

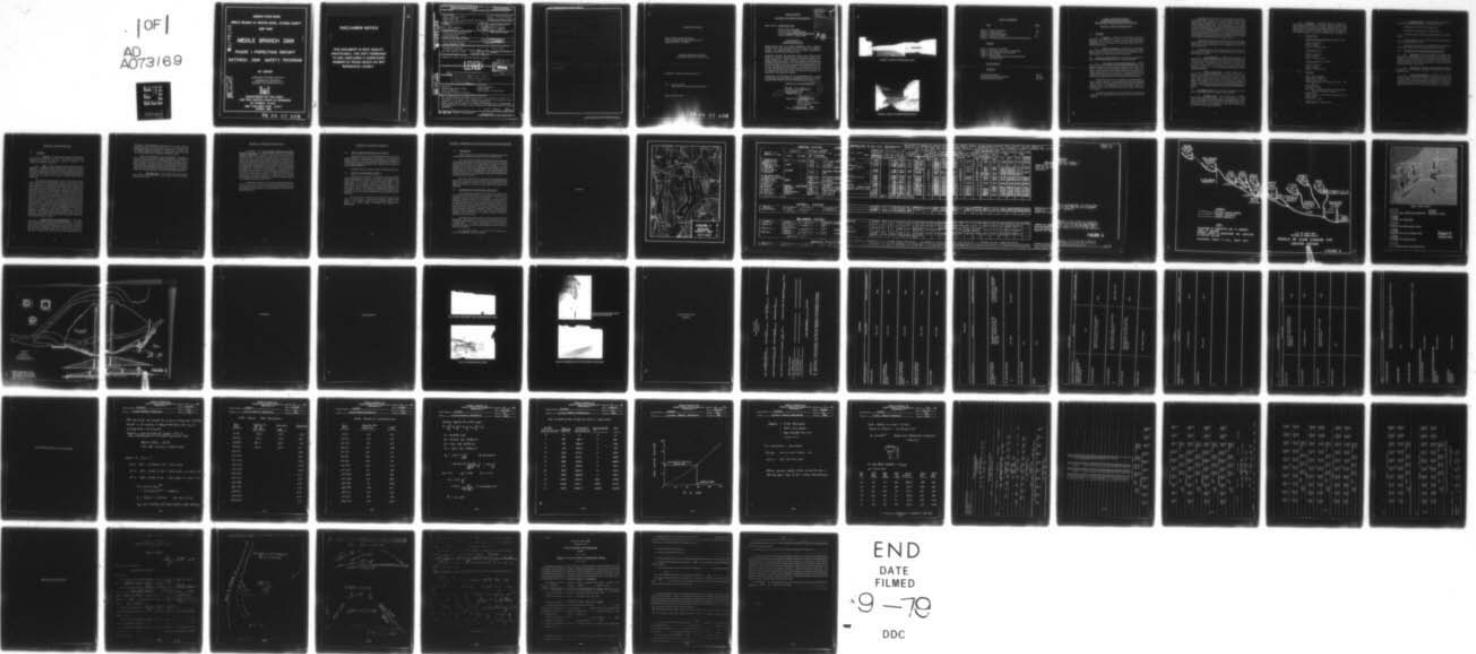
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NEW YORK STATE DEPT OF ENVIRONMENTAL CONSERVATION ALBANY F/G 13/2  
NATIONAL DAM SAFETY PROGRAM. MIDDLE BRANCH DAM (NY 00034), HUDS--ETC(U)  
SEP 78 J J WILLIAMS DACW51-78-C-0035

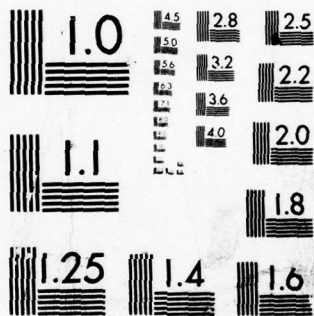
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HUDSON RIVER BASIN

MIDDLE BRANCH OF CROTON RIVER, PUTNAM COUNTY

NEW YORK

# MIDDLE BRANCH DAM

## PHASE I INSPECTION REPORT

### NATIONAL DAM SAFETY PROGRAM

ADAC 73169

NY 00034

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DEPARTMENT OF THE ARMY  
NEW YORK DISTRICT, CORPS OF ENGINEERS  
26 FEDERAL PLAZA  
NEW YORK, NEW YORK 10007  
AUGUST 1978

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REPORT DOCUMENTATION PAGE

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1. REPORT NUMBER		2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Inspection Report Middle Branch Dam Hudson River Basin, Putnam County, New York Inventory No. N.Y. 34		5. TYPE OF REPORT & PERIOD COVERED Phase I Inspection Report National Dam Safety Program	
7. AUTHOR(s) John J. Williams / P.E.		6. CONTRACT OR GRANT NUMBER(s) DACW-51-78-C-0035	
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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. Middle Branch Dam was judged to be unsafe, non-emergency due to seepage and saturated ground at junction of west abutment and downstream slope of the earth embankment.			

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REPORT DOCUMENTATION PAGE

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2. GOVT ACCESSION NO.	
3. PERFORMING ORG. REPORT NUMBER	Phase I Inspection Report Middle Branch Dam Hudson River Basin, Putnam County, New York Inventory No. N.Y. 74
4. AUTHORING ORG. REPORT NUMBER	
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HUDSON RIVER BASIN

Name of Dam: Middle Branch Dam  
County and State: Putnam County, New York  
Inventory Number: NY 00034

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM

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Prepared by: O'Brien & Gere Engineers, Inc.

For: New York State  
Department of Environmental Conservation

Date: August 17, 1978

79 08 27 028



PHASE I REPORT  
NATIONAL DAM INSPECTION PROGRAM

Name of Dam: Middle Branch Dam

State Located: New York  
County Located: Putnam County  
Stream: Middle Branch of the Croton River  
Date of Inspection: July 17, 1978

Accession For	
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Unannounced	<input type="checkbox"/>
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By _____	
Distribution/	
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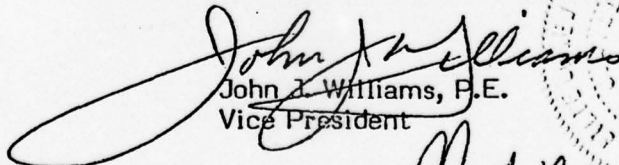
ASSESSMENT OF  
GENERAL CONDITIONS

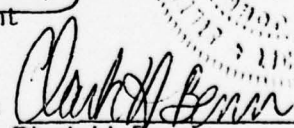
Middle Branch Dam is an earth embankment with a masonry corewall, about 615 feet long and 94 feet high at its maximum section. An ungated spillway and outlet channel, excavated in bedrock, are located west of the structure.

Significant seepage and saturated ground were noted at the junction of the west abutment and the downstream slope of the earth embankment. This condition should be monitored on a regular basis to determine if the flow increases or if discoloration and fines migration develop. The trees and brush growing on the downstream slope near the west abutment have a deleterious effect on the compacted earth embankment. This vegetation should be cut near the ground surface so that conditions of the abutment can be assessed, and the root systems of the trees investigated to determine if they should be removed.

Examination of the results of the hydrologic/hydraulic analysis indicates that the dam would be overtopped by all floods exceeding approximately 58 per cent of the Probable Maximum Flood.

O'BRIEN & GERE ENGINEERS, INC.

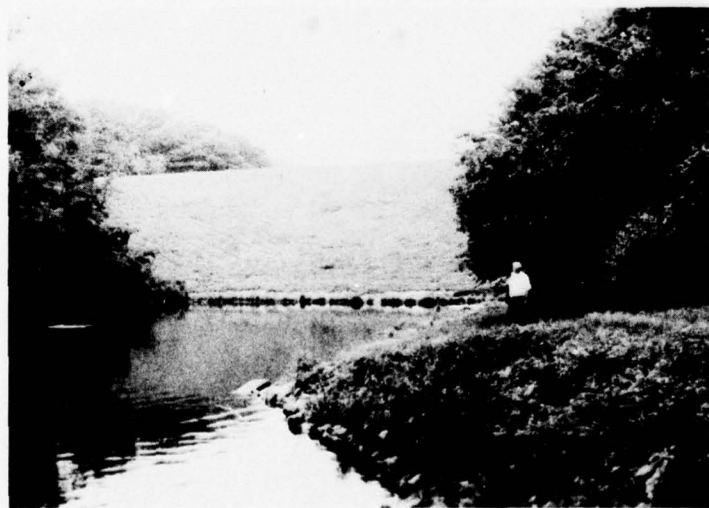
  
John A. Williams, P.E.  
Vice President

Approved by:   
Clark H. Benn  
Colonel, Corps of Engineers  
District Engineer

Date: 21 September 1978



OVERALL VIEW OF UPSTREAM SLOPE



OVERALL VIEW OF DOWNSTREAM SLOPE



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PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM  
NAME OF DAM MIDDLE BRANCH DAM ID# 00034

SECTION I - PROJECT INFORMATION

1.1 GENERAL

a. Authority - This report is authorized by the Dam Inspection Act, Public Law 92-367, and has been prepared in accordance with Contract #1467.021 between O'Brien and Gere Engineers, Inc. and the New York State Department of Environmental Conservation.

b. Purpose of Inspection - The purpose of this inspection is to evaluate the structural and hydraulic conditions of Middle Branch Dam and appurtenant structures, and to determine if the Dam constitutes a hazard to human life or property.

1.2 PROJECT DESCRIPTION (from information supplied by the New York City Department of Environmental Protection)

a. Description of Dam and Appurtenances - Middle Branch Reservoir is located in southeastern Putnam County and is about  $1\frac{1}{2}$  miles west of the Village of Brewster, New York. The dam is constructed across the Middle Branch of the Croton River which is also blocked by the Croton Falls Dam located about  $2\frac{1}{4}$  miles downstream and to the southwest. The upper reaches of the Croton Falls impoundment extends to the downstream toe of the Middle Branch Dam and forms the stilling pond for outlet works.

Middle Branch Dam is a homogeneous, earth embankment with a masonry corewall. The structure has a maximum height of about 94 feet, is approximately 615 feet long and has a top width of about 50 feet. The upstream face of the dam is about 4.5 horizontal to 1 vertical; the downstream slope is about 3 horizontal to 1 vertical.

The spillway, located west of the embankment, consists of a 100 feet wide ungated flat crested, cut stone weir and an outlet channel.

Discharge from the reservoir is accomplished through two uncontrolled inlets located in a stone masonry intake tower upstream of the embankment. The flow passes through a brick lined, horseshoe shaped tunnel (8 feet by 8 feet) to a vault which houses two 36 inch gate valves. Two conduits, housed in a similarly constructed tunnel, continue downstream and, after passing through a stone masonry gatehouse adjacent to the downstream toe of slope, the two pipes bifurcate to four 20 inch diameter pipes. These pipes continue about 120 feet to the stilling basin where each one terminates as a vertical fountain-type orifice. Refer to Figure 5 for a plan and section drawing of the outlet works.

Middle Branch Reservoir is part of the Croton Water Supply System; the Dam and Appurtenance Structures are owned by the City of New York and operated by the Department of Environmental Protection.

The Middle Branch Dam, originally called Tilly Foster, was designed by The Aqueduct Commissioners, City of New York and was completed in 1878.

b. Size Classification - Middle Branch Reservoir was designed for a storage volume of 4.005 billion gallons (12,300 acre-feet) at the maximum operating pool elevation of 371.55 feet mean sea level (MSL). The dam has a maximum height of 94 feet. Both of these criteria place the structure in the intermediate size category as defined by the Recommended Guidelines for Safety Inspection of Dams.

c. Hazard Classification - Middle Branch Dam is located about  $2\frac{1}{4}$  miles upstream of the Croton Falls Dam. A failure or overtopping of the Middle Branch structure would allow flood waters to discharge into the downstream reservoir. This might cause failure or overtopping of the Croton Falls Dam and result in the possible loss of many lives and extensive property damage. Therefore, the structure is in the high hazard category as defined by the Recommended Guidelines for Safety Inspection of Dams.

