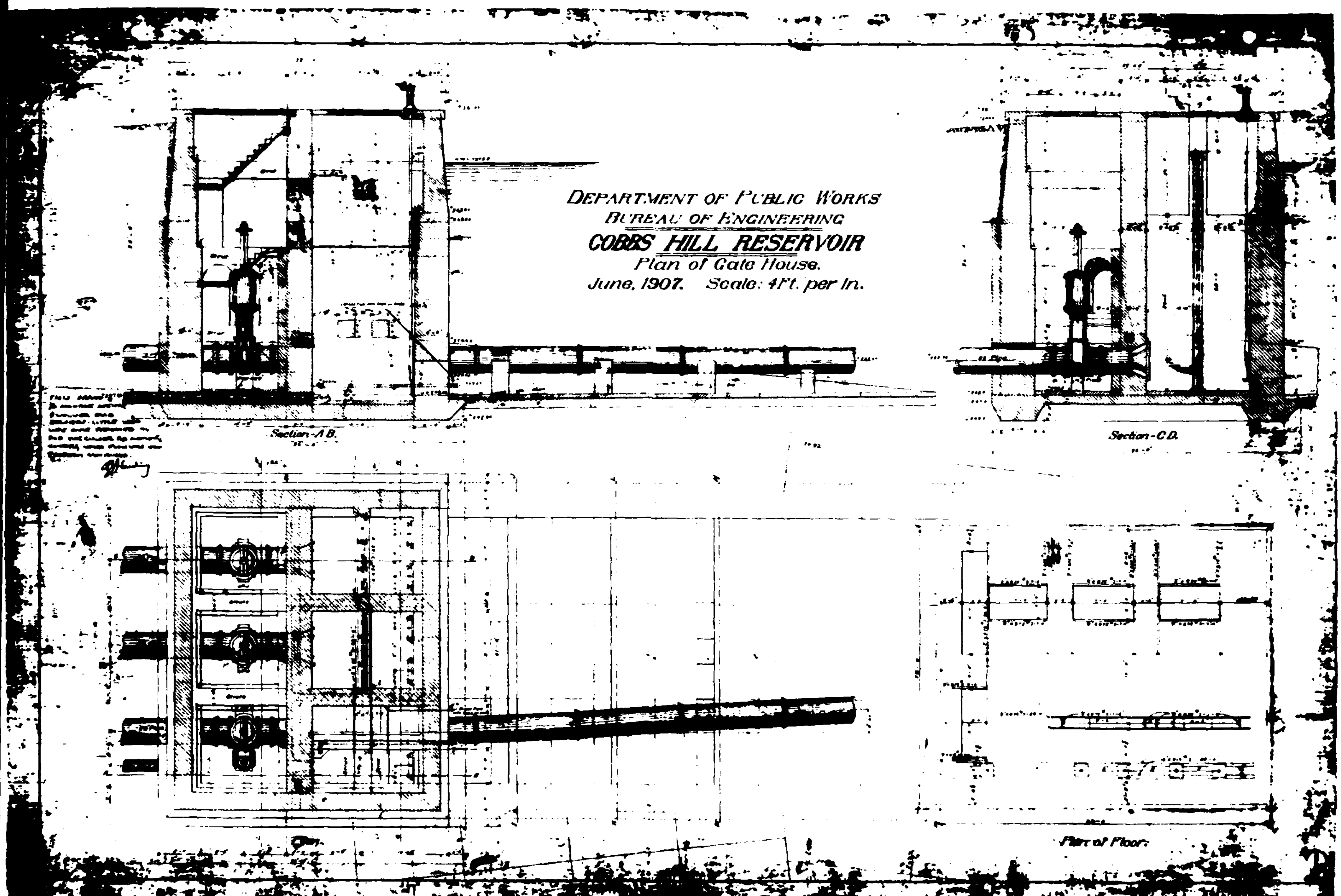

DEPARTMENT OF PUBLIC WORKS
BUREAU OF ENGINEERING
COBBS HILL RESERVOIR
Plan of Gate House.
June, 1907. Scale: 4 Ft. per In.
Section-A.B.
Section-C.D.
Plan.
Plan of Floor.

