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2 OCT 1978

NANEN-F

Honorable Hugh L. Carey Governor of New York Albany, New York 12224

Dear Governor Carey:

The purpose of this letter is to inform you of a clarification of the guidelines used by this office in assessing dams under the National Program of Inspection of Dams.

Office of the Chief of Engineers has recently provided a clarification that dams with seriously inadequate spillways are to be assessed as unsafe, nonemergency, until more detailed studies prove otherwise or corrective measures are completed.

The following dams in your state have previously been assessed as having seriously inadequate spillways, with capability to pass safely only the percentage of the probable maximum flood as noted in each report. They are now to be assessed as unsafe:

| 1.D. NO. | NAME OF DAM |
|----------|--|
| N.Y. 59 | Lower Warwick Reservoir Dam |
| N.Y. 4 | Salisbury Mills Dam |
| N.Y. 45 | Amawalk Dam |
| N.Y. 418 | Jamesville Dam |
| N.Y. 685 | Colliersville Dam |
| N.Y. 6 | Delta Dam |
| N.Y. 421 | Oneida City Dam |
| N.Y. 39 | Croton Falls Dam |
| N.Y. 509 | Chadwick Dam (Plattenkill) |
| N.Y. 66 | Boyds Corner Dam |
| N.Y. 397 | Cranberry Lake Dam |
| N.Y. 708 | Seneca Falls Dam |
| N.Y. 332 | Lake Sebago Dam |
| N.Y. 338 | Indian Brook Dam |
| N.Y. 33 | Lower(S) Wiccopee Dam (Lower Hudson W.S. for Peekskill) |

NANEN-F Honorable Hugh L. Carey

| I.D. NO. | NAME OF DAM |
|----------|-----------------------------|
| N.Y. 49 | Pocantico Dam |
| N.Y. 445 | Attica Dam . |
| N.Y. 658 | Cork Center Dam |
| N.Y. 153 | Jackson Creek Dam |
| N.Y. 172 | Lake Algonquin Dam |
| N.Y. 318 | Sixth Lake Dam |
| N.Y. 13 | Butlet Storage Dam |
| N.Y. 90 | Putnam Lake (Bog Brook Dam) |
| N.Y. 166 | Pecks Lake Dam |
| N.Y. 674 | Bradford Dam |
| N.Y. 75 | Sturgeon Pool Dam |
| N.Y. 414 | Skaneateles Dam |
| N.Y. 155 | Indian Lake Dam |
| N.Y. 472 | Newton Falls Dam |
| N.Y. 362 | Buckhorn Lake Dam |
| | |

The classification of "unsafe" applied to a dam because of a seriously inadequate spillway is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. It does mean, however, that based on an initial screening, and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard to loss of life downstream from the dam.

Consequently, it is advisable to implement the recommendations previously furnished in the reports for the above-mentioned dams as soon as practicable.

It is requested that owners of these dams be furnished a copy of this letter and that copies be permanently appended to all reports previously furnished to you.

Sincerely yours,

CLARK H. BENN Colonel, Corps of Engineers District Engineer

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CROTON RIVER BASIN

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AMAWALK DAM WESTCHESTER COUNTY, NEW YORK INVENTORY NO. 45

PHASE I INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM



Prepared by: TIPPETTS-ABBETT-McCARTHY-STRATTON

NEW YORK DISTRICT CORPS OF ENGINEERS

MAY 24, 1978

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(a) List of Reviewed Drawings

 (b) Vicinity Map Topographic Map (USGS) General Plan of the Embankment Section of the Dam and Profiles Along Center Wall and Guard Dam Section of Spillway Section of Intake Tower, Upstream Conduit and Spillway Section of Masonry Center Core Wall Profile Showing Grades of Pipe Conduits, Spillway and Outlet Pipes Locations of Observations

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C. ENGINEERING DATA CHECKLIST

D. VISUAL INSPECTION CHECKLIST

- E. HYDROLOGIC DATA AND COMPUTATIONS
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PHASE I REPORT NATIONAL DAM SAFETY PROGRAM

Name of Dam: State Located: County Located: Stream: Date of Inspection:

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AMAWALK (I.D. NO. 45) NEW YORK STATE WESTCHESTER COUNTY MUSCOOT RIVER 27 APRIL 1978

ASSESSMENT

The examination of documents and visual inspection of Amawalk Dam and appurtenant structures did not reveal conditions which constitute an immediate hazard to human life or property. The dam project, however, has a number of deficiencies which, if not thoroughly monitored, evaluated and remedied, may have the potential for developing into hazardous conditions. Although the dam is not in imminent danger in its present condition, additional investigations should be undertaken to evaluate the need for and type of remedial measures. The investigations should be started immediately and should be performed in accordance with the requirements of the applicable sections of Chapter 4 of the RECOMMENDED GUIDELINES FOR SAFETY IN-SPECTION OF DAMS. The immediate investigations should include, but not necessarily be limited to, periodic and systematic observations and measurement of the quantity of seepage, chemical analyses of the seepage discharge, piezometric observations, seepage and stability analyses. Other investigations, including sampling and testing may be found necessary to evaluate the condition of the structures and their foundation.

The total discharge capacity of the spillway and regulatory outlets at maximum pool is about 6,470 cfs. This is less than the estimated probable maximum flood (PMF) of 35,000 cfs and also less than the standard project flood of 13,370 cfs, both as determined by the Corps of Engineers screening criteria. The project discharge capacity is, therefore, seriously inadequate according to the Corps of Engineers adopted general principle that structures be designed for the maximum flood reasonably characteristic of the region, which is, in practice, the Standard Project Flood. Additional hydrologic investigations to more reliably estimate the PMF are recommended; site-specific characteristics of the watershed, such as surcharge storage at the dam and upstream lake control should be considered. In addition to the investigations recommended above, the following improvements are suggested:

- Correct deficiencies related to surface drainage:
- Remove vegetation growing on embankments and treat animal burrows.
- Repair spillway walls.
- Develop programs for operation, maintenance and inspection.

Eugene O'Brien, P.E. New York No. 29823

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Approved By:

New York District Engineer

Date: 30 June 78



PHASE I INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM AMAWALK DAM, INVENTORY NO. 45 CROTON RIVER BASIN WESTCHESTER COUNTY, NEW YORK

SECTION I PROJECT INFORMATION

1.1 <u>GENERAL</u>

a. Authority

The Phase I Inspection reported herein was authorized by the DEPARTMENT OF THE ARMY, NEW YORK DISTRICT, CORPS OF ENGINEERS by letter dated 31 March 1978, in fulfillment of the requirements of the National Dam Inspection Act, Public Law 92-367, 8 August 1972.

b. Purpose of Inspection

The purpose of this inspection and report is to investigate and evaluate the existing conditions of the subject dam in order to: identify deficiencies and hazardous conditions; determine if they constitute hazards to human life or property; and notify the State of New York of these results along with recommendations for remedial measures where necessary.

