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Phase I Inspection Report
Watervliet Upper Dam
Lower Hudson River Basin, Albany County, N.Y.
Inventory No. 1356

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

The examination of documents and visual inspection of the Watervliet Upper Dam and appurtenant structures did not reveal conditions which constitute a hazard to human life or property.
The discharge capacity of the spillway is inadequate for all storms in excess of 55% of the PMF (Probable Maximum Flood). During the 1/2 PMF event, the maximum water surface will be 1.2 feet below top of dam. However, the dam will be overtopped by 2.3 feet during the full PMF; therefore, the spillway is assessed as "Inadequate."
PREFACE

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

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

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

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

Name of Dam: Watervliet Upper Dam (I.D. No. NY 1356)  
State Located: New York  
County Located: Albany  
River: Dry River (tributary to Lower Hudson River)  
Date of Inspection: November 7, 1980

ASSESSMENT

The examination of documents and visual inspection of the Watervliet Upper Dam and appurtenant structures did not reveal conditions which constitute a hazard to human life or property.

The discharge capacity of the spillway is inadequate for all storms in excess of 55% of the PMF (Probable Maximum Flood). During the 1/2 PMF event, the maximum water surface will be 1.2 feet below top of dam. However, the dam will be overtopped by 2.3 feet during the full PMF; therefore, the spillway is assessed as "Inadequate".

The following problems were observed which require remedial action within one year of notification to the owner:

1. Monitor the erosion observed at the abutment contacts of the downstream slope and repair as required.
2. Repair the seeping and deteriorated concrete surfaces of the horseshoe conduit.
3. Periodically remove the debris and sediment from the vicinity of the intake tower and the downstream channel.
4. Remove the tree and brush growth from the embankment and abutments. Provide a program of periodic cutting and mowing of these surfaces.
5. Provide a program of periodic inspection and maintenance of the dam and appurtenances. Document this information for future reference.
6. An emergency action plan must be developed.
Photo #1
Overview, Watervliet Upper Dam
from left abutment looking across the top of the embankment
PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
WATERVLIET UPPER DAM I. D. No. NY 1356
DEC # 226A-1407 Lower Hudson River Basin

SECTION 1: PROJECT INFORMATION

1.1 GENERAL

a. Authority
The Phase I Inspection reported herein was authorized by the Department of the Army, New York District, Corps of Engineers, to fulfill the requirements of the National Dam Inspection Act, Public Law 92-367.

b. Purpose of Inspection
Evaluation of the existing conditions of the subject dam to identify deficiencies and hazardous conditions, determine if they constitute hazards to human life and property and recommend measures where necessary.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances
The Watervliet Upper Dam consists of a 72 feet high homogenous earth embankment with a 6 inch concrete core wall. The spillway is a tower type intake with a 3 foot radius, modified horseshoe conduit. The normal water surface is approximated by the low stage inlet of the tower, resulting in no impoundment during normal conditions. The embankment is approximately 500 feet long. The 440 feet long conduit is reinforced concrete on a slope of .113%. The invert elevation is level with the toe of the embankment resulting in no normal pool behind the dam. There are several large openings located on the sides of the tower; as seen in the photos. There is no overflow or emergency spillway as indicated on plans.

b. Location
The dam is located on Dry River, tributary to the Lower Hudson, west of Watervliet, Albany County, New York.

c. Size
The dam is 72 feet high and impounds approximately 1220 acre feet at top of dam. The normal water surface elevation is kept at the toe of the dam, resulting in no impoundment during normal conditions. The dam is, therefore, classified as intermediate (40 to 100 ft. high, 1,000 to 5,000 acre feet).

d. Hazard Classification
The dam is classified as high hazard due to its location in relation with the City of Watervliet. The downstream channel is confined by some low lying homes and converts into a closed system within the City.
### Ownership

The dam is owned and maintained by the City of Watervliet, New York. Mr. Jim Davin, Supt. D.P.W., was our contact with the owner. He can be contacted at City Hall, Watervliet, NY (518) 270-3821.

### Purpose of the Dam

The dam was designed as a storm water detention dam.

### Design and Construction History

The dam was constructed in 1912 by Leary and Morrison Co. and designed by Solomon, Norcross & Keis, Watervliet, New York. There has been no recorded changes to this structure since original completion.