FIGURE 4

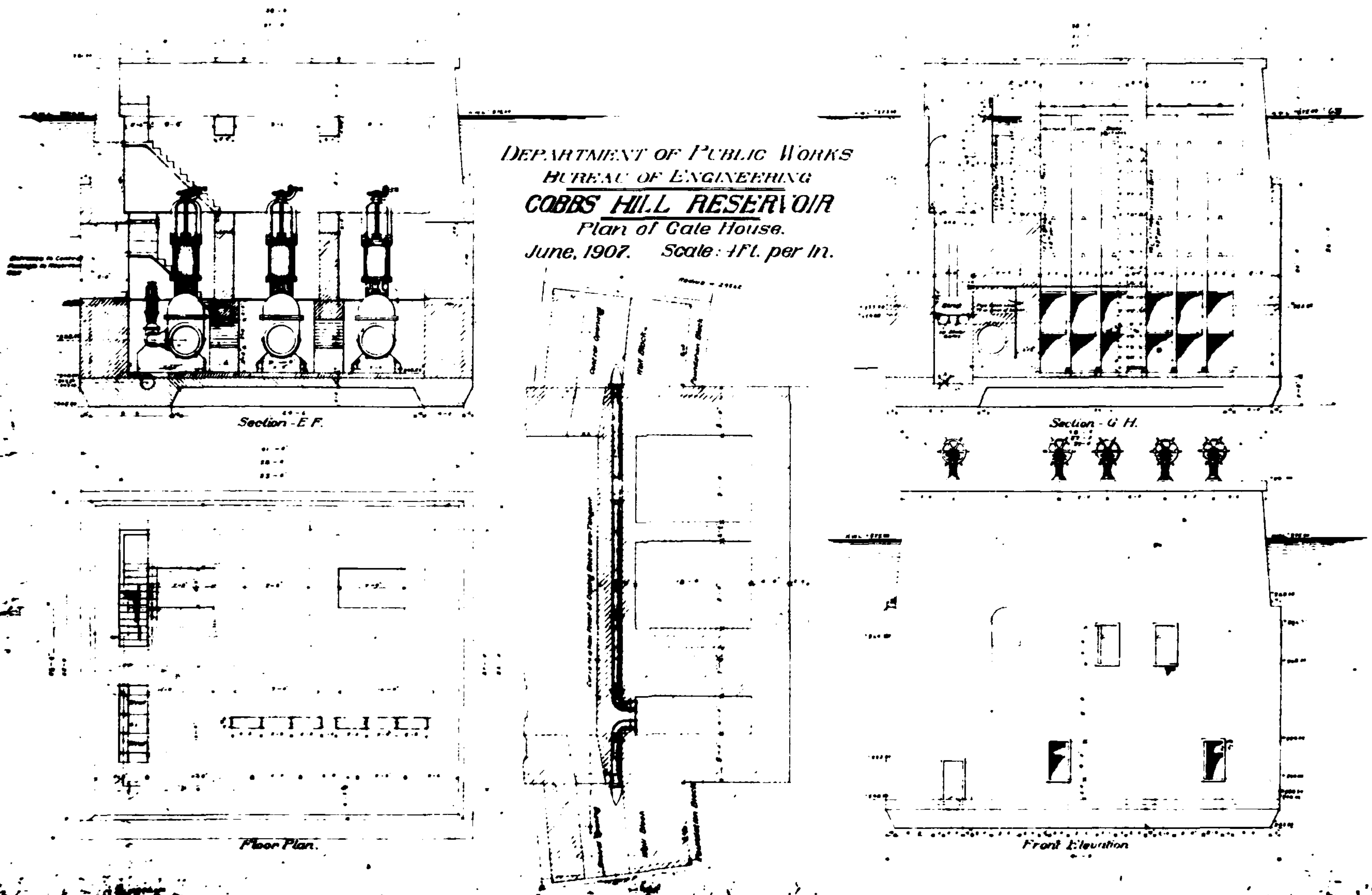

DEPARTMENT OF PUBLIC WORKS
BUREAU OF ENGINEERING
COBBS HILL RESERVOIR
Plan of Gate House.
June, 1907. Scale: 4 Ft. per In.
Section - E F.
Section - G H.
Floor Plan.
Front Elevation

FIGURE 5

DA

FIL