1.2 DESCRIPTION OF THE PROJECT

a. Description of the Dam and Appurtenant Structures

The Amawalk Dam is composed of a 1,270 foot long earth embankment and a 50 foot wide ogee type masonry spillway. Two 30-inch diameter pipes serve as low level outlets; the flow through these pipes is regulated by gate valves.

The crest of the embankment is 55 feet wide, the upstream slope is 1 on 5 and the downstream slope is 1 on 3. Near the two sidewalls of the spillway, which is located slightly left (looking downstream) of the center of the embankment, the downstream slope of the embankment is locally steepened. The maximum height of the embankment above the old stream bed, which is located right of the center of the embankment, is 82 feet. The downstream slope, the crest and about 20 feet wide top section of the upstream slope are covered with grass. The remainder of the upstream slope is protected by riprap. There are two vertical masonry rubble walls inside of the embankment; one of these, the center core wall, runs below the center of the crest. The second wall, called the guard wall, is parallel with the first and located about 290 feet upstream of the center wall. The dimensions of the center wall are: width at the base 15 feet, width at the top 8 feet, maximum height: 85 feet. It appears that in line with this wall the crest is raised approximately 2 feet over a width of 12 feet. The guard wall is 8 feet wide at the base, 4 feet wide at the top and its maximum height is 28 feet.

There is a small auxiliary earthfill embankment constructed west of the main embankment, near the intersection of Routes 35 and 202. The auxiliary embankment is about 300 feet long and 25 feet high. Its upstream slope is protected by heavy riprap; the crest and the downstream slopes are grass covered.

The ungated spillway is constructed of masonry rubble; the surface of its 50 foot wide ogee section is faced with stone blocks. The ogee is flanked by two side walls also built of stone blocks. The elevation of the spillway crest is 400 feet (above M.S.L.-Croton Datum), which is 10 feet below the crest of the embankment.

The intake structure of the low level outlet is a masonry intake tower located near the upstream toe of the embankment. From this tower a 9.5 foot inside diameter conduit leads to the center wall. The center wall provides a seal around the outlet conduit which bifurcates into two 30-inch diameter pipes at the wall. These two pipes continue downstream, inside of a 12 foot diameter brick conduit, from the center wall to the gate house located at toe of the dam. A gate vault, which is near and downstream of the center wall, houses two 30-inch diameter gate valves and their controls. In the gate house the two 30-inch diameter pipes further branch into four 20-inch diameter pipes. The flow is controlled by two 30-inch diameter gate valves located upstream of the branching and four 20-inch diameter valves, one on each pipe, downstream of the branching. Downstream of the gate house, the four 20-inch diameter pipes continue underground and terminate in a circular discharge fountain from which the water cascades to the tailrace channel of the spillway. There is a drainage vault just upstream of the discharge fountain for draining the gate house and also for draining the water out of the outlet pipes and fountain when required. The spillway tailrace channel is 50 feet wide; it is stone paved and bordered by two vertical stone walls. The water released into the tailrace channel contributes to the water supply of the City of New York.

A 20-inch diameter pipe leads from the discharge fountain to a pump house downstream of the fountain. The other user of the water from the Amawalk reservoir, the Westchester County Water District, pumps water from this pump house to its facilities located south of Route 35.

b. Location

Amawalk Dam is located on the Muscoot River, a tributary of the Croton River, near Route 35 and about 0.6 miles east of the intersection

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of this highway with Route 202. The nearest village is Amawalk located just north of the intersection. The closest sizable settlements are: Yorktown Heights, about 2 miles to the southwest and Katonah, about 4 miles to the southeast.

c. Size Classification

The dam is 82 feet high and therefore it is classified as an "intermediate" dam (between 40 and 100 feet high).

d. Hazard Classification

The dam is in the "high" hazard potential category.

e. Ownership

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Amawalk Dam is owned and operated by the New York City Bureau of Water Supply (BOWS); the operation and maintenance of the dam and related structures are carried out by the Katonah Section of the East-of-Hudson Division of BOWS.

f. Purpose of Dam

The dam impounds water for the use of the City of New York and the County of Westchester.

g. Design and Construction History

The dam and its appurtenant structures were designed by the Department of Public Works of New York in the early 1890's. The construction contract was awarded to John McQuade; the works were completed in 1897.

h. Normal Operating Procedures

Water is released from the Amawalk reservoir either by the low level outlets or over the spillway. Approximately 5 mgd is released into the Muscoot River for the use of New York City. The other user of the water, Westchester County Water District, pumps water from the discharge fountain at a rate ranging from 2.5 to 4.5 mgd.

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1.3 PERTINENT DATA

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| a. | <u>Drainage Area</u> (sq. mi | •) | 19.5 |
|----|--|--|--|
| b. | Discharge at Dam Site Maximum known flood Ungated Spillway at D Ungated Spillway at m Maximum capacity of Total Discharge, Max Average daily discharge | (cfs) (October 16, 1955) esign Pool (El 405) aximum pool (El 410) low level outlets (Estimated) . pool (El 410) ge | 1,677 2,180 6,170 300 6,470 12.4 |
| c. | <u>Elevation (ft above MS</u> Top of dam Maximum design pool Spillway crest Tailrace channel Invert low level outlet Discharge level at fou | <u>SL-Croton Datum)</u> (top of riprap) ntain | 410.0 405.0 400.0 324.0 330.5 331.0 |
| d. | <u>Reservoir</u> Length of maximum poo Length of shoreline (sy Surface area (spillway | ol, miles pillway crest),miles crest),acres | 2.4 8.5 606.1 |
| е. | <u>Storage, (acre-feet)</u> Spillway crest Maximum design pool Top of dam | | 20,500 23,170 24,975 |
| f. | Dam Embankment Type: Length, ft. Upstream slope: Downstream slope: Impervious core: Crest elevation, ft. | Earthfill with rubble masonry core wall and upstream guard 1 on 5 1 on 3 rubble masonry central core 15 feet wide at the base, an 8 feet wide at the top | v central d wall 1,220 wall d 410 |
| | Crest width, ft. Grout curtain: | none | 55 |

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Sec. Sta

| g. | Spillway | | |
|----|------------------------|-------------------------|-------------|
| | Type: | Ungated - ogee; masonry | rubble with |
| | | stone facing | |
| | Length, ft. | | 50 |
| | Crest elevation MSL - | Croton Datum | 400.00 |
| | Crest elevation MSL - | Sandy Hook Datum | 399.55 |
| | Upstream channel: | none | |
| | Downstream channel: | 50 ft. wide | |
| | | Stone side walls, stone | pavement |
| | | discharges into Muscool | River |
| h. | Regulating Outlets | | |
| | Upstream of central co | ore wall: | |

Intake channel and tower near upstream toe; 9.5 ft. inside diameter masonry conduit between intake tower and central wall. No regulatory gates.