### Normal Operating Procedures

All releases from the Upper Reservoir are passed through the orifice and conduit. The system involves no operation. Maintenance is on an "as needed" basis.

### Pertinent Data

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Drainage Area (sq. mi.)</td>
<td>2.88</td>
</tr>
<tr>
<td>b. Height of dam (ft.)</td>
<td>72.</td>
</tr>
<tr>
<td>c. Discharge at Dam Site</td>
<td></td>
</tr>
<tr>
<td>Maximum Spillway Capacity (cfs.)</td>
<td>272.</td>
</tr>
<tr>
<td>d. Elevations (ft., USGS.)</td>
<td></td>
</tr>
<tr>
<td>Top of Dam</td>
<td>215.</td>
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<tr>
<td>Spillway Crest</td>
<td>146.0</td>
</tr>
<tr>
<td>Original Streambed</td>
<td>145.</td>
</tr>
<tr>
<td>e. Storage (acre ft.)</td>
<td></td>
</tr>
<tr>
<td>Top of Dam</td>
<td>1217.</td>
</tr>
<tr>
<td>Normal</td>
<td>0</td>
</tr>
<tr>
<td>f. Dam</td>
<td></td>
</tr>
<tr>
<td>TYPE: Homogeneous earth fill with concrete core wall.</td>
<td></td>
</tr>
<tr>
<td>Length (ft.)</td>
<td>500.</td>
</tr>
<tr>
<td>Upstream slope</td>
<td>2.5: 1</td>
</tr>
<tr>
<td>Downstream</td>
<td>2.0: 1</td>
</tr>
<tr>
<td>Crest Width (ft.)</td>
<td>20.</td>
</tr>
<tr>
<td>g. Spillway</td>
<td></td>
</tr>
<tr>
<td>TYPE: Reinforced concrete tower intake; modified horseshoe tunnel through embankment.</td>
<td></td>
</tr>
<tr>
<td>Conduit Length (ft.)</td>
<td>440.</td>
</tr>
<tr>
<td>Slope (%)</td>
<td>1.13</td>
</tr>
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</table>
SECTION 2: ENGINEERING DATA

2.1 GEOLOGY
The Watervliet Upper Dam is located in the Hudson Mohawk Lowlands physiographic province of New York State. The general topography of this province resulted from erosion along outcrop belts of weak rocks. Most of the province has low relief and elevation. Bedrock in the vicinity of the dam is Ordovician shale 500 to 435 million years ago which has been exposed by the southward and westward stripping - off of Silvrian and Devonian Limestones.

Glacial cover has resulted from deposition during the Wisconsin glaciation, approximately 11,000 years ago.

The "Preliminary Brittle Structures Map of New York" developed by Yngvar W. Isachsen and William G. McKendree (dated 1977) indicates the presence of a gravity slide (rock into sediments) of the Early Taconian orogenic age, located in the watershed above the dam.

2.2 SUBSURFACE INVESTIGATION
No subsurface investigation could be located for the design of the structure. The "General Soil Map of New York" prepared by Cornell University Agricultural Experiment Station indicates that the surficial soils in the vicinity of the dam are the Hudson series of Glacial Lake and Marine sediment origin. These soils were formed on Lacustrine bottom sediments, and consist of varied silt sand and clay. The permeability is generally very slow. The depth to bedrock is variable. Bedrock was observed in the downstream and upstream channels.

2.3 DAM AND APPURTENANT STRUCTURES
The design of the dam was prepared by Solomon, Norcross & Keis, Engineers for the Watervliet Storm Sewer Commission in November, 1911. All pertinent drawings concerning the structure are included in Appendix E.

2.4 CONSTRUCTION RECORDS
No construction information was available.

2.5 OPERATION RECORDS
No operation records are maintained for the dam.

2.6 EVALUATION OF DATA
The data presented in this report has been compiled from information obtained from Mr. Jim Davin, Supt. of D.P.W., Watervliet, NY (518) 270-3821, and the NYS Department of Environmental Conservation files. This information appears adequate and reliable for Phase I Inspection purposes.
SECTION 3: VISUAL INSPECTION

3.1 FINDINGS

a. General
Visual inspection of Watervliet Lower Dam and the surrounding watershed was conducted on November 7, 1980. The weather was partly cloudy and the temperature ranged in the forties. The water level at the time of the inspection was approximating the inlet elevation of the reservoir drain, and only a small stream of water was apparent in the upstream area.