### 1.3 PERTINENT DATA (from information supplied by the City of New York, Department of Environmental Protection)

a. Drainage Area - The drainage area of Middle Branch Reservoir is 21.31 square miles. Lake Carmel is included within the drainage area and is located on the Middle Branch of the Croton River about 5 miles upstream of the Middle Branch Dam. The surface area of the reservoir at maximum operating pool (Elevation 371.55) is about 428.2 acres.



b. Discharges - Discharge from the reservoir is accomplished by means of two 36 inch manually operated gate valves located in the outlet gatehouse. Invert elevation of the outlet tunnel at the intake tower is 306.0 feet MSL. The maximum pool elevation of 375.55 feet MSL was recorded on October 16, 1955 and corresponds to a discharge of 2,640 cfs over the spillway.

c. Reservoir Data

Maximum Operating Pool (Reservoir at El. 371.55)

Length - 11,000 feet  
Area - 428 acres  
Volume - 12,300 acre-feet

Top of Dam (El. 380)

Length - 11,050 feet  
Area - 429 acres  
Volume - 16,150 acre-feet

Maximum Pool (PMF El. 382.75)

Length - 11,100 feet  
Area - 430 acres  
Volume - 17,100 acre-feet

d. Dam Data

Type - earth embankment  
Top Elevation - 380 feet  
Height - 94 feet (maximum)  
Streambed elevation at centerline of dam - 303 feet  
Length - 615 feet  
Top Width - 50 feet  
Side Slopes - upstream slope 4.5:1 (horizontal: vertical), downstream slope (3:1)  
Zoning - none  
Impervious Core - 8 feet thick masonry corewall  
Cutoff - none  
Grout Curtain - none

e. Outlet Works - See Section 1.2.a.

f. Engineering Data - The information available for review of Middle Branch Reservoir included the following:

- 1) Data Table - New York City Reservoirs,
- 2) Profile of Flow Diagram for Croton System,
- 3) Plan and Section Drawings of Dam, Spillway and Outlet Works,
- 4) Dam Report by the Conservation Commission, State of New York, dated August 6, 1915,
- 5) "Report of a Structure Impounding Water", State of New York, Department of State Engineer and Surveyor (undated).

#### 1.4 OPERATING AND MAINTENANCE PROCEDURES

a. Operation - Two 36 inch diameter drain pipes, used for drawdown are controlled by means of gate valves located in the gatehouse at the downstream toe. According to Mr. John Birrell, Section Engineer, New York City Department of Environmental Conservation, the valves are exercised every six months. Reservoir elevation readings are taken daily.

b. Maintenance of Dam and Operating Facilities According to Mr. Birrell, maintenance is performed on a "most needed" basis.

c. Flood Warning System - According to Mr. Birrell, inspection crews are placed on round the clock duty during periods of high runoff. Reservoir levels or unusual observations are reported to Mr. Birrell and the Deputy Chief Engineer. Mr. Birrell would contact local police and the Civil Defense for evacuation of downstream areas in the event of impending failure or overtopping.



## SECTION 2 - VISUAL INSPECTION

### 2.1 FINDINGS

a. General - The field inspection of the Middle Branch Dam took place on July 17, 1978. The reservoir water surface elevation was about 370 feet MSL during the inspection. No underwater areas were inspected.

b. Dam - The riprap protecting the upstream slope is composed of subangular stone ranging from 6 inches to 2 feet in diameter. A number of shallow depressions exist in the upstream slope protection giving the surface a gently undulating character. A copse of small trees and brush, on an otherwise clear slope, is growing at the junction of the riprap and grass near the west abutments.

The grass covering the upper portion of the upstream slope, crest of embankment and downstream slope is mowed a few times a year according to Mr. John Birrell, Section Engineer, New York City, Department of Environmental Protection. No misalignments were observed on the downstream slope. However, a large area of saturated ground and several springs discharging rust-colored water were noted along the west abutment. This wet condition extends from about 20 feet below the crest of the dam to the toe of the downstream slope and is characterized by a lush growth of trees and brush. The seepage has cut a channel which conducts the flow down the intersection between the downstream slope and natural valley abutment. The total visible discharge at the toe of slope was estimated to be about 0.5 cubic feet per second (cfs) at time of inspection. The eastern end of the downstream slope and abutment area is also covered with trees and underbrush but there is no evidence of seepage or wet ground conditions. The outlet gatehouse is constructed within the downstream slope at the east abutment. The riprap protecting the downstream toe consists of large, flat stones (1 to 3 feet in diameter). Some grass and bushes are growing between the stones.

c. Intake Tower and Appurtenances - The stone masonry of the intake tower is in very good condition. According to Mr. Birrell, there are stoplog slots for each of the two inlets in the tower; the access hatch to the interior of the tower was bolted down at time of inspection. Mr. Birrell stated that the valves in the vault have not been operable for twenty years and that an attempt to operate them a few years ago was unsuccessful. The

downstream outlet gatehouse appeared to be in good condition; however, one of the two valves housed in the structure was discharging water in a fountain-like fashion from its stuffing box. Mr. Birrell stated that attempts to repack the valve have been unsuccessful and that it is scheduled for further repairs.

The cut stone blocks forming the spillway crest appear in good condition, but have been slightly undermined. Although the reservoir level was about six inches below the spillway crest at time of inspection, the joints were allowing some discharge into the outlet channel. The upper reach of the discharge channel has a very mild slope and supports a heavy growth of brush. The bedrock, which forms the base of the outlet channel, provides a non-uniform surface for energy dissipation at the exit of the spillway channel.

d. Reservoir Area - The natural ground surrounding the reservoir has a moderate to steep slope and is well covered with trees and brush.

### SECTION 3 - HYDROLOGY/HYDRAULICS

According to the Recommended Guidelines for Safety Inspection of Dams, the Spillway Design Flood is the Probable Maximum Flood (PMF). The PMF was calculated from the 6 hour Probable Maximum Precipitation (PMP), using a loss rate of 0.1 inches per hour. The flood hydrograph was constructed from the Snyder unit hydrograph using average coefficients. Flood routing through the reservoir was performed assuming the gated outlets to be closed and the initial water surface elevation equal to the crest of the spillway. The peak inflow and outflow rates were calculated as 18,900 cfs and 18,200 cfs respectively. The peak outflow corresponds to a stage of 11.2 feet above the spillway crest (2.2 feet above the top of dam). Inflow and outflow peak rates for one-half of the PMF were calculated as 9,490 cfs and 7,300 cfs respectively. The spillway capacity was determined to be 8,910 cfs. Although the spillway capacity is insufficient to pass the PMF, it will safely discharge at least  $\frac{1}{2}$  PMF.

A drawdown analysis was performed assuming discharge from the two 36 inch diameter pipes and the starting water surface at the spillway crest, and 2 cfs per square mile inflow (42.6 cfs). According to the calculations, complete drawdown of the reservoir would take 55 days.



## SECTION 4 - STRUCTURAL STABILITY

### 4.1 VISUAL OBSERVATIONS AND DATA REVIEW

Visual inspection of the Middle Branch embankment did not reveal evidence of misalignments or settlement in the crest and slopes of the dam. However, the discolored seepage and saturated ground observed at the west abutment indicate the existence of uncontrolled seepage and possible fines migration which could lead to an unstable condition.

No design data was made available for Middle Branch Dam.

### 4.2 GEOLOGY AND SEISMIC STABILITY

Middle Branch Reservoir is located in the New England Uplands physiographic province. The rocks in this province are either metamorphic or igneous, and the land forms show a close relationship to the relative durability of these rocks. The embankment was constructed across the Middle Branch of the Croton River and is founded upon Precambrian metamorphic biotite and granitic gneiss. The spillway and discharge channel were constructed in the bedrock forming the north valley slope and are separated from the west dam abutment by an outcrop of the same formation.

No fault zones or lineaments are known to exist in the vicinity of the reservoir. The structure is located in Seismic Risk Zone 1 of the Seismic Zone Map of Contiguous States and it appears that static stability conditions are adequate for earthquakes.

## SECTION 5 - ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

### 5.1 ASSESSMENT

Visual inspection and analysis of the available information reveals that the embankment has a potential piping problem.

The uncontrolled seepage and saturated ground along the downstream slope near the west abutment is indicative of possible fines migration through the embankment or along the contact between the structure and natural valley abutment. It is also possible that the rust colored seepage is from discharge channels which may have formed through joints in the bedrock abutment. The discoloration may be attributable to iron oxides resulting from chemical weathering of ferromagnesian minerals contained within the local bedrock formation.

The root systems of the trees and brush growing on the downstream face near the west abutment have a deleterious effect upon the compacted materials in the embankment and provide seepage paths which may lead to future piping and failure of the structure.

### 5.2 RECOMMENDATIONS/REMEDIAL MEASURES

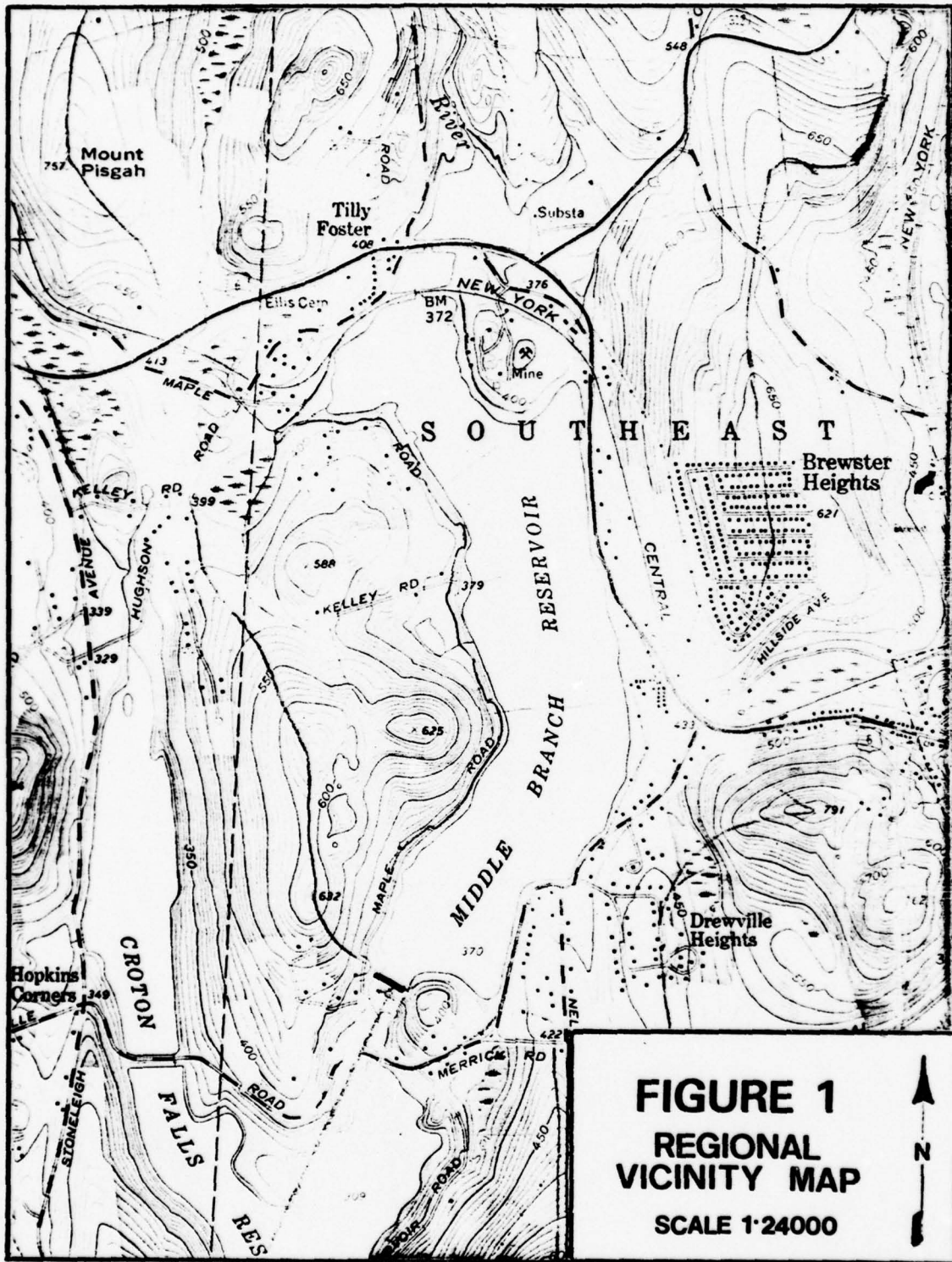
The uncontrolled seepage on the downstream slope of the west abutment should be monitored on a regular basis to see if flow increases or if fines migration can be detected. If either of these conditions develop, a subsurface investigation program should be initiated at several sections of the embankment with emphasis in the west abutment areas. The investigation should include, but not be limited to, the determination of the composition and in situ properties of the embankment, corewall and foundation materials, and to detect possible fines migration. Results of this program should be used to establish if the materials are satisfactory as designed and constructed; and to perform seepage and stability analyses of the embankment.