Downstream of central wall:

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Two 30-inch diameter pipes regulated by 30-inch gate valves at gate vault (valves are not functioning) and two additional 30-inch diameter gate valves in gate house. Both 30-inch diameter pipes bifurcate in gate house into 20-inch diameter pipes. These are controlled by 20-inch diameter gate valves in the gate house.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

a. Geology and Foundation

The Bureau of Water Supply files contain no data on site geology and foundation conditions. The search in connection with this inspection did not reveal any information on exploratory borings or foundation investigations made prior to or during construction. However, there is data available in the literature on the general geology of the area (References 6, 7 and 8 in Appendix F.)

The bedrock in the area of the Amawalk dam and reservoir is composed of Precambrian formations: granitic and schistose gneisses and paragneisses. There are also some local interlayers of amphibolite and marble. The rock is exposed at several places around the reservoir, one exposure is near the left abutment of the main embankment. The rock appears to be competent although some members are fractured and others contain wide open joints. These observations, however, may reflect only surface conditions. As indicated in Reference 8, a minor fault cuts through the lower portion of the reservoir; it strikes in NW-SW direction and passes near the auxiliary embankment.

b. Embankments and Appurtenant Structures

The dam was engineered by the Department of Public Works of New York. BOWS' files contain some project drawings; drawings obtained from the BOWS Appendix A. One of the Aqueduct Commission's Reports, Reference 10, also shows a cross-section of the dam. The ASCE and USBR publications, given as References 3 and 4, contain some data on the seepage profile through the embankment; these references describe the findings of a seepage study of several dams made by the U.S. Bureau of Reclamation in the early 1920's. No data has been found for the auxiliary dam.

2.2 CONSTRUCTION RECORDS

No information has been located in relation with the construction of the project except the year of completion, 1897, and the name of the contractor, John McQuade.

2.3 OPERATION RECORD

The pool level and rainfall are recorded on a daily basis. Except for a record of water released to Westchester County Water District, the secondary user, there are no records of gate operation or discharges. There is no operation or maintenance manual. Work orders in connection with repairs and maintenance are in the files of BOWS' District Office. Although the BOWS District and Section forces visually inspect the dam from time to time, no systematic monitoring of the performance of the dam is in effect.

2.4 EVALUATION OF DATA

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The existing data have been made readily available by the New York and Katonah Section Offices. In addition, the District and Section Engineers contributed valuable observations concerning the behavior of the structure in the past years. The drawings provide no information on the embankment material and the nature of the foundation; also, they do not represent the as-built conditions in all respects. The drawings of the spillway and low level outlets are more detailed and contain adequate data for the Phase I inspection and evaluation of these structures.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. <u>General</u>

The visual inspection of Amawalk Dam and its auxiliary embankment was made on April 27, 1978. The weather was cloudy and windy; temperature in the 40-45F^O range. The inspection was made 8 days after the last rainfall. The reservoir level at the time of the inspection was 2 inches above spillway crest level: at 400.17 feet.

b. Embankment and Abutments

The earth embankment, which was completed in 1897, shows no signs of major distress. The vertical and horizontal alignment of the crest appears to be unchanged; there are no cracks visible on the crest, downstream slope or portion of upstream slope exposed above reservoir level. There are no depressions, indications of sliding, sloughing, except as noted below. The grass covering the downstream slope, crest and portion of upstream slope above riprap is generally well maintained. However, the following adverse conditions were noted:

*(A) Seepage appears along the right abutment contact and on the lower portion of the downstream slope on the right side of the embankment. A reddish-brown deposit is evident where the water emerges from the ground or embankment slope and along the toe ditch. The Section Engineer thought that seepage has recently increased somewhat in this area. The water is clear, it does not seem to carry eroded particles; the reddish-brown material appears to be either bacterial growth or deposition of dissolved minerals. The toe portion of the slope surface in this area is saturated, soft and covered with bushes and also shows minor surface irregularities - possibly tractor track marks.

(B) The toe ditch on the right side of embankment contains debris, loose deposits and vegetation growth.

(C) The ground downstream of the embankment seepage described in (A) is soaked, wet and covered with marsh vegetation.

(D) Surface erosion was noted on the crest on both sides of the spillway wall.

*The location of these observations are marked on the enclosed sketch by the corresponding capital letters in parenthesis.

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(E) The maximum size of the riprap is 10 inches and many of the stones are weathered and unsound. There is some vegetation growth; bushes and saplings, in the riprap area.

way wall.

(F) There is some damage to the riprap near the left spill-

(G) Some animal burrows - 8 inch diameter, several feet deep, were noted on the upper portion of the downstream slope.

(H) The two surface drain ditches (one along the wall of the spillway and another along the toe of the embankment) which collect all surface water from the downstream slope of the left side of the embankment have no outlet on the surface. Water from these ditches enters the ground behind the gate chamber wall and exits through the wall. The embankment slope in this area shows several depressions indicating a loss of fines.

(I) Seepage emerges from the wall left of the gate chamber and also from between the stones serving as slope protection for the slope left and downstream of the gate chamber. The reddish-brown deposit mentioned in (A) is also apparent here.

(J) The ground downstream of the gate chamber is wet, the water is near or at the surface. The ground is soft; a walkway made of boards has been constructed here to facilitate the approach to the gate house.

(K) There is a brick-enclosed spring on the natural slope downstream on the left side of the dam.

c. Spillway and Tailrace Channel

The masonry spillway structure appears to be in good condition. The stones facing the spillway ogee section are sound and show no sign of movement or deterioration; the spillway walls show only minor cracks and some water seepage from the joints. During the inspection, water was flowing over the spillway. For this reason, possible leaks in the ogee section could not be observed. The Section Engineer did not notice such leaks during previous visits. On the negative side:

(L) Both spillway inlet walls at reservoir level are in damaged condition; large stones comprising the masonry wall are loose and/or dislocated.

(M) The walls of the tailrace moved inward both on the left and right side. Some of the stones in the wall are loose. There are several cracks in the wall and some of the stones have fallen into the tailrace channel. (N) The tailrace channel has some debris accumulation.

d. <u>Regulating Outlets</u>

Most of the intake tower and the portion of the intake conduit upstream of the center core wall are submerged, and were therefore, not inspected. The gate house and the brick walled lower pipe conduit are in good condition; no cracks are evident. The pipes and valve-housings show no signs of significant corrosion.