b. Embankment
The earth embankment shows no signs of major distress. While some minor erosion was apparent on the rock and earth slopes of the abutment areas of the downstream slope of the dam, no evidence of sloughing, sliding, seepage, depressions, or unusual growth was apparent. The slopes and crest of the embankment are heavily vegetated with small diameter trees and brush.

c. Spillway
The only spillway is the intake tower, located near the center of the embankment at the upstream toe of the dam. The tower has numerous screened intakes at various elevations along the sides of the tower. The area surrounding the tower periodically fills in with sediment and requires cleaning of this material and the associated debris. The modified horseshoe conduit is generally in good condition; several small areas were observed which were seeping slightly (less than 1 gpm) and exhibited either a rusty or calcification strain, surrounding the seepage point. The concrete of the intake tower and the conduit is in good condition with the exception of some minor deterioration in the vicinity of the seepage areas on the walls of the conduit.

d. Downstream Channel
The downstream channel is in the natural stream channel of the Dry River. While some minor debris (primarily dead trees) was observed in the immediate channel, the channel appears to be of adequate capacity to discharge the outflow from the conduit.

e. Reservoir
Sedimentation was observed in the vicinity of the intake tower. Due to the steep slopes of the upstream area sedimentation is a continuing problem, which must be periodically addressed.

f. Reservoir Drain
There is no separate reservoir drain. Under normal operating conditions, the water level in the upstream area is approximated by the ground level intake of the tower.
3.2 EVALUATION OF OBSERVATIONS

The problem areas observed during the inspection and the recommended remedial actions are as follows:

1. Erosion of the soil near the abutment contacts of the downstream face was observed. Monitor this erosion and repair as required.

2. Seepage and slight deterioration of the horseshoe conduit concrete was noted. Repair the affected areas to prevent further deterioration.

3. Debris and sediment was observed in the vicinity of the intake tower and the immediate downstream channel. Periodically remove this material.

4. Extensive tree and brush growth was noted on the surfaces of the embankment and the abutment areas. Remove this vegetation and provide a program of periodic cutting and mowing of these surfaces.

5. Provide a program of periodic inspection and maintenance of the dam and appurtenances. Document this information for future reference. Also develop an emergency action plan for notification of downstream residents and the proper governmental authorities.
SECTION 4: OPERATION AND MAINTENANCE PROCEDURES

4.1 Procedures
The normal water surface is approximated by the low stage inlet of the intake tower, the result being that little water is impounded on the upstream side of the structure. All flows are discharged through the intake tower.

4.2 Maintenance of the Dam
Maintenance of the dam is provided by the owner, the City of Watervliet, N.Y. Maintenance is not considered satisfactory as evidenced by the tree and brush growth, seepage in the horseshoe conduit, erosion and the downstream abutment contacts, and debris at the intake and downstream channel.

4.3 Warning System
There is no warning system in effect or in preparation.

4.4 Evaluation
The dam and appurtenances have been maintained in unsatisfactory condition as noted in "Section 3: Visual Inspection".
SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Drainage Area Characteristics

The Watervliet Upper Dam is located on Dry River, tributary to the lower Hudson. The total area of the watershed at the dam is 2.88 square miles. The drainage paths are well defined, but the slopes are moderate. Some of the area is developed.

5.2 Analysis Criteria

The analysis of the spillway capacity of the dam and storage of the reservoir was performed using the Corps of Engineers HEC-1 computer model. The unit hydrograph was defined by the Snyder Synthetic Unit Hydrograph method, and the Modified Puls routing procedure was incorporated. The Probable Maximum Precipitation (PMP) was 20.5 inches (24 hrs., 200 sq. miles) from Hydro meteorological Report #33 in accordance with recommended guidelines of the Corps of Engineers. Several floods were selected for analysis including 50% and 100% of the Probable Maximum Flood (PMF). The PMF inflow of 5828 cfs. was routed through the reservoir, resulting in a 5377 cfs outflow.