The trees and brush growing on the western portion of the downstream slope should be cut near the ground surface so that conditions at this location can be further assessed and monitored on a regular basis. A further investigation should be made to determine the extent of the root systems before remedial measures can be recommended.

The inoperable valves in the vault and the leaking gate valve in the gatehouse should be repaired.



FIGURES



**FIGURE 1**  
**REGIONAL**  
**VICINITY MAP**

SCALE 1:24000



## CROTON SYSTEM

DATA

Name of Reservoir	Location		Drainage Area		Date Pl.	Kind
	Town	County	Sq Mi	Includes Items		
1 BOYD'S CORNERS	KENT	PLUM	23.46	1	1873	MASONRY, EARTH
2A BARRETT'S POND			25	2	1875	EARTH
3A LAKE GLENDA	CARMEL	"	0.68	3	1870	EARTH
4 WEST BRANCH (CORME)	"	"	42.87	1 to 4	1895	EARTH, MASONRY
5 WEST BRANCH	"	"				
6 MIDDLE BRANCH	SOUTHEAST	"	21.31	5	1878	EARTH, MASONRY
7 BOO BROOK	"	"	3.87	6	1892	"
8 EAST BRANCH (BOOM)	"	"	80.26	6 & 7	1891	MASONRY, EARTH
9 CROTON FALLS (OVERTING)	"	"	87.58	6 to 8	1911	EARTH, CONCRETE
10 LAKE GILEAD	CARMEL	"	0.82	9	1870	EARTH
11 CROTON FALLS	"	"	188.84	4, 5, 8, 9, 10	1911	CYCLOPEAN MASONRY
12 LAKE KIRK	"	"	2.84	11	1870	EARTH
13 AMANALK	SOMERS - WESTCHESTER		19.15	10 to 12	1897	EARTH, MASONRY
14 TITICUS	NORTH SALEM	"	25.33	13	1893	MASONRY, EARTH
15 CROSS RIVER	BEDFORD	"	29.80	14	1908	CYCLOPEAN MASONRY
16 MUSCOG	SOMERS & BEDFORD	"	315.73	10 to 15	1905	MASONRY
17 NEW CROTON	CORTLAND	"	375.00	1 to 16	1905	MASONRY
x Controlled Lakes			CROTON TOTALS			

## CATSKILL SYSTEM

1 ASHOKAN	OLIVE BRIDGE - ULSTER	25.00	1	1875	MASONRY
2 SCHOMARIE	GILBOA - GREENE	34.00	2	1876	MASONRY
CATSKILL TOTALS					

## DELAWARE SYSTEM

1 NEVERSINK	NEVERSINK SULLIVAN	49.0	1	1853	EARTH, CONCRETE	
2 PEFACTON	COLCHESTER HILLS	DELAWARE	372.0	2	1854	"
	& MIDDLETON					
3 CANNONSVILLE	DEPOSIT, TOWNSHIP	DELAWARE	450.0	3	1867	ROLLE
	& WALTON					
4 RONDOUT	WARWARSING,	ULSTER	35.00	1 to 4	1851	CONCRETE
	NEVERSINK					
DELAWARE TOTALS						

## KENSICO RESERVOIR

KENSICO	WESTCHESTER	13.33	1	1875	MASONRY
---------	-------------	-------	---	------	---------



PERTAINING TO N.Y. CITY RESERVOIRS

THE IMPOUNDING RESERVOIRS BELONG TO THE CITY OF NEW YORK  
OPERATING LEVEL & 560.0 BILL GAL. (AVAIL)

Name of Dam	Capacity (Bill. Gal.)		Area of water surface at Spillway Elev.		Length of Spillway V.L. 89	Elev. of Spillway M.S.L. Sandy Hook Feet	Elev. of Top of Max. Dept (Min) Oper. Level Feet	Elev. of Sill or Outlet Feet	Depth of Spillway to Outlet Feet
	Total Available Above Sill or Outlet	Vol. Dept. Above Min. Op. Lev.	Sq. Mi.	Acres					
N 135	1.696		0.464	296.9	6.2	560.05		596.7	43.4
	0.170		0.108	67.1	1.4	776.55		766.6	10.0
	0.163		0.264	166.9	2.2	504.53		499.6	3.0
CORE & SPILLWAY	10.070		1.692	1062.8	15.6	503.2		455.6	47.0
						514.55 Top		466.1	
CORE	4.005		0.609	428.2	6.62	371.55		310.5	61.1
"	4.400		0.640	399.0	4.9	418.53		365.1	51.5
N 135	5.243		0.698	536.8	10.5	416.53		351.8	65.0
CORE & SPILLWAY	0.888		0.240	153.6	4.2	309.53		275.8	33.8
	0.380		0.197	122.2	2.1	496.53		480.6	16.0
MASONRY	14.192		1.680	1062.4	18.0	309.4		214.8	95.0
	0.365		0.158	101.1	3.1	502.53		324.8	18.0
CORE	6.692		0.947	606.1	8.5	399.53		334.6	63.0
WINGS W/ MASONRY CORE	7.167		1.046	664.4	8.7	324.5		299.8	75.0
MASONRY, CONCRETE FACES	10.308		1.202	764.2	12.9	324.53		224.6	105.0
	4.914		1.822	1166.1	35.0	190.53		164.6	30.0
	25.782		3.330	2254.2	38.0	193.53		194.6	36.0
	94.637	86.6	13.531	9911.0	177.52				

127.858	122.9	12.99	8315.2	40.2	8.850	UNKNOWN	308.80	37.75
19.583	17.8	1.79	1145.0	16.5	1130.0	"	1050.0	80.00
147.441	140.5	14.73	9460.2	36.5				

CONCRETE CORE	35.466	34.9	2.3	1470	16.5	1440.00	1319.00	1314.00	126.00
"	143.701	140.2	8.9	5700	53.5	1250.00	1152.00	1143.00	137.00
ROCK FILL	96.726	95.7	7.5	4600	53.5	1150.00 1150.00	1040.00	1035.00	115.00
CONCRETE CORE	50.048	49.6	3.25	2080	17.0	840.00	723.00	720.00	120.00
	325.941	320.4	21.95	14050	140.5	LOW WEIR HIGH "			

A SAFETY OR INTERMEDIATE STORAGE RES FOR ALL OF THE CITY OF NEW YORK & DELAWARE SUPPLIES

30.573	UNKNOWN	3.47	2216.3	33.0	357.00	UNKNOWN	295.92	67.63
--------	---------	------	--------	------	--------	---------	--------	-------

2

THE CROTON, CATSKILL & DELAWARE SYSTEMS TOTTALING 547.5 BIL. GAL. ABOVE MIN. AVAILABLE ABOVE SILL, AN ADDITIONAL 30.6 BILL. GAL. IS STORED IN A SAFETY STORAGE RES. KENSIC

Dam No.	Dead Storage Billion Gallons	Length of Spillway Feet	Max Depth Below Spillway Feet	Max Hgt of Main Dam		Width of Dam Feet		Length of Dam Feet	
				Above Lowest Foundation Feet	Above N.P.C. Surface Feet	Top	Bot.	Total	Masonry Portion
4		135.0		78.0	57.0	6.60	53.60	670.0	670.0
0									
0		260.0		66.0	62.0	15.00	307.50	1794.5	260.0
1		100.0		65.0	50.0	23.00	240.00	741.0	
5				99.0		50.00	660.00	615.0	100.0
0				58.8	53.8	32.88	338.88	338.8	
0		500.0		96.0	78.0	12.00	53.00	1100.0	500.0
0		1000.0		51.0	45.0	15.00	240.00	2190.0	1000.0
0		700.0		173.0	113.0	23.00	118.00	1300.0	1100.0
0		50.0			62.0	55.00	656.00	1270.0	50.0
0		230.0		135.0	107.0	25.70	75.21	1312.0	230.0
0		240.0		170.0	126.0	23.00	118.30	1060.0	640.0
0		950.0		36.0		4.00	40.00	1150.0	1133.0
0		1000.0		297.0	174.0	16.00	206.00	2165.0	2165.0

REMARKS  
Most of the Cr. carried by the Aqueduct

00	4.137	950.0	150.0	252.0	210.0	26.33	200.00	4650.0	1000.0
		1324.0		182.0	155.0	15.00	158.00	2280.0	2000.0

Schoharie water Tunnel to Albany enter the Catskill

00	1.680	600.0	175.00	345.0	195.0	60.00	1392.00	2820.0	NONE
00	6.000	800.0	180.00	304.0	204.0	60.00	1460.00	2450.0	"
00	1.892	3240.0	76.00	196.0	179.0	45.00	1312.00	2800.0	"
		560.0	8.53						
00	2.387	600.0	175.00	375.0	195.0	60.00	1392.00	2400.0	"

Neversink, Pep. are conveyed & W Delaware Thence all Four

RES ALSO SOME OF THE CROTON SUPPLY (SEE REMARKS).

63	UNKNDWN	50.0	155.50	307.0	165.0	23.00	235.00	1643.0	1643.0
----	---------	------	--------	-------	-------	-------	--------	--------	--------

of the Croton S plus pumpage Falls flows in

2 1'

3



STATION  
me

S.CO  
S.CO

Camp J.J.D  
SPAWN J.P.D  
Crown J.P.D

MARKS

Croton Supply is  
the New Croton is  
the New Croton

er is conveyed by the Shandaken  
can Res. Thence both supplies  
Del. Aqueduct.  
Del. Aqueduct.

action & Cannonsville supplies  
via the Never sink, East Delaware  
tunnels to the Conduit Res.  
ur supplies enter the Del. Aqueduct.  
ur supplies enter the Del. Aqueduct.

**FIGURE 2**

Supply, all of the West Branch  
Upper Cross River & Croton  
via Kensico Reservoir Croton  
to Kensico Reservoir.