The following observations of adverse nature were made:

(O) Seepage is evident on the ceiling and walls of the gate chamber and pipe conduit. Water is flowing on the floor of the conduit and 2-3 inches of water and semi-solid deposits cover the floor of the lower level of the gate chamber. In the conduit the seepage is more intense near the gate chamber and decreases toward the center core wall. Seepage is greater on the left side of both gate house and conduit. The reddish-brown deposit mentioned in (A) is noticeable on the left side of these structures. The right side of the conduit shows white mineral deposits - these are thought to be dissolved from the mortar. At the time of the inspection, the Section Engineer pointed out a seepage spot on the right wall of the gate house that he had not noticed before.

(P) The components of the gate operating structures (stands, stems, gears, etc.) are corroded and rusted at most places and some of the parts (stands) are broken. The 30-inch diameter gate valves in the gate vault, located downstream of the center wall, have not been operated for many years and it is presumed that they are not operational. These valves are in the fully open position. There were no major deficiencies noted in connection with the valves located in the gate house. Some of these gates, however, cannot be closed completely. The valves are not periodically inspected and, except for some greasing of the gears, no inspection or maintenance is performed.

(Q) The stone wall left of the gate chamber has moved about 3-inches downstream and 2-inches vertically downward along a construction joint. This movement appears to be the result of inadequate surface drain-age mentioned in (H).

e. <u>Reservoir Area</u>

There were neither slides, rockfalls, sloughing or other signs of instability noted in the vicinity of the dam nor were objectionable amounts of floating debris observed in the reservoir.

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3.2 EVALUATION OF OBSERVATIONS

Although deficiencies were observed there is no indication that the dams are in imminent danger. A number of the deficiencies listed in the previous paragraph are minor and may be either tolerated or corrected by the maintenance forces. Other deficiencies described above, however, represent conditions which may have potential for further deterioration; for this reason, these conditions need to be further investigated.

The most significant of the observations in this later category are the persistent foundation seepage on the right side of the embankment and the seepage in the area of the gate chamber and pipe conduit. (Items(A) (C) (I) (J) (O). Since the pattern of seepage and possible changes in this pattern are not known and little is known about the condition of the embankment and foundation, additional investigations and a program of systematic observations are warranted.

It is necessary to improve surface drainage on the left side of the embankment (Items (H) (J) (O)). The inadequate drainage noted in (H) may contribute to or possibly cause most of the seepage observed in the gate chamber and pipe conduit. The surface water can be diverted from behind the gate chamber and adjacent walls by surface drainage improvements requiring only minor effort. The correction of the condition described in Items (H) (J) (M) and (O) may require more extensive construction.

Most of the conditions covered by Items (B) (D) (E) (F) (G) (L) and (N) can be handled as part of the maintenance work.

The gate operating structures - Item (D) - need to be inspected periodically and repaired if necessary. The improper functioning or failure, of these components may not, for all practical purposes, reduce the maximum discharge capacity of the project but could hinder the water supply releases and may not allow rapid emptying of the reservoir.

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SECTION 4 - OPERATION AND MAINTENANCE PROCEDURES

4.1 PROCEDURES

Amawalk Reservoir discharges approximately 5 mgd into the water supply system of New York City. In addition, an average 3 mgd is released to the Westchester County Water District. During the summer months, in July and August, this quantity is increased to 4.5 mgd. The release to Westchester and the flow over the spillway varies but the release to New York is kept nearly constant. In order to provide New York with 5 mgd, the total outflow is regulated by the gate valves located in the gate house. The release facilities are not calibrated, the quantities released are only estimated.

4.2 MAINTENANCE OF DAM

The reservoir is frequently visited by the watershed inspector and gate operators who do not necessarily examine the dam or other project features. Although the Section Engineer inspects the dam and other structures periodically, there is no formally established program of inspections and there are no operation and maintenance manuals for the project.

The grass slope protection on the main embankment and auxiliary embankment is mowed every few months. Maintenance of the grass surfaces on the main dam appears to be adequate except for the growth of brush at the toe of the sufface of the small auxiliary embankment, which is not as easily accessible, is less than adequate. No regular maintenance procedures are established for the masonry structure and spillway, although some minor repair of stone work is done occasionally. The toe collector ditch at the left embankment is not cleaned and the amount of seepage is not monitored.

4.3 MAINTENANCE OF OPERA FING FACILITIES

The 30 and 20-inch diameter gate valves in the gate house used for regulating the water releases appear to be in acceptable operating condition, although some of these gates cannot be closed fully. The 30-inch diameter valves in the upstream valve vault have not been operated for many years and it is presumed that they are not in working condition. There is no periodic inspection of the operating facilities and there is no regular program of repairs.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 DRAINAGE AREA CHARACTERISTICS

The Amawalk Reservoir is located on the Muscoot River, a small tributary of the Croton River, located on the west-central boundary of the latter's basin. The total drainage area at Amawalk Dam is 19.1 sq. mi. The area is in a region of rapidly growing suburban development, with considerable density in limited village areas and shopping centers. The topography is characterized by steep hills and ridges running in a general northsouth direction, interspersed with flat valleys containing lakes and swamps. The total area of lakes and swamps is 3.85 sq. mi., or 20 percent of the drainage area. The largest lakes, Lake Mohopac and Kirk Lake at the northern limits of the basin, appear to modify the runoff from 5.56 sq. mi. or 29 percent of the drainage area. The basin has an unusual length to width ratio of four, which in addition to the natural storage, can be expected to modify flood runoff.

5.2 SPILLWAY CAPACITY

The spillway design is unusual for a structure built in 1897 in that it is shaped to conform to the overfall jet. The length is 50 feet which is small compared with other spillways for dams in the Croton Basin, having similar drainage areas. The maximum head possible between the crest of the spillway and the top of the dam is 10 feet. No data are available on the discharge-rating of the spillway, so that weir coefficient was assumed to vary from 3.0 at one foot head to 3.9 at five feet of head and above. The computed capacity at maximum head is 6,170 cfs. The spillway rating curve is shown on Figure 1 of the Appendix.

5.3 <u>RESERVOIR CAPACITY</u>

The total reservoir capacity at the spillway crest is 6,692 million gals. (20,500 acre-feet). The storage capacity curve, based on a table furnished by the Department of Water Supply, is shown on Figure 2. The capacity curve has been extrapolated to an elevation corresponding to the top of the dam and indicates a surcharge storage above the spillway crest of 4,475 acre-feet, which is equivalent to a runoff depth of 4.4 inches over the drainage area. This is an important factor in considering the adequacy of the spillway to pass design floods.

5.4 FLOODS OF RECORD

The greatest floods in the Croton River Basin since completion of

the New Croton Dam in 1905 and probably since the completion of Amawalk Dam in 1897 were in August and October, 1955. The record of these floods at the dam is as follows:

| | Elev. | Head | Disc | charge |
|--------------------|--------|--------|-------|---------------|
| Date | (feet) | (feet) | (cfs) | (cfs/sq. mi.) |
| August 20-21, 1955 | 403.33 | 3.33 | 1,050 | 55.0 |
| October 16, 1955 | 404.33 | 4.33 | 1,667 | 87.3 |

The record of precipitation at the dam indicates that 6.96 inches occurred in three days from August 12-14, inclusive, followed by 6.66 inches on August 17 and 18, for a total of 13.62 inches in eight days. The October storm was more concentrated with a total of 9.06 inches in three days from October 14-16, inclusive, of which 5.95 inches fell October 15.