5.3 Spillway Capacity

The spillway is a tower type intake with a modified horseshoe outlet conduit. The intake consists of a 24 inch orifice into the conduit. The spillway crest elevation is at the toe of embankment resulting in no normal storage capacity, but high head allowable before overtopping occurs. There is another 18" inlet to the conduit which is closed off at this time and assumed so for the analysis. The maximum capacity of the spillway at top of dam is 272 cfs.

5.4 Reservoir Capacity

The reservoir capacity, as previously stated, is 0.0 acre feet at spillway crest and 1217.0 acre feet at top of dam. Surcharge storage between spillway and top of dam is equivalent to 7.92 inches of runoff.

5.5 Floods of Record

There are no gaging stations on Dry River nor are there any accounts of high flows or levels.
5.6 Overtopping Potential

The maximum capacity of the spillway before overtopping occurs is 272 cfs. This combined with the large amount of surcharge storage available the dam will attenuate 55% of the PMF. The maximum outflow at 1/2 the PMF will be 270 cfs. The dam will be overtopped by 2.3 feet during the full PMF event.

5.7 Evaluation

The Watervliet Upper Dam will safely pass 55% of the PMF. By the Corps of Engineers Screening Criteria, it is considered inadequate.
SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations
No signs of major distress were observed in connection with the earth embankment. The embankment is not considered to be unstable.

b. Design and Construction Data
No design or construction data could be located concerning the slope stability of the embankment.

c. Post Construction Changes
No post construction changes were instituted.
SECTION 7: ASSESSMENT/RECOMMENDATIONS

7.1 ASSESSMENT

a. Safety
   The Phase I Inspection of Watervliet Upper Dam did not reveal any conditions which constitute a hazard to human life or property. The embankment is not considered to be unstable. The dam, has a number of problem areas which require remedial attention.

b. Adequacy of Information
   The information reviewed is considered adequate for Phase I Inspection purposes.

c. Need for Additional Investigation
   No further investigation is required at this time.

d. Urgency
   The areas listed below requiring remedial action should be initiated within 3 months and completed within 1 year from notification to the owner.

7.2 RECOMMENDATIONS

1. Monitor the erosion observed at the abutment contacts of the downstream slope and repair as required.

2. Repair the seeping and deteriorated concrete surfaces of the horseshoe conduit.

3. Periodically remove the debris from the vicinity of the intake tower and the downstream channel.

4. Remove the tree and brush growth from the embankment abutments. Provide a program of periodic cutting and mowing of these surfaces.

5. Provide a program of periodic inspection and maintenance of the dam and appurtenances. Document this information for future reference.

6. An emergency action plan must be developed.
APPENDIX A

PHOTOGRAPHS
Photo # 2
Tower intake of the spillway.

Photo # 3
View of the tower intake and upstream slope of the embankment
Note: Debris around low level orifice
Photo # 4
View of the 24" orifice from the tower into the conduit.

Photo # 5
Pitting of the concrete and seepage in the conduit.
Photo #6
Pitting and Seepage in the conduit.

Photo #7
Weep hole in the conduit.
Photo # 8
Outlet of horseshoe conduit.
Note bedrock outcrop.

Photo # 9
Downstream Channel.
APPENDIX B

VISUAL INSPECTION CHECKLIST
VISUAL INSPECTION CHECKLIST

1) Basic Data

a. General

Name of Dam: WATERVLIET UPPER DAM
Fed. I.D. #: NY 1356, DEC Dam No. 2691-1407
River Basin: LOWER HUDSON RIVER
Location: Town COLONIC, County ALBANY
Stream Name: DRY RIVER
Tributary of: LOWER HUDSON
Latitude (N): 42° 49.5', Longitude (W): 73° 43.1'
Type of Dam: EARTH
Hazard Category: High
Date(s) of Inspection: Nov. 7, 1980
Weather Conditions: Cloudy, 40's
Reservoir Level at Time of Inspection: Invert of Spillway


c. Persons Contacted (Including Address & Phone No.): JIM DAVIN

Supt. D.P.W.
CITY HALL
WATERVLIET NY
(518) 270-3821

d. History:

Date Constructed: 1912, Date(s) Reconstructed: ________

Designer: SOLOMON NOBERGROSS & KEIS

Constructed By: LEARY & MACKERON CO.