Acc NS  
Acc NS

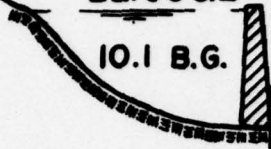
H

BOYDS  
CORNERS  
RESERVOIR  
EL. 580



1.7 B.G.

WEST BRANCH  
RESERVOIR  
EL. 503.2



10.1 B.G.

TO DELAWARE  
AQUEDUCT

BOG  
BROOK  
EL. 416.5



4.4 B.G.

EAST  
BRANCH  
EL. 416.5



5.2 B.G.

MIDDLE  
BRANCH  
EL. 371.5



4.0 B.G.

EL. 309.5

0.9 B.G.

CROTON  
FALLS  
DIVERTING

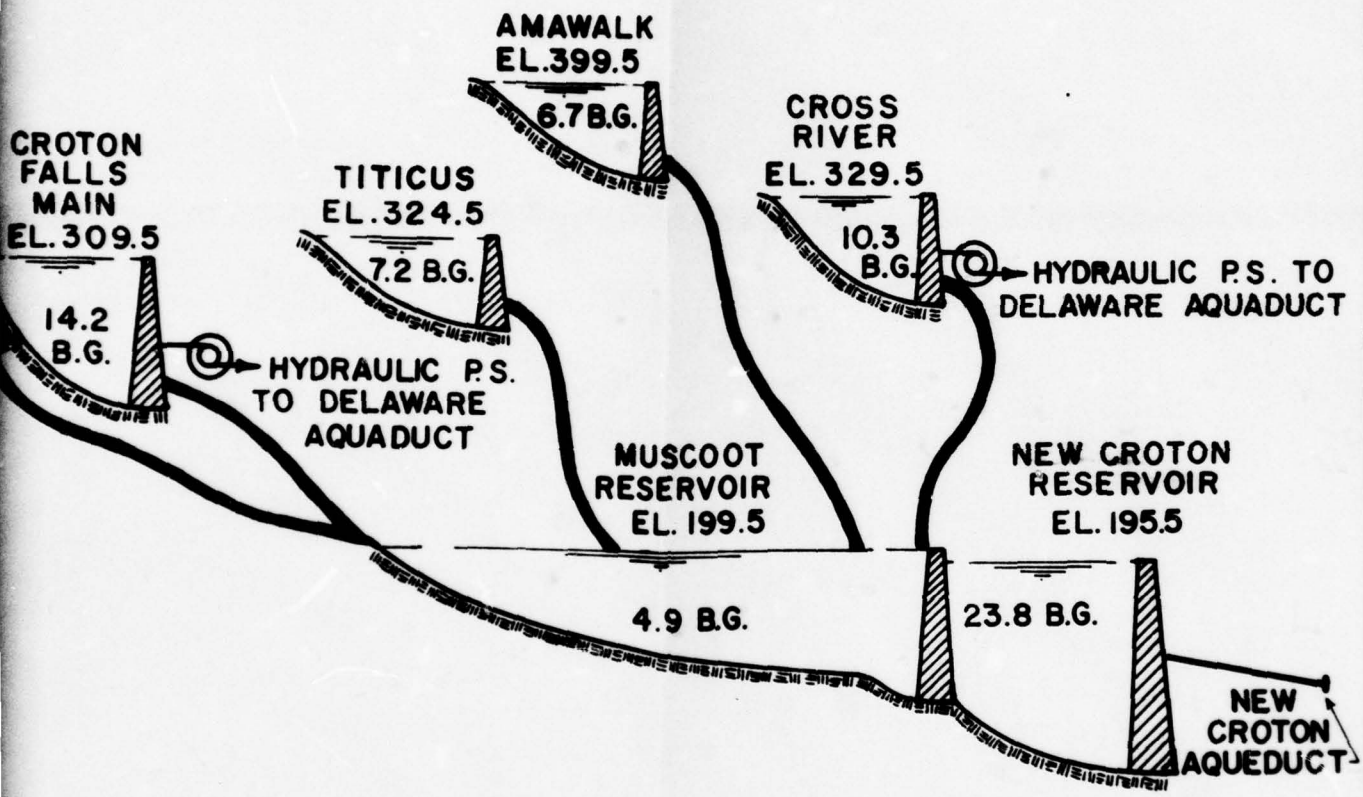
LEGEND

-  = NATURAL WATER COURSE.
-  = TUNNEL AQUEDUCT.
-  = GRADE AQUEDUCT.

NOTE

ELEVATIONS OF RESERVOIRS ARE AT MASONRY  
CREST OF SPILLWAY.  
FIGURES SHOWN IN RESERVOIRS ARE CAPACITIES  
IN BILLION GALLONS.

ELEVATIONS REFER TO M.S.L. SANDY HOOK.