Although the precipitation in the 1955 storms appears to have been as severe in the Amawalk Basin as the other parts of the Croton River Basin, the peak runoffs per square mile were considerably less, indicating a lowe flood potential for the Amawalk.

5.5 OVERTOPPING POTENTIAL

The maximum spillway discharge capacity of 6,170 cfs given in Paragraph 5.2 above has been compared with generalized flood criteria as explained below. The Probable Maximum Flood for the 19.1 sq. mi. drainage area has been extrapolated from maps of Probable Maximum Flood Potential for selected sizes of drainage (Ref. 11). The smallest drainage area for which floods have been plotted was 100 sq. mi. The extrapolation to 19.1 sq. mi. must be considered approximate but indicates a Probable Maximum Flood peak inflow of about 35,000 cfs. or about 5.67 times the spillway discharge capacity.

A second criteria for evaluating a design flood is the Standard Project Flood which is usually about one half of the Probable Maximum Flood. Derivations of Standard Project Floods in the Lower Hudson Basin are available in a report made for the Corps of Engineers (Ref. 12). Data in this report permitted interpolation of the Standard Project Flood for an area of 19.1 sq. mi. and indicated a flood potential of 700 cfs per sq. mi. or a total discharge of 13,370 cfs on 2.17 times the spillway capacity.

5.6 EVALUATION

The estimated Probable Maximum Flood inflow of 35,000 cfs and the Standard Project Flood inflow of 13,370 cfs must be considered as representing potential inflow to a reservoir from a drainage area that has little natural or artificial storage. To properly evaluate the relation between Amawalk Dam spillway capacity and the probable outflow from these design floods it would first be necessary to develop complete hydrographs and route them through the available storage. If such hydrographs were based on average drainage area conditions in the general region, they still would not reflect the affect of upstream surface storage in the basin. To evaluate time conditions it would be necessary to develop hydrographs for sub-areas and route them through related storage areas. Without this latter detailed analysis, it is not possible to say whether or not the spillway capacity is inadequate relative to either of the design floods.

Because of the relatively small spillway capacity relative to potential design flood inflows, it is advisable that further hydrologic analyses be made for the Amawalk Dam.

5.7 POTENTIAL FOR LOSS OF LIFE DOWNSTREAM

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The Muscoot River between Amawalk Reservoir and its outlet in New Croton Reservoir flows in a steep valley about 3 miles long with an average slope of approximately 60 feet per mile. In the event of a failure of Amawalk Dam a flood wave in the form of a hydraulic bore with high velocity and destruction forces could be expected.

The hills adjacent to the valley are rapidly developing with suburban homes, most of which appear to be on high ground. However, some homes, particularly those adjacent to Highway 35 which crosses the valley immmediately below the dam, are low enough to be destroyed by a flood wave from a dam break.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. <u>Visual Observations</u>

Visual observations did not indicate any serious structural problems with the masonry spillway section or sign of major distress in connection with the earth embankment.

The spillway walls show only minor cracks and some water seepage from the joints. It was not possible to ascertain the existence of additional leaks on the face of the chute, if any, because of the water flowing over the spillway.

b. Design and Construction Data

No design computations or other data regarding the structural stability of the spillway or earth embankments are available. Data or information regarding the construction of these structures has not been located.

Although there are no design computations available, it is likely that the spillway had been designed in accordance with Chapter VI, Overflow Weirs of E. Wegmann's book "Design and Construction of Dams" (Reference I) and therefore it may be considered stable. Mr. Wegmann, at the time when the dam was put in service, was an engineer of the Aqueduct Commission. His theoretical studies and calculations explained in his book, were generally followed by the designers of dam projects in the area. It should be noted that flashboards had been previously installed on top of the spillway without adverse effects.

c. Operating Records

Records of operation and repairs are available at the Katonah Section of the BOWS. No major operational problems which would affect the stability of the spillway or earth embankment were reported.

d. Post-Construction Changes

There are no post-construction changes recorded.

e. Seismic Stability

The dam is located in Seismic Zone No. 1, (Reference 13) therefore, no seismic analyses are warranted.

SECTION 7 - ASSESSMENT/RECOMMENDATIONS

7.1 ASSESSMENT

a. <u>Safety</u>

Phase I investigation of Amawalk Dam did not indicate conditions which would constitute an immediate hazard to human life or property. On the basis of the performance of the spillway and the earth embankment as well as engineering judgement, both the spillway and the earth embankment are considered not to be unstable in their present condition. The dam project, however, has a number of deficiencies, the causes of and circumstances related to some of which are not sufficiently defined. These deficiencies if not thoroughly monitored, evaluated and remedied, as required, may have the potential of developing into hazardous conditions.

It should be noted that the design of the embankment dam does not follow the usual geometric design generally in use in the area at the time of the construction indicating that adverse foundation conditions and/or poor quality construction materials had been encountered by the designers. Amawalk Dam has a wider crest, flatter slopes - particularly flatter upstream slope - than other dams in the area and it also has double masonry protection wall.

The total discharge capacity of the spillway and regulating gates without overtopping of the dam is approximately 6,170 cfs. This is less than the estimated probable maximum flood (PMF) of 35,000 cfs and also less than the standard project flood of 13,370 cfs, both as determined using the Corps of Engineer's screening criteria. The project discharge capacity is therefore inadequate relative to either of the design floods.

For the reasons described above and also because of the inadequate spillway capacity, Amawalk Dam requires special attention. Measures and improvements are required in connection with the most serious deficiencies. Some of these measures need to be carried out immediately.

b. Adequacy of Information

The information related to the spillway and low level structures has been found adequate for the Phase I investigation. Design and performance data related to the embankment, however, were not sufficient to judge the effects of deficiencies noted in Paragraph 3.1 on the future performance of the dam. In addition to the dams unusual design there is a long history of seepage problems in connection with Amawalk Dam. Under these circumstances further evaluation of the conditions is essential. For the proper operation and maintenance of the project, the following items would be required:

- a. Up-to-date project drawings.
- b. Operation and maintenance manuals.
- c. Ratings for the release facilities.
- d. Inspection schedule and record of inspections.
- e. Monitoring schedule and record of data obtained by monitoring.
- f. Schedule and record of maintenance.
- g. Periodic inspection of the spillway for leaks at the time when the reservoir level is below spillway crest.

c. Urgency

Some of the recommended observations and corrective measures need to be carried out on a priority basis - otherwise damage may occur at some of the project features.

d. Need for Additional Investigations

Although the dam is not in imminent danger in its present condition, additional investigations should be undertaken to determine the exact nature and cause of the seepage conditions and to evaluate the need for and type of remedial measures. The investigations should be initiated immediately.