Owner: CITY OF WATERVLIET
2) **Embankment**

a. **Characteristics**

1. Embankment Material: earth

2. Cutoff Type

3. Impervious Core: concrete (6"")

4. Internal Drainage System: some weep holes into conduit

5. Miscellaneous: heavy growth over embankment

b. **Crest**

1. Vertical Alignment: good, roadway causing some minor depressions & erosion

2. Horizontal Alignment: good

3. Surface Cracks: none apparent

4. Miscellaneous


c. **Upstream Slope**

1. Slope (Estimate) (V:H): 2:1

2. Undesirable Growth or Debris, Animal Burrows: heavy growth

3. Sloughing, Subsidence or Depressions: none
(4) Slope Protection  

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(5) Surface Cracks or Movement at Toe  

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d. Downstream Slope

(1) Slope (Estimate - V:H)  

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(2) Undesirable Growth or Debris, Animal Burrows  

-----------

-----------

(3) Sloughing, Subsidence or Depressions  

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(4) Surface Cracks or Movement at Toe  

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(5) Seepage  

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(6) External Drainage System (Ditches, Trenches; Blanket)  

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(7) Condition Around Outlet Structure  

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(8) Seepage Beyond Toe  

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e. Abutments - Embankment Contact  

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93-15-3(9/80)

(1) Erosion at Contact *some slight due to local runoff*

(2) Seepage Along Contact *none*

3) **Drainage System**
   a. Description of System *as plans indicate, some type of drainage on berms (not west) small seeps along conduit*
   b. Condition of System *working*
   c. Discharge from Drainage System *small weep seeping* 

\[ \frac{1}{2} \text{gal/min} \]

4) **Instrumentation** (Monumentation/Surveys, Observation Wells, Weirs, Piezometers, Etc.) *none*
5) Reservoir
   a. Slopes stable, heavily wooded
   b. Sedimentation around intake tower
   c. Unusual Conditions Which Affect Dam normally empty

6) Area Downstream of Dam
   a. Downstream Hazard (No. of Homes, Highways, etc.) lower dam deep channel through rock
   b. Seepage, Unusual Growth no seepage
   c. Evidence of Movement Beyond Toe of Dam none
   d. Condition of Downstream Channel some debris

7) Spillway(s) (Including Discharge Conveyance Channel)
   a. General generally good some slight maintenance needed
   b. Condition of Service Spillway good - cosmetic/preventive maintenance needed
93-15-3(9/80)

c. Condition of Auxiliary Spillway

N/A

d. Condition of Discharge Conveyance Channel


8) Reservoir Drain/Outlet /primary spillway

Type: Pipe[ ] Conduit[√] Other[ ]

Material: Concrete[√] Metal[ ] Other[ ]

Size: 3' 40. Modified horizontal Length 440'

Invert Elevations: Entrance 135.5 Exit 130.

Physical Condition (Describe): relatively good Unobservable

Material: concrete some settling

Joints: recurred Alignment good

Structural Integrity: good

Hydraulic Capability: wet control

Means of Control: Gate[ ] Valve[ ] Uncontrolled[√]

Operation: Operable[ ] Inoperable[ ] Other[ ]

Present Condition (Describe): good debris
9) Structural
   a. Concrete Surfaces

   b. Structural Cracking

   c. Movement - Horizontal & Vertical Alignment (Settlement)

   d. Junctions with Abutments or Embankments

   e. Drains - Foundation, Joint, Face

   f. Water Passages, Conduits, Sluices

   g. Seepage or Leakage
h. Joints - Construction, etc.  good

i. Foundation  good

j. Abutments  good

k. Control Gates  not

l. Approach & Outlet Channels  approach - heavy sediment, debris

m. Energy Dissipators (Plunge Pool, etc.)  not, rock

n. Intake Structures  good

o. Stability  good

p. Miscellaneous
10) **Appurtenant Structures** (Power House, Lock, Gatehouse, Other)
   a. Description and Condition

11) **Operation Procedures** (Lake Level Regulation):
    