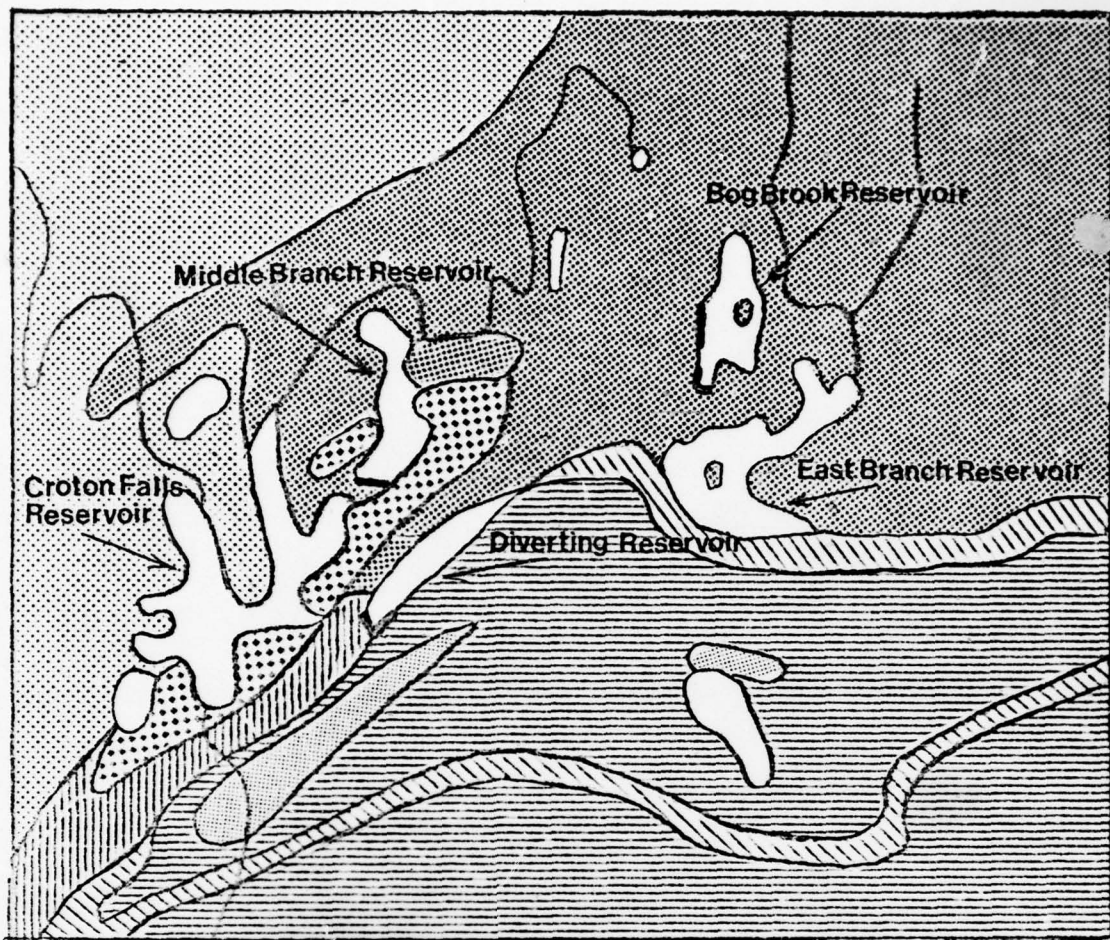


CITY OF NEW YORK  
 BUREAU OF WATER SUPPLY  
**PROFILE OF FLOW DIAGRAM FOR  
 CROTON SYSTEM**

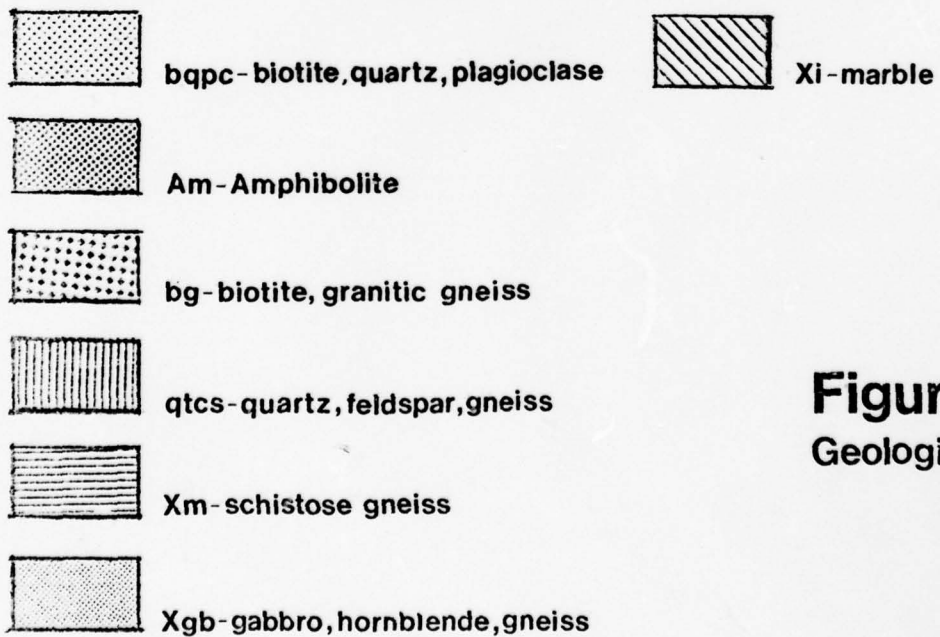
**FIGURE 3**

2



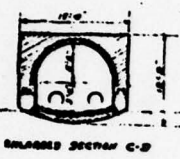


Scale: 1 inch = 1.7 miles

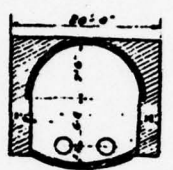


**Figure 4**  
Geologic Map





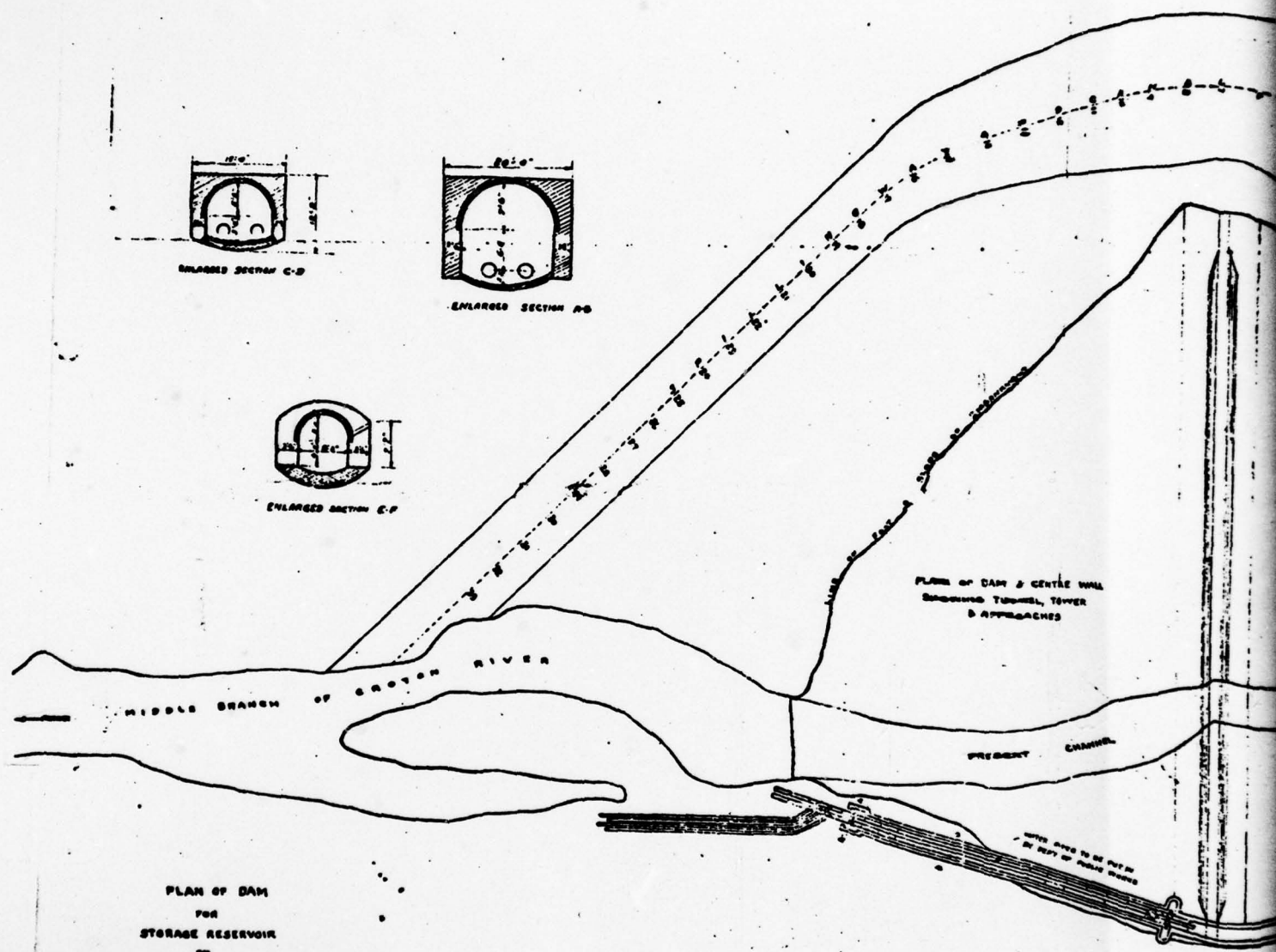
ENLARGED SECTION C-D



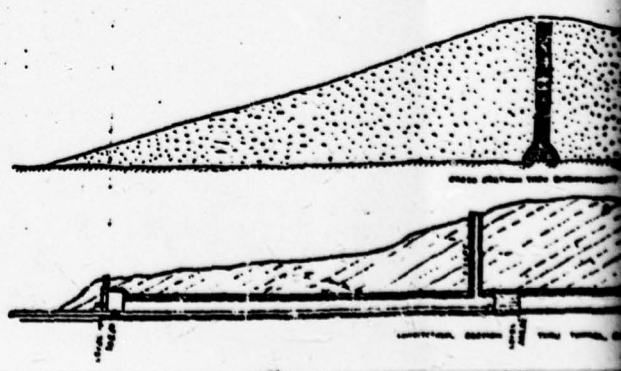
ENLARGED SECTION A-B



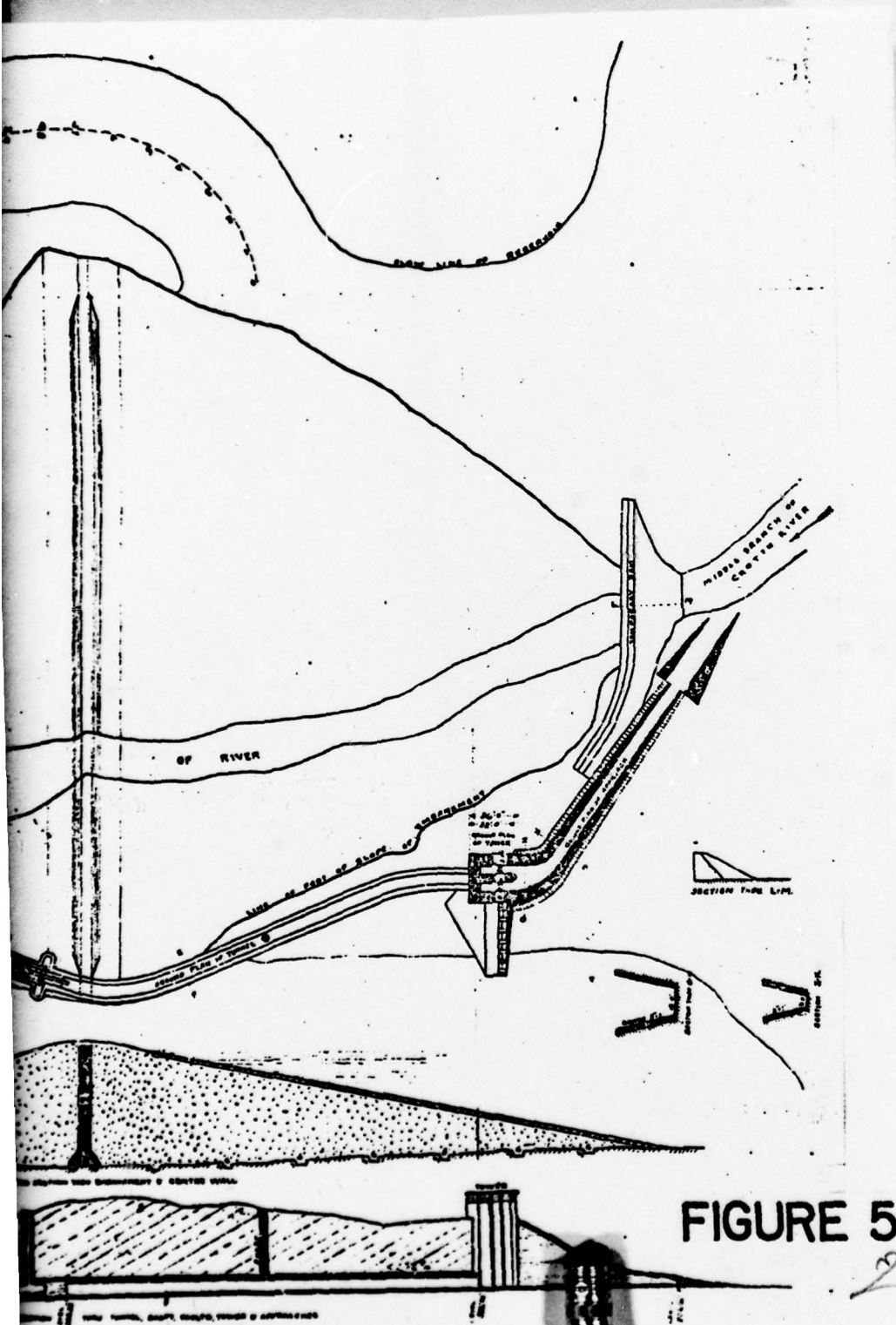
ENLARGED SECTION E-F



PLAN OF DAM  
FOR  
STORAGE RESERVOIR  
ON  
MIDDLE BRANCH OF CROTON RIVER  
IN  
TOWN OF SOUTH EAST PUTNAM COUNTY, NEW YORK



*Traced from attached photo print of the  
"Contract & Specifications of the Middle  
Branch Reservoir" at the Library of the  
United Engineering Societies - 27 W. 39th St. N.Y.*  
Traced by O.W. NOV 22 1921.



**FIGURE 5**

13

APPENDIX



PHOTOGRAPHS



SOUTHEAST ABUTMENT AND DOWNSTREAM SLOPE



TOE OF DOWNSTREAM SLOPE



WATER DISCHARGING FROM  
36 INCH GATE VALVE



HEAVY OVERGROWTH AT NORTHWEST ABUTMENT



FIELD INSPECTION  
REPORT

Check List  
Visual Inspection  
Phase 1

Name Dam Middle Branch Dam County Putnam State New York Coordinators -----

Date(s) Inspection July 17, 1978 Weather Overcast Temperature 75°

Pool Elevation at Time of Inspection 370 M.S.L. Tailwater at Time of Inspection ----- M.S.L.

Inspection Personnel:

A-1  
Mr. George Elias  
Mr. David Campbell  
Mr. Steve Snider

Mr. Steve Snider Recorder

Accompanied by:

Mr. John Birrell - Section Engineer, New York City Department of Environmental Protection  
Mr. Edward Stoorza - Section Foreman, New York City Department of Environmental Protection

**EMBANKMENT**

**REMARKS OR RECOMMENDATIONS**

**OBSERVATIONS**

**VISUAL EXAMINATION OF**

**SURFACE CRACKS**

None noted.

None.

**UNUSUAL MOVEMENT OR  
CRACKING AT OR BEYOND  
THE TOE**

None noted.

None.

**SLOUGHING OR EROSION OF  
EMBANKMENT AND ADJUTENT  
SLOPES**

None noted.

None.

A-2

**VERTICAL AND HORIZONTAL  
ALIGNMENT OF THE CREST**

None noted.

None.

**RIPRAP FAILURES**

None noted.

None.



EMBANKMENT

REMARKS OR RECOMMENDATIONS

OBSERVATIONS

VISUAL EXAMINATION OF

JUNCTION OF EMBANKMENT  
AND ABUTMENT, SPILLWAY  
AND DAM

Some seepage noted at the west  
abutment. Ground surface was  
moist and saturated in some  
locations.

A study should be undertaken  
to determine the cause and  
source of seepage.

ANY NOTICEABLE SEEPAGE

A-3

See above.

See above.

STAFF GAGE AND RECORDER

N/A

DRAINS

N/A

OUTLET WORKS

REMARKS OR RECOMMENDATIONS

OBSERVATIONS

VISUAL EXAMINATION OF

CRACKING AND SPALLING OF  
CONCRETE SURFACES IN  
OUTLET CONDUIT

N/A

INTAKE STRUCTURE

Stone deck of intake tower prohibits  
access to interior of structure.

None.

OUTLET STRUCTURE

One of the gate valves was discharging  
water from its stuffing box.

Repair gate valve.

A-4

OUTLET CHANNEL

Discharge from the outlet conduits  
Flows directly into the Croton Falls  
Reservoir.

None.

EMERGENCY GATE

See "Outlet Structure"

RESERVOIR

REMARKS OR RECOMMENDATIONS

OBSERVATIONS

VISUAL EXAMINATION OF

SLOPES

No problems noted.

None.

SEDIMENTATION

None noted.

None.



UNGATED SPILLWAY

REMARKS OR RECOMMENDATIONS

OBSERVATIONS

VISUAL EXAMINATION OF

CONCRETE WEIR

The cut stone blocks forming the spillway crest have been slightly undermined.

None.

APPROACH CHANNEL

No problems noted.

None.

DISCHARGE CHANNEL

Heavy growth of brush on upper reach of channel.

None.

A-6

BRIDGE AND PIERS

N/A

ITEM

REMARKS

**MONITORING SYSTEMS**

Personnel from the New York City Department of Environmental Protection operate and monitor operation of the reservoir.

**MODIFICATIONS**

None.

**HIGH POOL RECORDS**

Maximum pool of record was 375.55 feet MSL recorded on October 16, 1955.

**POST CONSTRUCTION ENGINEERING  
STUDIES AND REPORTS**

None available.

A-7

**PRIOR ACCIDENTS OR FAILURE OF DAM  
DESCRIPTION  
REPORTS**

None available.

**MAINTENANCE  
OPERATION  
RECORDS**

None available.

HYDROLOGIC/HYDRAULIC CALCULATIONS



NAME OF CLIENT NYSDEC

PROJECT MIDDLE BRANCH RESERVOIR

PMP east of the 105° meridian for an area of 10 sq. miles and 6 hour duration is 24" according to Design of Small Dams, SCS, Fig. 15

Drainage Area = 21.31 sq. miles

Reduction in order to provide for imperfect "fit" of storm isohyetal patterns to the shape of a particular basin.

Reduction Factor - 18.6%

$$6\text{-hr. PMP} = 24 \text{ inches} * 0.814 = 19.536$$

Figure 16, Zone 1:

$$6 \text{ hr. PMP} = 19.536 * 0.92 = 18.0 \text{ inches}$$

$$12 \text{ hr. PMP} = 19.536 * 1.04 = 20.3 \text{ inches} \rightarrow -18.0 = 2.3$$

$$24 \text{ hr. PMP} = 19.536 * 1.13 = 22.0 \text{ inches} \rightarrow -20.3 = 1.7''$$

$$\begin{aligned} t_p &= C_t (L * L_{ca})^{0.3} \\ &= 2.0 (15 * 7)^{0.3} = 8.08 \text{ hr.} \end{aligned}$$

$$t_r = t_p / 5.5 = 1.47 \text{ hrs.} \quad \text{Use: } t_R = 1.5 \text{ hrs.}$$

$$t_{PR} = t_p + 0.25(t_R - t_r) = 8.08 + 0.25(1.5 - 1.47) = 8.09 \text{ hrs.}$$

NAME OF CLIENT NYSDEC

COMP. BY LW

PROJECT MIDDLE BRANCH RESERVOIR

CHECKED BY DBC

6 HR. - 18 inch PMP Distribution

<u>Time (hrs)</u>	<u>Fig. 18 (zone c) % of 6 hr. PMP</u>	<u>Accumulate PMP</u>	<u>Increment</u>
0-1.5	57.0	10.3	10.3
1.5-3.0	76.0	13.7	3.4
3.0-4.5	88.0	15.9	2.2
4.5-6.0	100.0	18.0	2.1
6.0-7.5			0.6
7.5-9.0			0.6
9.0-10.5			0.6
10.5-12.0			0.5
12.0-13.5			0.3
13.5-15.0			0.2
15.0-16.5			0.2
16.5-18.0			0.2
18.0-19.5			0.2
19.5-21.0			0.2
21.0-22.5			0.2
22.5-24.0			0.2

NAME OF CLIENT NYSDEC

DATE 7/19/78

PROJECT MIDDLE BRANCH RESERVOIR

COMP. BY LW

CHECKED BY DBC

THIRD QUANTILE DISTRIBUTION

<u>Time (hrs.)</u>	<u>Adjusted PMP Increments</u>	<u>Σ PMP</u>
0-1.5	0.2	0.2
1.5-3.0	0.2	0.4
3.0-4.5	0.2	0.6
4.5-6.0	0.2	0.8
6.0-7.5	0.2	1.0
7.5-9.0	0.3	1.3
9.0-10.5	0.6	1.9
10.5-12.0	0.6	2.5
12.0-13.5	2.1	4.6
13.5-15.0	3.4	8.0
15.0-16.5	10.3	18.3
16.5-18.0	2.2	20.5
18.0-19.5	0.6	21.1
19.5-21.0	0.5	21.6
21.0-22.5	0.2	21.8
22.5-24.0	0.2	22.0



NAME OF CLIENT NYSDEC

PROJECT MIDDLE BRANCH RESERVOIR

Discharge capacity for outlet pipes:

$$H = \frac{V^2}{2g} + K_e \frac{V^2}{2g} + K_b \frac{V^2}{2g} + K_v \frac{V^2}{2g} + h_f$$