The additional investigations should be performed in accordance with the requirements of the appropriate sections of Chapter 4 of the RECOM-MENDED GUIDELINES FOR SAFETY INSPECTION OF DAMS. The immediate investigations should include, but not necessarily be limited to, periodic and systematic observations and measurement of the quantity of seepage, chemical analyses of the seepage effluent, piezometric observations as required, as well as seepage and stability analyses of the affected areas. Other investigations, including sampling and testing, may be subsequently found necessary to evaluate the condition of the embankment and the foundation.

It is recommended that the changes in the quantity of seepage, chemical composition of the seep water and of the solids carried by the seepage discharge and also the movement of some of the structures be monitored periodically and systematically. This monitoring - deemed to be the first priority item - can be accomplished by cleaning the drainage facilities and installing seepage measuring devices such as weirs, flowmeters, etc. and also by installing simple movement measuring gauges and surface reference points.

As second priority item, the seepage pattern through the embankment and the foundation needs to be defined and the condition of the embankment and its foundation needs to be determined. This part of the investigation may require the installation of piezometers, movement devices and also obtaining and testing samples from the embankment and foundation as well as seepage and stability analyses.

It is further recommended that additional hydrologic studies be made to more reliably estimate the PMF for this reservoir; the studies should consider site-specific characteristics of the Amawalk watershed such as surcharge storage at the dam and upstream lake control.

To evaluate the potential for loss of life in case of failure of the dam, it is recommended that a survey be made of the development in the Muscoot River valley between Amawalk Dam and New Croton Reservoir, including a census of all homes, school, churches or recreation facilities located within a height of 100 feet above the river channel.

7.2 RECOMMENDED MEASURES

a. The results of the additional investigations recommended in Paragraph 7.1d may indicate a need for corrective measures in connection with the seepage conditions which were observed at locations (A), (C), (I), (J), (O) and are described in Paragraph 3.1. Recommendations concerning possible corrective measures can only be made after the completion of the additional investigations.

b. The surface drainage, particularly in areas described at locations (D) (H) and (J) of Chapter 3.1 needs to be improved immediately in order to prevent further movements of the wall left of the gate chamber (described at location (Q)).

Additional improvements listed below can be handled as part of the maintenance work:

c. The gate operating structures need to be inspected periodically and repaired when the inspection reveals the need.

d. The minor vegetation growth noted on both upstream and downstream slopes of the main embankment should be removed. There is much denser and heavier growth, however, on the auxiliary dam which should also be removed.

e. After the evacuation of the occupants, the animal burrows should be backfilled.

f. The damage to the spillway walls should be repaired. The movements of the spillway chute walls will probably stop after the downstream drainage improvements have been carried out. g. Minor riprap damage should be corrected. The small size riprap on the main embankment is subject to damage by major storms. An inspection, and, if needed, corrective work should be carried out after such storms. The riprap on the auxiliary dam is considerably heavier than that on the main dam; there are some depressions, however, in this riprap which require some maintenance work.

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APPENDIX A

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a. List of Drawings Reviewed in Connection with Phase I Investigation of Amawalk Dam

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| BOWS REFERENCE NO |
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| No. 9985* |
| No. 9983* |
| No. 9979* |
| No. 9980* |
| No. 9976* |
| No. 9978* |
| No. 10044 |
| |
| No. 9981 |
| No. 3613 |
| From Reference 9 |
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*Drawings reproduced in this report - see Item b in this Appendix








































This drawing is reproduced from the Bureau of Water Supply Reference No. 9983-X

CROSS SECTIONS MAIN DAM AND GUARD DAM

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Bureau of Water Supply Refnce No. 9979-X

ON ALONG SPILLWAY. AMAWALK DAM.





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Reservoir A

Profile

showing Grades of Adit. Turnich, Spillway & Pipes

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TRACING OF OLD ORIGINAL TRACING BEARING IDENTICAL FILE NO. OCTOBER 1,1942.

This drawing is reproduced from the Bureau of Water Supply Reference No. 9978-X









PHOTOGRAPHS

APPENDIX B

See An



LEFT ABUTMENT AREA WHERE SEEPAGE HAS BEEN NOTED [OBSERVATIONS (A), (B) AND (C)]



DOWNSTREAM SLOPE, TOE DITCH, RIGHT ABUTMENT CONTACT SHOWING THE AREA OF SEEPAGE [OBSERVATIONS (A), (B) AND (C)]




SEEPAGE AT RIGHT ABUTMENT CONTACT [OBSERVATION (A)]



The

SPILLWAY AND GATEHOUSE





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DETAIL OF WALL JOINT LEFT OF GATEHOUSE WHERE MOVEMENT AND SEEPAGE WAS NOTED. [OBSERVATIONS (I) AND (Q)]







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EROSION ON CREST AT SPILLWAY WALL [OBSERVATION (D)] (THE STEP IN THE WALL IS NOT MOVEMENT)



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RIP-RAP AND SPILLWAY WALL DAMAGES [OBSERVATIONS (F) AND (L)]



UPSTREAM SLOPE OF AUXILIARY EMBANKMENT



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| DESIGN REPORTS | |
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| GEOLOGY REPORTS | • |
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| DESIGN COMPUTATIONS | Nace |
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| DAM STABILITY | Hine |

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POST-CONSTRUCTION SURVEYS OF DAM

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POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS

"Seepage statics reprised in USBR. TM. 389. (1932)

PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION Nime ruceded REPORTS

> Record hept in kitnick office of Bows.