    
    
    no operation reg'd.
APPENDIX C

HYDROLOGIC / HYDRAULIC

ENGINEERING DATA AND COMPUTATIONS
**CHECK LIST FOR DAMS**

**HYDROLOGIC AND HYDRAULIC ENGINEERING DATA**

### AREA–CAPACITY DATA:

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<tr>
<th></th>
<th>Elevation (ft.)</th>
<th>Surface Area (acres)</th>
<th>Storage Capacity (acre-ft.)</th>
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<tbody>
<tr>
<td>1) Top of Dam</td>
<td>215</td>
<td>~50</td>
<td>1217</td>
</tr>
<tr>
<td>2) Design High Water</td>
<td></td>
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</tr>
<tr>
<td>(Max. Design Pool)</td>
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<tr>
<td>3) Auxiliary Spillway</td>
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<td></td>
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<tr>
<td>Crest</td>
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<tr>
<td>4) Pool Level with</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flashboards</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5) Service Spillway</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crest</td>
<td>145</td>
<td>0</td>
<td>0</td>
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</tbody>
</table>

### DISCHARGES

<table>
<thead>
<tr>
<th></th>
<th>Volume (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Average Daily</td>
<td>2</td>
</tr>
<tr>
<td>2) Spillway @ Maximum High Water</td>
<td>272</td>
</tr>
<tr>
<td>3) Spillway @ Design High Water</td>
<td>2</td>
</tr>
<tr>
<td>4) Spillway @ Auxiliary Spillway Crest Elevation</td>
<td>272</td>
</tr>
<tr>
<td>5) Low Leve’ Outlet Max.</td>
<td>272</td>
</tr>
<tr>
<td>6) Total (of all facilities) @ Maximum High Water TMD</td>
<td>272</td>
</tr>
<tr>
<td>7) Maximum Known Flood</td>
<td>2</td>
</tr>
<tr>
<td>8) At Time of Inspection</td>
<td>~1</td>
</tr>
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</table>

93-15-4(9/80)
CREST:

<table>
<thead>
<tr>
<th>Type</th>
<th>Compacted earth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width:</td>
<td>20</td>
</tr>
<tr>
<td>Length:</td>
<td>500</td>
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</tbody>
</table>

Spillway Location: NA

SPILLWAY:

<table>
<thead>
<tr>
<th>SERVICE</th>
<th>AUXILIARY</th>
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<tbody>
<tr>
<td>145°</td>
<td>Elevation</td>
</tr>
<tr>
<td>Concrete Tower Intake</td>
<td>Type</td>
</tr>
<tr>
<td>Width</td>
<td></td>
</tr>
<tr>
<td>Type of Control</td>
<td>Uncontrolled</td>
</tr>
<tr>
<td>Controlled:</td>
<td></td>
</tr>
<tr>
<td>24” ORIFICE</td>
<td>Type</td>
</tr>
<tr>
<td>(Flashboards; gate)</td>
<td>Number</td>
</tr>
<tr>
<td>Size/Length</td>
<td></td>
</tr>
<tr>
<td>Invert Material</td>
<td></td>
</tr>
<tr>
<td>Anticipated Length of operating service</td>
<td></td>
</tr>
<tr>
<td>440' Chute Length</td>
<td></td>
</tr>
<tr>
<td>1 Sam d. 145</td>
<td>Height Between Spillway Crest &amp; Approach Channel Invert (Weir Flow)</td>
</tr>
</tbody>
</table>

93-15-4(3/80)
HYDROMETEOROLOGICAL GAGES:

Type: ________

Location: ________

Records:

Date: ________

Max. Reading: ________

FLOOD WATER CONTROL SYSTEM:

Warning System: ________

Method of Controlled Releases (mechanisms):

No control.
DRAINAGE AREA: 2.88

DRAINAGE BASIN RUNOFF CHARACTERISTICS:

Land Use - Type: some residential development

Terrain - Relief: moderate slope, well defined channel

Surface - Soil: low perm - some rock outcrop

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

future development possible

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

sediment problem now - normal maintenance would solve problem

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

No

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

Location: None

Elevation: 

Reservoir:

Length @ Maximum Pool 400 (Meters)

Length of Shoreline (@ Spillway Crest) 100 (Miles)
Intervest Upper + Lower Days

\[ L = \frac{\text{72}}{12} \text{ in.} = 6 \text{ in.} \]

\[ L = \frac{\text{48}}{16} \text{ in.} = 3 \text{ in.} \]

\[ L = \text{2.0} + 1.0 \text{ in. elongation} \]

\[ T_p = L(L + L) = 2.35 \text{ hr} \]

\[ T_p = 2.35 \text{ hr} \text{ say 2.40 hr.} \]

\[ T_p = t_p + 0.20 = 2.35 + 0.20 = 2.55 \text{ hr.} \]

\[ Q_p = 2.55 \]

\[ \text{Table:} \]