H = available head

$K_e$  = entrance loss coefficient

$K_b$  = bend loss coefficient

$K_v$  = valve loss coefficient

$$h_f = 2.87 n^2 \frac{LV^2}{d^{4/3}} \quad (6-262) \text{ Brater}$$

$$= 2.87 (0.013)^2 \frac{500 (2g) \cdot \frac{V^2}{2g}}{\left(\frac{30}{12}\right)^{4/3}} = 4.6 \frac{V^2}{2g}$$

$$K_e = 0.5 \quad K_b = 0.08 \quad K_v = 0.07$$

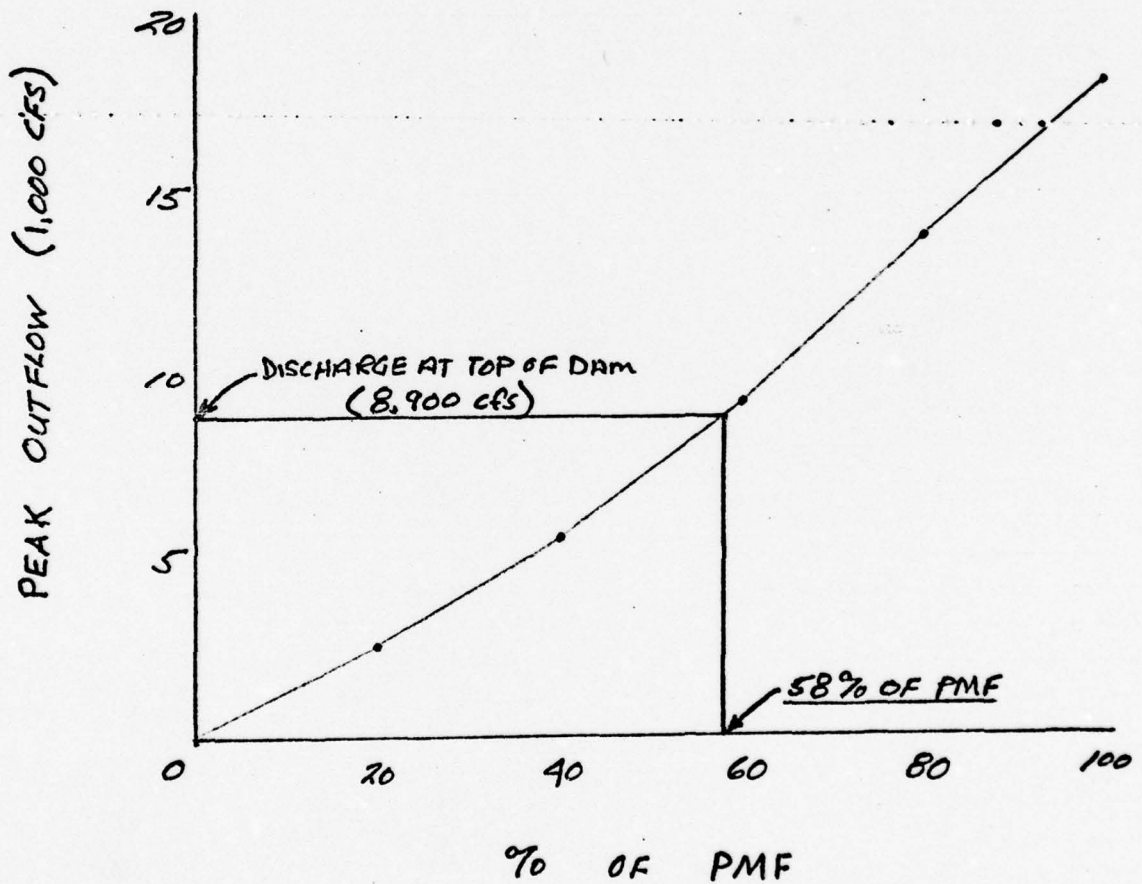
$$H = 6.25 \frac{V^2}{2g}$$

$$= 6.25 \cdot \frac{Q^2}{27g \left(\frac{30}{12}\right)^2} = 0.0049427 Q^2$$

$$Q = 14.1 H^{1/2}$$

Area of water surface at Spillway Crest is 428.2 acres

$\Delta H$ (ft.) Above spillway crest	$Q_{\text{spillway}}$ $(3.3)100 H^{3/2}$	STORAGE (A-F) Above spillway crest	$Q = \frac{(3.3)615(H-9)^{3/2}}{2.0m}$	$\Sigma Q$
0	0	0	0	0
1	330	428.2	0	330
2	933	856.4	0	933
3	1715	1284.6	0	1715
4	2646	1712.8	0	2646
5	3690	2141.0	0	3690
6	4850	2569.2	0	4850
7	6112	2997.4	0	6112
8	7467	3425.6	0	7467
9	8910	3853.8	0	8910
10	10436	4282.0	2030	12466
11	12039	4710.2	5740	17779
12	13718	5138.4	10546	24264





NAME OF CLIENT NYSDEC

COMP. BY LW

PROJECT MIDDLE BRANCH RESERVOIR

CHECKED BY DSC

Capacity = 4.005 Billion gallons  
= 4005 Million gallons  
= 4005 (3.0689) Acre-Feet  
= 12,291 A-F

Size Classification - Intermediate

Storage :  $1000 \leq 12,291 < 50,000$  A-F

HEIGHT :  $40 \leq 94 < 100$  Feet

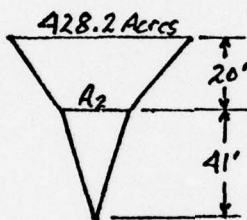
Maximum spillway capacity without overtop the Dam is  
8910 cfs; about 74% of PMF. Outflow Peak Discharge

Depth - spillway to outlet = 61 feet

Volume of reservoir = 12,291 acre-feet

$$Q = 2(14.1) H^{0.5} \quad Q_B \text{ (Base Flow)} = 2(\text{cfs/sq.mile}) 21.3 (\text{sq.mile})$$

$$= 47.6 \text{ CFS}$$



$$V = 12291 = (428.2 + A_2) / 2(20) + A_2 / 2(41)$$

$$A_2 = 262.6 \text{ acres}$$

<u>(ft)</u> <u>ΔH</u>	<u>(ft)</u> <u>H<sub>avg.</sub></u>	<u>(cfs)</u> <u>Q<sub>avg.</sub></u>	<u>(cfs)</u> <u>Q<sub>net</sub></u>	<u>(acres)</u> <u>AVG. Area</u>	<u>(hrs.)</u> <u>Δt</u>	<u>(hrs.)</u> <u>ΣΔt</u>
10	56	211	168	386.8	278	278
10	46	191	148	304.0	249	527
10	36	169	126	231.0	222	749
10	26	144	101	167.0	200	949
10	16	113	70	102.0	176	1125
11	5.5	66	23	35.0	203	1328

$$\therefore \text{TIME OF DRAWDOWN} = 1328 / 24 \approx 55 \text{ Days}$$

\*\*\*\*\*  
 4EC-1 VERSION DATED JAN 1973  
 UPDATED AUG 74  
 CHANGE NO. 01  
 \*\*\*\*\*

NATIONAL DAM INSPECTION PROGRAM  
 MIDDLE BRANCH RESERVOIR  
 PMF HYDROGRAPH

JOB SPECIFICATION  
 N2 NHR NMIN IDAY IHR IMIN METRC IPLT IPRI NSTAN  
 50 1 30 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0  
 JOPER NMT  
 5 0

MULTI-PLAN ANALYSES TO BE PERFORMED  
 MPLAN= 1 NRATIO= 5 LRTIO= 1

RIIOS= .20 .40 .60 .80 1.00

A-16

SUB-AREA RUNOFF COMPUTATION  
 ISTAQ ICOMP IECON ITAPE JPLT JPRJ IINAME  
 1 0 0 0 0 0 0 0 0 0

HYDROGRAPH DATA  
 IHYDG IJHG IAREA SNAP TRSDA TRSPC RATIO ISNOW ISAME LOCAL  
 0 1 21.31 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

PRECIP DATA  
 NP STORM DAV DAK  
 16 0.00 0.00 0.00  
 PRECIP PATTERN  
 .20 .20 .20 .30 .60 .60 2.10 3.40  
 10.30 2.20 .60 .50 .20 .20

LOSS DATA  
 STRKR DLTKR RTIOL ERAIN STRKS RTIOK STRTL CNSTL ALSMK RTIMP  
 0.00 0.00 1.00 0.00 0.00 1.00 0.00 .10 0.00 0.00

UNIT HYDROGRAPH DATA  
 TP= 8.09 CP= .63 NTA= 0

RECESSION DATA  
 STRIO= 0.00 QROSN= 0.00 RTIOR= 1.00  
 APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 6.30 AND R= 4.89 INTERVALS

UNIT HYDROGRAPH 30 END-OF-PERIOD ORDINATES. LAG= 9.07 HOURS, CP= .63 VOL= 1.00  
 76. 277. 545. 814. 1006. 1072. 985. 815. 663. 540.  
 440. 358. 292. 238. 193. 158. 128. 104. 69.  
 56. 46. 37. 30. 25. 20. 16. 13. 11. 9.

END-OF-PERIOD FLOW  
 TIME RAIN EXCS COMP Q  
 1 1 30 .20 .05 4.



1	7	30	.20	.05	136.
1	8	60	.30	.15	197.
1	10	30	.60	.45	297.
1	11	60	.60	.45	475.
1	13	30	2.10	1.35	868.
1	14	60	3.40	3.25	1754.
1	16	30	10.30	10.15	3893.
1	17	60	2.20	2.05	7533.
1	19	30	.60	.45	11906.
1	20	60	.50	.35	15894.
1	22	30	.20	.05	18450.
1	23	60	.20	.05	18975.
2	1	30	0.00	0.00	17464.
2	2	60	0.00	0.00	14846.
2	4	30	0.00	0.00	12270.
2	5	60	0.00	0.00	10082.
2	7	30	0.00	0.00	8233.
2	8	60	0.00	0.00	6710.
2	10	30	0.00	0.00	5455.
2	11	60	0.00	0.00	4450.
2	13	30	0.00	0.00	3624.
2	14	60	0.00	0.00	2951.
2	16	30	0.00	0.00	2403.
2	17	60	0.00	0.00	1957.
2	19	30	0.00	0.00	1593.
2	20	60	0.00	0.00	1297.
2	22	30	0.00	0.00	1056.
2	23	60	0.00	0.00	860.
3	1	30	0.00	0.00	700.
3	2	60	0.00	0.00	569.
3	4	30	0.00	0.00	463.
3	5	60	0.00	0.00	376.
3	7	30	0.00	0.00	303.
3	9	60	0.00	0.00	244.
3	10	30	0.00	0.00	184.
3	11	60	0.00	0.00	126.
3	13	30	0.00	0.00	30.
3	14	60	0.00	0.00	9.
3	16	30	0.00	0.00	4.
3	17	60	0.00	0.00	1.
3	19	30	0.00	0.00	0.
3	20	60	0.00	0.00	0.
3	22	30	0.00	0.00	0.
3	23	60	0.00	0.00	0.
4	1	30	0.00	0.00	0.
4	2	60	0.00	0.00	0.

SUM	22	00	19.60	178638.
PEAK	18976.	17696.	10174.	3726.
2ES	18976.	17696.	10174.	3726.
INC-MES	7.72	17.76	19.52	19.52
AC-FI	9779.	20190.	22181.	22191.

72-HOUR	72-HOUR	TOTAL VOLUME
3726.	178638.	178638.
19.52	19.52	19.52
22181.	22191.	22191.

HYDROGRAPH AT STA 1 FOR PLAN 1, RITE 1			
1.	9.	17.	27.
779.	2381.	3179.	3690.
1647.	1342.	890.	725.
211.	172.	114.	93.
5.	2.	0.	0.
174.	174.	95.	95.
2450.	2450.	2969.	2969.
319.	319.	391.	391.
37.	37.	47.	47.
0.	0.	0.	0.
351.	351.	351.	351.
2016.	2016.	2016.	2016.
259.	259.	259.	259.
25.	25.	25.	25.
0.	0.	0.	0.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 2

2.	18.	34.	54.	79.	119.	170.	347.	702.
1555.	3021.	4762.	6358.	7380.	7590.	5938.	4915.	4033.
3293.	2684.	1780.	1449.	1180.	961.	783.	637.	519.
422.	344.	228.	185.	150.	121.	97.	74.	51.
12.	2.	0.	0.	0.	0.	0.	0.	0.
	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME			
	JFS	7590.	4070.	1498.	71535.			
	INCHES	3.09	7.11	7.81				
	AC-FT	3512.	8076.	8873.				