MAINTENANCE OPERATION RECORDS

ITEM

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REMARKS

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VISUAL INSPECTION CHECKLIST

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APPENDIX D

VISUAL INSPECTION CHECKLIST

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| a. General Name of Dam <u>Amawalk</u> Hazard Category County <u>Westchester</u> ID# 45 Stream Name <u>MUSCOOT</u> Tributary of <u>Croton</u> Location <u>Westchester</u> County Nearest Town (P.O.) <u>Amewalk</u> Longitude <u>41°17'17</u> Latitude <u>73°45'49</u> Other Directions <u>On 2t. 35 between Katonah and Amawalk</u> Date of Insp. <u>Apr.27,78</u> Weather <u>Coludy</u> Temperature <u>45°</u> b. Inspection Personnel <u>Kalmon Szalay</u> <u>Harold Leventhal</u> c. Persons Contacted <u>Carl A Picha - Division Engine</u> <u>City of New York</u> , Dept of Mater Re <u>John Byrnes - Section Engineer</u> 1. History: Date Constructed <u>1897</u> Present Owner <u>City of Public Works Cityo</u> | |
|--|------|
| Name of Dam <u>Amawalk</u> Hazard Category County <u>Westchester</u> ID# <u>45</u> Stream Name <u>MUSCOOt</u> Tributary of <u>Croton</u> Location <u>Westchester</u> County Nearest Town (P.O.) <u>Amewalk</u> Longitude <u>41° 17' 17"</u> Latitude 73°45' 49" Other Directions On <u>Pt. 35 between Latonah and Amawalk</u> Date of Insp <u>Apr. 27, 78</u> Weather <u>Coludy</u> Temperature <u>45°F</u> b. Inspection Personnel <u>Kalmon Szalay</u> <u>Harold Leventhal</u> <u>Mike Gazit</u> c. Persons Contacted <u>Carl A Picha - Division Engine</u> <u>John Byrnes - Section Engine</u> I. History: Date Constructed <u>1897</u> Present Owner <u>City of New York</u> Designed by <u>Scpt of Public Works City of</u> | |
| County_WestchesterID#45 Stream NameMVSCOOTTributary ofCroton LocationVestchester_County Nearest Town (P.O.)Amawalk Longitude 41°17'17"Latitude 73°45'49 Other Directions On Et. 35 between katonah and Amawalk Date of Insp Apr. 27, 78 WeatherColudyTemperature 45°F b. Inspection PersonnelKalmon Szalay Harold_Leventhal Harold_Leventhal | |
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| Location <u>Westchester</u> County Nearest Town (P.O.) <u>Amawalk</u> Longitude <u>41°17'17</u> Latitude <u>73°45'49</u> Other Directions <u>On Pt. 35 between Katonah and Amawalk</u> Date of Insp <u>Apr. 27, 78</u> Weather <u>Coludy</u> Temperature <u>45°F</u> b. Inspection Personnel <u>Kalman Szalay</u> <u>Harold Leventhal</u> <u>Mike Gazit</u> 2. Persons Contacted <u>Carl A Picha - Division Engine</u> <u>City of New York</u> , Dept of Mater Re <u>John Byrnes - Section Engineer</u> 1. History: Date Constructed <u>1897</u> Present Owner <u>City of New York</u> Designed by <u>Dept of Public Works City of</u> | |
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| b. Inspection Personnel <u>Kalman Szalay</u> <u>Harold Leventhal</u> <u>Mike Gazit</u> c. Persons Contacted <u>Carl A Picha - Division Engine</u> <u>City of New York, Dept of Water Re</u> <u>John Byrnes - Section Engineer</u> i. History: Date Constructed <u>1897</u> <u>Present Owner</u> <u>City of New York</u> <u>Designed by Dept of Public Works Cityo</u> | |
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| Mike Gazit c. Persons Contacted <u>Carl A Picha - Division Engine</u> <u>City of New York</u> , Dept of Nater Re <u>John Byrnes - Section Engineer</u> i. History: Date Constructed <u>1897</u> <u>Present Owner</u> <u>City of New York</u> <u>Designed by</u> <u>Dept of Public Works City of</u> | |
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| c. Persons Contacted <u>Carl A Picha - Division Engine</u> <u>City of New York, Dept of Water Re</u> <u>John Byrnes - Section Engineer</u> 1. History: Date Constructed <u>1897</u> <u>Present Owner</u> <u>City of New York</u> <u>Designed by</u> <u>Dept of Public Works Cityo</u> | |
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| Recent History | |
| Technical Data | |
| Earth fill with Type of Dam mosenny Cone, Drainage Area 19.15 Sq. Mi | |
| Height 82 FT Length /270 FT | |
| Upstream Slope / 0n 5 Downstream Slope / nn 3 | |
| Crest Width 55 Freehoard Crest Inff | |
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| | Low Level Control: (Type and Size) 20 inch and 30 mir diametergate ville. | 5 |
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| | Valve Condition Fair | |
| | Emergency Spillway Type (Material) Marchine Width 3014 | * |
| | Side Slopes See Dwgs . 9979x = 9980 x | |
| | Height (Crest to Top) | |
| | Exit Slope″ " | |
| 1 | Exit Length " | |
| | Ponded Surface Area 6061 (Spilling Kiel) | |
| | Capacity (Normal Level) 5.692 Acre Feet | |
| - | Embankment (Capacity Emergency Spillway Level Acre Feet (Flashboards no longer used on spillway (rest after floods of 1955 | |
| | a. Crest | |
| | (1) Vertical Alignment No apparent definition | |
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| Ш | (2) Horizontal Alignmentfine | |
| П | | |
| Ц | • | |
| | (3) Longitudinal Surface Cracks <u>11me content</u> | |
| 1.1 | | |
| | | |
| | (4) Transverse Surface Cracks | |
| | | |
| | (5) General Condition of Surface from a with grows | |
| .[] | | |
| | (6) Miscellaneous Third is a 12 for which prime | |
| 1 | at the condici 1/10 ct it which is clored adont | |
| п | 2 It above the remainder it the 55 it was used | |
| Ш | This polism teem to convoide worth the | |
| 11 | center massing are well. | |
| 12 | | |

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b. Upstream Slope Alout 20 ft mer cred will gren; baland this rip report. (1) Undesirable Growth or Debris Some busches and Small trees (2) Sloughing, Subsidence, or Depressions_____ Mund depende mer let spilling well. Apers to be were damage. (3) Slope Protection Reg. 1- f - meaceous schent and greis'; serves generally unables than 10.m. (a) Condition of Riprap Somewist determine to of but no major damage. (b) Durability of Individual Stones Nemerica weather of picco. (c) Adequacy of Slope Protection Against Waves and Runoff first riviap appers to be much that no major damage is erident. (d) Gradation of Slope Protection - Localized Areas of Fine Material - Heli are de d' riperale de mile de l'and aver thefere area (4) Surface Cracks Mine c. Downstream Slope _____ (1) Undesirable Growth or Debris liell merrianced grass marcer france Anshes where Anifere - wet and could have met reach à by tra tec.

(2) Sloughing, Subsidence, or Depressions; Abnormal Bulges or Non-Uniformity tome irranletition - pombly treater marks neer right aboutment where insince is wet. Depressions above gete chember on left side of Nor C (3) Surface Cracks on Face of Slope_____ None. There are some animal burrows, about \$ Sinch a the surfice (woodclinck ') (4) Surface Cracks or Evidence of Heaving at Embankment Toe Vine (5) Wet of Saturated Areas or Other Evidence of Seepage on Face of Slope; Evidence of "Piping" or "Boils" Wet area near left at atment - bris at toe in the same are. (6) Fill Contact with Outlet Structure Surface dramage madequate at left side of embankment above gate chamber (7) Condition of Grass Slope Protection go ally well marian -1. d. Abutments (1) Erosion of Contact of Embankment with Abutment from Surface Water Runoff, Upstream or Downstream Minor at right abriment (2) Springs or Indications of Seepage Along Contact of Embankment with the Abutments At right abadment.

(3) Springs or Indications of Seepage in Areas a Short Distance Downstream of Embankment - Abutment Tie-in Are downstream of right side of dem is wet and covered with marsh vgetator. The are spreas to be filled up above trip vel grad e. Area Downstream of Embankment, Including Tailrace Channel Brick endored spin on the left abutment abut. 200 ft down to an of toe (1) Localized Subsidence, Depressions, Sinkholes, Etc.____ Wet ground and downshear of the velve chember in the area of the approach to the chamber (2) Evidence of "Piping" or "Boils" Seepic fim left well it value dember (3) Unusual Presence of Lush Growth, such as Swamp Grass, etc. fee above (4) Unusual Muddy Water in Downstream Channel No Red: 14 yellins h deposit of growth where Acepie wet & Emtents as (5) Sloughing or Erosion Plannets wells if dailinger channel have moved inward on bitte rides. Some stones fell off wall into downstream channel. (6) Surface Cracks or Evidence of Heaving Beyond Embankment, Toe Pois of well lest of yelre chamber mored about 3in descontrance and & in vestically. Some crantis on wall right of value deantis.

(7) Stability of Tailrace Channel Sideslopes Side well- here mored but up in be stable (8) Condition of Tailrace Channel Riprap No rip- 1- F (9) Adequacy of Slope Protection Against Waves, Currents and Surface Runoff time coloreste (10) Miscellaneous ine debie a fairare decunel f. Drainage System No istics wells. Tit drama dalle at back right and left enter ment prise (1) Condition of Relief Wells, Drains and Appurtenances The tee detales se not surfable for their proposed in their primit condition On the right pile ero Prite d'a in needer of m the left side the sidet concertion here be in Discharge from Rollof Wolls The Section Engineer thought that the seepage on the right about ment somewhat increased recently 4. Instrumentation wall of the valve chamber. (1) Monumentation/Surveys______ ۲. on the spilling steeded there is mit bern used to be se ret revenuent 12 d'al standard

(2) Observation Wells_ None (3) Weirs None (4) Piezometers Il strady pe presmet of the crest and divide and slope. These are mit, a use (Other)_____ . 5. Reservoir a. Slopes Appen to he stable. _____ .

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b. Sedimentation 1/2 indication of accessive Acolimente dam 6. Spillways a. Principal Spillway: Inlet Condition # 1 4979 x the sector is the Pipe Condition General Remarks (include information such as recently repaired, potential for debris accumulation, special items of note, etc.) * Upstream ends of both inlet walls are damaged Looking hystream a Carge block of mesony on The lift pidewall has been destodged. The alignment on the night side has been somewhat altered . b. Emergency Spillway: General Condition Chute of fallway seemed in good condition. Blockout in walls and all for steplings arreared in good condition . Tree Growth Erosion Other Observations See Note 1. on next page, Holes for flash boards were visible but no longer used. 7. Structural (if required) See Attached Appendix Stability calculation are not required for Phase I Dam Inspection.

Note 1. with small quantities of water flowing smoothly over and down the spillway chute a large number of "outer tails "were formed at the intersection of the horizontal and vertical joints in the mesonry chuits Inspection of the spillway when water is not flower. down chute would reveal the presence of leakings, if any.

. 8. Downstream Channel Immediately downstream of the spillway chute the channel on the old river bod is masonry lined. Some debris in tailiace a. Condition (obstructions, debris, etc.)______ b. Slopes_____ . c. Approximate No. Homes and Population_____ . d. General . Iman Scalar TEAM CAPTAI

STRUCTURAL INSPECTION CHECKLIST PHASE I DAM INSPECTION . Dam type-Earthfill with masonry core there are no 1. Concrete Surfaces exposed concrete surfaces. The spillway walls and chute are finished with masonry blocks The downstream portion of the chute is also a masonry-lined channel in the old uver bed 2. Structural Cracking No structural cracking is visible 3. Movement - Horizontal and Vertical Alignment in sither the horizontal or vertical alignment of the spillway. There are USGS survey point, close to the spilling ptructure but they have not been used to check the 4. Junctions with Abutments or Embankments 4. Junctions with Abutments or Embankments Some surface erorion of embankment was noted on crest near - pides of childway walk 5. Drains - Foundation, Joint, Face no drains under the pullway structure are visible or indicated on the drawings. In addition to the water over the 6. Water Passages, Conduits, Sluices gulling there is a fountrin outle on the lift ide of the tribace (see sketch) supplying water to the downstream channel 7. Seepage or Leakage chacks and some water supage from the jointe and crack. Because water ista, flowing over the spillway it was difficult to check the oyee rection where the stone facing is source and then mo sign of movement. 8. Monolith Joints - Construction Joints There are no Concrete structure - no monolith, conts or construction joints. Stone facing at 9. Foundation No apparent ficklim. base of thate is sound and show no sign of movement or crackin

10. Abutments There are no structural (concrete) abutments

11. Control Gates There are no structural or mechanical control gates on the chillway . There is provision for Approach and Outlet Channels Level are in damaged condition. Som large stones of the inlet masonry wall, are loose and some have been dislodged . The wall, of the tail ace, dozonstream of the spillway chute, have moved inward on both sides. Some stone in the tailiace walls are loose and some have fallen into the channel 13. Stilling Basin - There is no ptilling basin 14. Intake Structure this tower structure partially submerged, is locates in the perervoir directly upstream of chilles ay an is also lined with maronry stones. It looked in good condition and no forollim were reported to us by local personnel. No beat was provided Legain access for inspection no apparent or right cant settlement of 15. Settlement no computations are available of ptu ichire 16. Stability for the pilling structure. None are required a. Overturning b. Sliding After so years of operation - none necessary. Seismic C. 17. Instrumentation none installed a. Alignment b. Uplift c. Seismic Spillway ages and chute should be checked 18. Miscellaneous reserver level is below spillway crest. for leaks in Obtain use of beat techeck condition of intake tower.

HYDROLOGIC DATA AND COMPUTATIONS

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APPENDIX E

TIPPETTS-ABBETT-McCARTHY-STRATTON JOB NO. 1487 EERS AND ARCHITECTS NEW YORK ct_ Pain . Decllor A manath. Dan Spilling Paling Curve Chik. by .:: Spillwoy Rating Leigth = 50' Grest Eler. 400 Hes/ 1.0 3.0 150 2.0 3.2 452 3.0 3.4 883 3.6 4.0 1440 5.0 3.9 2180 6.0 3.9 28.66 8.0 3.9 4412 10.0 3.9 6166 Elods of Perord Dote Eley. Head 0 Ang. 20-21, 1755 403.33 3.33 1054 1289 8.60" in two dos Oct. 18, 1955 403.75 3.75





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APPENDIX F

APPENDIX F

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