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 3

2.	11.	51.	82.	118.	178.	285.	521.	1053.
2333.	4532.	7144.	11070.	11385.	10479.	8908.	7374.	5049.
4940.	4026.	2670.	2174.	1770.	1442.	1174.	956.	770.
634.	516.	420.	278.	226.	182.	146.	111.	76.
18.	3.	1.	0.	0.	0.	0.	0.	0.
	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME			
	JFS	11385.	6104.	2235.	107303.			
	INCHES	4.63	10.66	11.71				
	AC-FT	5268.	12114.	13309.				

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 4

3.	14.	69.	109.	159.	238.	380.	694.	1404.
3111.	5043.	9225.	12716.	15180.	13971.	11877.	9832.	8066.
6896.	5368.	4372.	2899.	2361.	1922.	1565.	1275.	1038.
845.	688.	560.	371.	301.	242.	195.	147.	101.
24.	7.	3.	1.	0.	0.	0.	0.	0.
	PEAK	5-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME			
	JFS	15180.	8139.	2991.	143070.			
	INCHES	6.18	14.21	15.61				
	AC-FT	7824.	16152.	17745.				

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 5

4.	18.	86.	136.	197.	297.	475.	868.	1754.
3889.	7553.	11906.	18450.	18976.	17464.	14846.	12290.	10082.
8233.	6710.	5465.	3624.	2951.	2403.	1957.	1593.	1297.
1056.	860.	700.	463.	376.	303.	244.	184.	126.
30.	9.	4.	1.	0.	0.	0.	0.	0.
	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME			
	JFS	18976.	17696.	3726.	178830.			
	INCHES	7.72	17.76	19.52				
	AC-FT	8779.	20190.	22181.				

HYDROGRAPH ROUTING

ISIAQ	ICOMP	IECON	ITAPE	JPLT	JPR1	INAME
2	1	0	0	2	0	0
ROUTING DATA						
QLOSS	CLOSS	AVG	IRCS	ISAME	ISAME	ISAME
0.0	0.000	0.00	1	1	1	1
NSIPS NSTDL LAG AMSKK X TSK STORA						
0	0	0	0.000	0.000	0.000	-1.

STORAGE= 0. 428. 956. 1286. 1713. 2181. 2569. 3426. 4282. 5136.

1.	1.	2.	3.	4.	7.	11.	17.	28.	49.
96.	368.	756.	1252.	1764.	2209.	2451.	2513.	2448.	2448.
2302.	1899.	1689.	1510.	1337.	1175.	1025.	898.	801.	801.
710.	551.	403.	422.	368.	324.	299.	276.	254.	254.
232.	211.	175.	159.	140.	131.	119.	100.	98.	98.

STOR

1.	1.	2.	3.	6.	9.	14.	22.	36.	63.
124.	248.	730.	1031.	1308.	1514.	1626.	1654.	1624.	1624.
1597.	1469.	1371.	1272.	1078.	999.	907.	831.	762.	762.
638.	630.	585.	536.	493.	459.	420.	389.	358.	329.
301.	274.	249.	226.	206.	187.	170.	154.	140.	124.

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME  
 2513. 2428. 1711. 725. 34795.

DES 1.06 2.99 3.80  
 INCHES AC-FT 1205. 3396. 4316.

STATION 2, PLAN 1, R110 2

2.	2.	3.	5.	8.	14.	22.	34.	55.	98.
192.	424.	993.	1953.	3172.	4366.	5244.	5632.	5567.	5219.
4736.	4233.	3716.	3256.	2823.	2447.	2121.	1825.	1583.	1380.
1196.	1031.	895.	792.	698.	613.	536.	468.	405.	351.
313.	285.	259.	236.	214.	195.	177.	161.	146.	133.

STOR

2.	2.	4.	6.	11.	18.	28.	44.	71.	127.
249.	494.	889.	1396.	1930.	2390.	2698.	2825.	2804.	2690.
2527.	2341.	2151.	1964.	1708.	1524.	1474.	1337.	1214.	1102.
1000.	910.	829.	756.	689.	629.	574.	526.	482.	443.
406.	370.	336.	306.	278.	252.	229.	209.	189.	172.

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME  
 5632. 5416. 3618. 1463. 70228.

SFS 2.36 6.32 7.66  
 INCHES AC-FT 2687. 7181. 8710.

STATION 2, PLAN 1, R110 3

2.	3.	4.	7.	13.	21.	32.	51.	83.	147.
288.	761.	1750.	3387.	5403.	7257.	9069.	9401.	8731.	7658.
6893.	6125.	5338.	4611.	3982.	3427.	2946.	2527.	2181.	1870.
1512.	1402.	1212.	1044.	903.	798.	703.	616.	538.	466.
399.	337.	304.	276.	251.	228.	207.	188.	171.	156.

STOR

3.	3.	5.	10.	17.	27.	42.	65.	107.	190.
373.	734.	1302.	2018.	2750.	3357.	3700.	3757.	3642.	3459.
3238.	2987.	2729.	2481.	2249.	2034.	1838.	1661.	1501.	1357.
1223.	1114.	1010.	917.	835.	760.	693.	631.	576.	525.
477.	433.	390.	358.	325.	296.	269.	244.	222.	202.

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME  
 9401. 8715. 5558. 2204. 105777.

SFS 3.80 9.71 11.54  
 INCHES AC-FT 4324. 11031. 13117.



\*OVN\*

STATION		2. PLAN 1, RTIO 4		43.		67.		110.		196.	
3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
425.	1133.	2610.	4969.	7956.	11684.	13775.	12991.	11633.	11633.	10206.	10206.
8675.	7332.	6548.	5726.	4931.	4261.	3655.	3150.	2694.	2694.	2324.	2324.
1397.	1707.	1487.	1289.	1111.	954.	840.	740.	649.	649.	565.	565.
484.	409.	344.	307.	279.	253.	230.	209.	190.	190.	173.	173.
STOR											
4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
495.	366.	1699.	2608.	3510.	4148.	4377.	4320.	4139.	4139.	3895.	3895.
3533.	3382.	3125.	2856.	2596.	2352.	2127.	1921.	1735.	1735.	1567.	1567.
1416.	1281.	1161.	1052.	954.	868.	790.	719.	654.	654.	595.	595.
537.	484.	430.	399.	362.	329.	299.	271.	247.	247.	224.	224.
PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME											
JFS 13775. 12521. 7512. 2945. 141380.											
INCHES 5.47 13.12 15.43 15.43											
AC-FI 6212. 14307. 17535. 17535.											

\*OVN\*

STATION		2. PLAN 1, RTIO 5		54.		84.		138.		245.	
4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
534.	1544.	3547.	6689.	11740.	17633.	18174.	16314.	13784.	13784.	11845.	11845.
10417.	8851.	7416.	6333.	5807.	5005.	4320.	3704.	3194.	3194.	2732.	2732.
2355.	2024.	1729.	1505.	1305.	1126.	966.	848.	746.	746.	651.	651.
553.	473.	338.	334.	302.	274.	243.	227.	206.	206.	187.	187.
STOR											
5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
615.	1192.	2093.	3171.	4158.	4657.	4696.	4561.	4378.	4378.	4176.	4176.
3931.	3663.	3409.	3153.	2992.	2620.	2374.	2146.	1939.	1939.	1751.	1751.
1581.	1429.	1293.	1171.	1061.	962.	874.	796.	723.	723.	656.	656.
591.	529.	476.	431.	392.	356.	324.	294.	267.	267.	243.	243.
PEAK 5-HOUR 24-HOUR 72-HOUR TOTAL VOLUME											
JFS 18174. 16476. 9492. 3688. 177012.											
INCHES 7.19 16.57 19.32 19.32											
AC-FI 8174. 18030. 21954. 21954.											

A-20

PEAK FLOW SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS

OPERATION	STATION	PLAN	.20	.40	.60	.80	1.00
HYDROGRAPH AT	1	1	3735.	7590.	11305.	15140.	18976.
	2	2	0.	0.	0.	0.	0.
ROUTED TO	1	1	2513.	5632.	9401.	13775.	18174.
	2	2	0.	0.	0.	0.	0.

PREVIOUS INSPECTION REPORTS

NOTE: After filling out one of these forms as completely as possible for each dam in your district, return it at once to the Conservation Commission, Albany.

STATE OF NEW YORK  
CONSERVATION COMMISSION  
ALBANY

DAM REPORT

*Aug 6th*, 191*5*

CONSERVATION COMMISSION,

DIVISION OF INLAND WATERS.

GENTLEMEN:

I have the honor to make the following report in relation to the structure known as the *Middle Branch or Tilly Foster* Dam.

This dam is situated upon the *Middle Branch of Boston River* in the Town of *South East*, *Putnam* County,

about *2 1/4 miles* from the Village of *Beacon*.

The distance *up* stream from the dam, to the *Tilly Foster Railroad, via Post Office* is about *1 1/2 miles*.

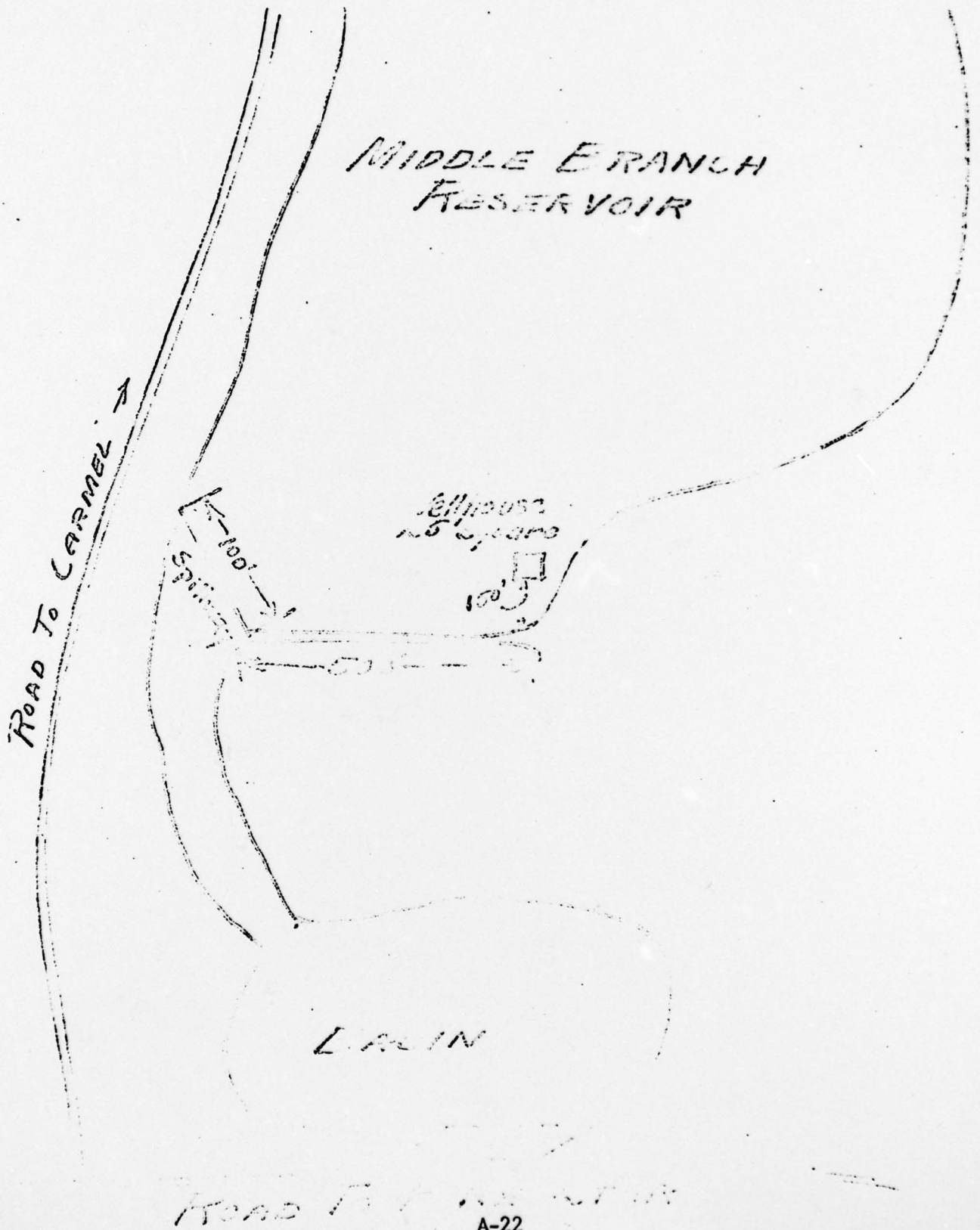
The dam is now owned by *New York City* and was built in or about the year *1875* and was extensively repaired or reconstructed during the year *1915*.

As it now stands, the spillway portion of this dam is built of *granite* and the other portions are built of *rough masonry*.

As nearly as I can learn, the character of the foundation bed under the spillway portion of the dam is *granite* and under the remaining portions such foundation bed is *granite*.

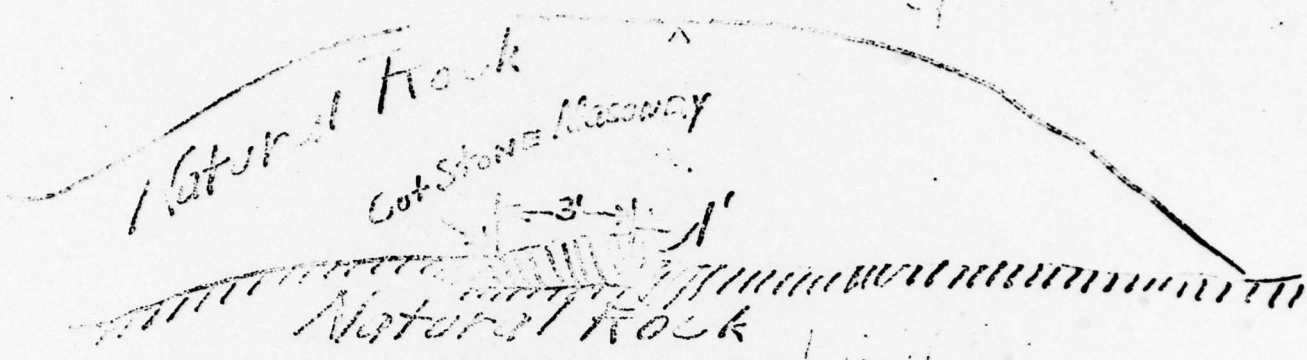


(In the space below, make a third sketch showing the general plan of the dam, and its approximate position in relation to buildings, other conspicuous objects in the vicinity.)

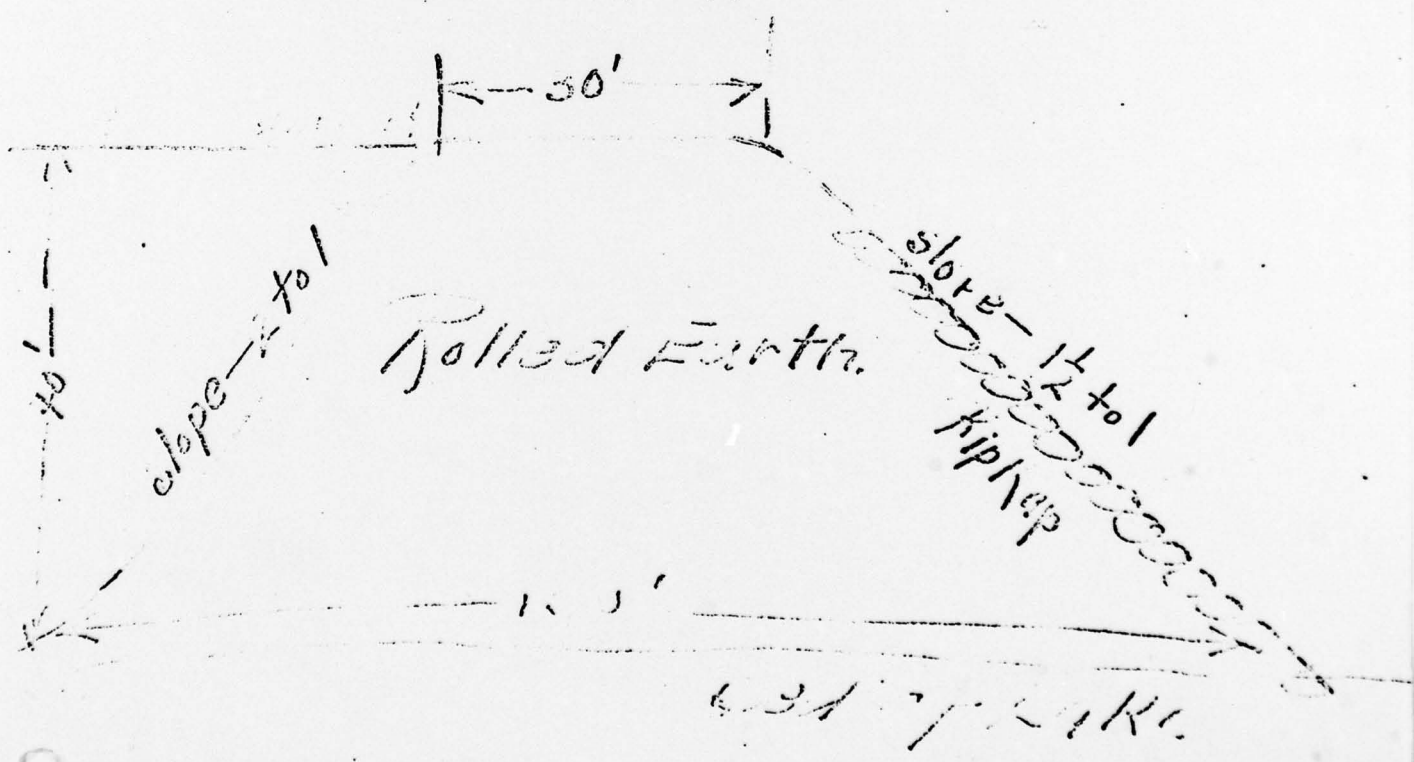


(In this section, make a sketch showing the form and disposition of a cut section through the spillway or waste-weir of this dam, and also a cross-section for a cross section through the other portion of the dam. Show particularly the general outline of the dam above the stream bed, its thickness at the top, and inclinations at the bottom, as nearly as you can learn.)

SPILLWAY SECTION



OTHER SECTION



The total length of this dam is 500 feet. The spillway or waste-  
way portion, is about 100 feet long, and the crest of the spillway is  
about 2-10 feet below the top of the dam.

The number, size and location of discharge pipes, waste pipes or gates which may be used  
for drawing off the water from behind the dam, are as follows: Two

30" pipes leading into 4 20" pipes at millhouse

At the time of this inspection the water level above the dam was 3 ft. 0 in.  
below ~~the~~ the crest of the spillway.

(State briefly, in the space below, whether, in your judgment, this dam is in good condition, or bad condition, describing particularly  
any leaks or cracks which you may have observed.)

This dam seemed to be in  
good condition and appears  
to be a simple one as it  
is simply flow into the  
cut & the base is not doing  
any harm except to carry away  
at about a highway bridge  
the water from the dam.

Reported by [Signature]



300 48

STATE OF NEW YORK  
 DEPARTMENT OF  
**State Engineer and Surveyor**  
 ALBANY

**Report of a Structure Impounding Water**

To assist in carrying out the provisions of Section 22 of the Conservation Law, being Chapter LXV of the Consolidated Laws of New York State, relating to safeguarding life and property and the erection, reconstruction or maintenance of structures for impounding water, owners of such structures are requested to fill out as completely as possible this report form for each such dam or reservoir owned within the State of New York for which no plan or reports relative thereto are on file in this Department, and to return this report form, together with prints or photographs explanatory thereof to the Department, Branch Reservoir

1. The structure is on the Middle branch flowing into the Crater River in the Town of Carmel County of Rutland and NY New York about a mile west from Brewster's Station on the Harlem Division of the N.Y.C.R.R.  
(Give exact distance and direction from a well-known bridge, dam, village main cross-roads or mouth of a stream)

2. Is any part of the structure built upon or does its pond flood any State lands? No

3. The name and address of the owner is The City of New York

4. The structure is used for impounding water for water supply

5. The material of the right bank, in the direction with the current, is \_\_\_\_\_; at the spillway crest elevation this material has a top slope of \_\_\_\_\_ inches vertical to a foot horizontal on the center line of the structure, a vertical thickness at this elevation of \_\_\_\_\_ feet, and the top surface extends for a vertical height of \_\_\_\_\_ feet above the spillway crest.

6. The material of the left bank is \_\_\_\_\_; has a top slope of \_\_\_\_\_ inches to a foot horizontal, a thickness of \_\_\_\_\_ feet and a height of \_\_\_\_\_ feet.

7. The natural material of the bed on which the structure rests is (clay, sand, gravel, boulders, granite, shale, slate, limestone, etc.) \_\_\_\_\_

8. State the character of the bed and the banks in respect to the hardness, perviousness, water bearing, effect of exposure to air and to water, etc. \_\_\_\_\_

9. If the bed is in layers, are the layers horizontal or inclined? ..... If inclined what is the direction of the horizontal outcropping relative to the axis of the main structure and the inclination and direction of the layers in a plane perpendicular to the horizontal outcropping? .....

10. What is the thickness of the layers? .....

11. Are there any porous seams or fissures? .....

12. The watershed at the above structure and draining into the pond formed thereby is 21.31 square miles

13. The pond area at the spillway crest elevation is 430 acres and the pond impounds 535.4 cubic feet of water.

14. The maximum known flow of the stream at the structure was ..... cubic feet per second on

(Date) .....

15. Has the spillway capacity ever been exceeded by a high flow? No .....

Can any possible flood flow from the pond otherwise than through the wastes noted under 17 and 18 of this report? No ..... If so, give the location, the length and the elevation relative to the spillway crest and the character and slopes of the ground of such possible wastes. ....

16. State if any damage to life or to any buildings, roads or other property could be caused by any possible failure of the above structure. Describe the location, the character and the use of buildings below the structure which might be damaged by any failure of the structure; of roads adjacent to or crossing the stream below the structure, giving the lowest elevation of the roadway above the stream bed and giving the shape, the height and the width of stream openings; and of any embankments or steep slopes that any flood could pass over. Also indicate the character and use made of the ground below the structure. ....

The failure of this dam could cause no great loss of life or damages as it is only about 100 feet up stream from the Croton Falls Reservoir .....

17. WASTES. The spillway of the above structure is 100 feet long in the clear; the waters are held at the right end by a ..... the top of which is ..... feet above the spillway crest, and has a top width of ..... feet; and at the left end by a ..... the top of which is ..... feet above the spillway crest, and has a top width of ..... feet.

18. There is also for flood discharge a pipe 2 30 inches in diameter and the bottom is ..... feet below the spillway crest; and a (sluice, gate outlet) ..... wide in the clear by ..... feet high, and the bottom is ..... feet below the spillway crest.

no

19. APRON. Below the spillway there is an apron CONCRETE (Material)

XXXXXXXXXXXXXXXXXXXX for thickness of the abutment side of the apron bottom thickness of XXXXXXXXXXXXXXX feet  
XXXXXXXXXXXXXXXXXXXX

20. Has the structure any weaknesses which are liable to cause its failure in high flows? .....

.....

21. SKETCHES. On the back of this report make a sketch to scale for each different cross-section of the above structure at the greatest depth; giving the height and the depth from the surface of the foundation, the bottom width, the top width (for a concrete or masonry spillway at two feet below the crest), the elevation of the top in reference to the spillway crest, the length of the section, and the material of which the section is constructed; on the spillway section show a cross section of the apron, giving its width, thickness and material, and show the abutment or wash wall at the end of the spillway, giving its heights and thickness. Mark each section with a capital letter. Also sketch a plan; show the above sections by their top lines, giving the mark and the length of each; the openings by their horizontal dimensions; the abutments by their top width and top lengths from the upstream face of the spillway section; and outline the apron. Also sketch an elevation of each end of the structure with a cross section of the banks, giving the depth and width excavated into the banks.

22. WATER SUPPLY. The waters impounded by the above structure have (not) been used for a public water supply since 1878 by City of New York

.....

7  
535.4