<table>
<thead>
<tr>
<th>Flow</th>
<th>Rate (cfs)</th>
<th>C</th>
<th>T</th>
<th>Flow (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>20.</td>
<td>6</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>91</td>
<td>119</td>
<td></td>
<td>12</td>
<td>19.1</td>
</tr>
<tr>
<td>140</td>
<td>140</td>
<td>17</td>
<td>27</td>
<td>14.3</td>
</tr>
<tr>
<td>175</td>
<td>202</td>
<td>37</td>
<td>1210</td>
<td></td>
</tr>
<tr>
<td>205</td>
<td>250</td>
<td>47</td>
<td>124.4</td>
<td></td>
</tr>
<tr>
<td>256</td>
<td>267</td>
<td>57</td>
<td>266.3</td>
<td></td>
</tr>
<tr>
<td>304</td>
<td>267</td>
<td>67</td>
<td>986.3</td>
<td></td>
</tr>
</tbody>
</table>

\[ C = 3.0 \]

\[ C = \text{3.14} \]
DA = 102 acres
= 0.16 mi^2

\[ L = 20 \text{ ft} (\frac{20}{12}) \times 5280 = 0.75 \text{ mi} \]

\[ L' = 0.65 \text{ ft} (\frac{0.65}{12}) \times 5280 = 0.25 \text{ mi} \]

\[ CP = 20 \]

\[ LP = 1.2 \text{ hr} \]

\[ TP = 0.2 \text{ hr} \]

\[ Tr = 1.8 \text{ hr} \]

\[ CP = 0.05 \]

---

**Channel**

<table>
<thead>
<tr>
<th>C</th>
<th>S</th>
<th>Storage ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>.</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>.</td>
<td>-</td>
</tr>
<tr>
<td>12</td>
<td>21</td>
<td>21</td>
</tr>
<tr>
<td>15</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>18</td>
<td>43</td>
<td>43</td>
</tr>
<tr>
<td>20</td>
<td>49</td>
<td>49</td>
</tr>
<tr>
<td>22</td>
<td>51</td>
<td>51</td>
</tr>
<tr>
<td>24</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>26</td>
<td>69</td>
<td>69</td>
</tr>
<tr>
<td>30</td>
<td>74</td>
<td>74</td>
</tr>
<tr>
<td>36</td>
<td>81</td>
<td>81</td>
</tr>
</tbody>
</table>

For a D.A. = 57.5

\[ h = 0.5 \text{ ft} \]

\[ CP = 0.05 \]

\[ C = 5 \]

\[ L = 11.5 \text{ ft} = 22.5 15.5 = 38 \]

\[ S = 1.7 \text{ ft} \]

\[ Storage = 48 \text{ ft} \]

<table>
<thead>
<tr>
<th>Storage ft.</th>
<th>S = 1.7</th>
<th>Storage ft.</th>
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</thead>
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<tr>
<td>48</td>
<td>11.5</td>
<td>1.8</td>
</tr>
<tr>
<td>10</td>
<td>20.7</td>
<td>11.5</td>
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<tr>
<td>56</td>
<td>16.5</td>
<td>7.3</td>
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<td>1.12</td>
<td>25.7</td>
<td>18.5</td>
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<td>1.37</td>
<td>31.5</td>
<td>23.3</td>
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<tr>
<td>1.45</td>
<td>39.1</td>
<td>28.9</td>
</tr>
<tr>
<td>7.01</td>
<td>46.1</td>
<td>33.7</td>
</tr>
<tr>
<td>2.42</td>
<td>55.0</td>
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<tr>
<td>3.45</td>
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Rainfall \( \Delta \text{PVP} = 20.55 \)

<table>
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<th>6</th>
<th>17</th>
<th>24</th>
<th>49</th>
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<tr>
<td>%</td>
<td>111</td>
<td>122</td>
<td>153</td>
<td>142</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>---</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td></td>
<td>A1</td>
<td>A2</td>
<td>A3</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>inflow-outflow upper reservoir</td>
<td>water supply storm detention</td>
<td>BCEC1980</td>
<td>200</td>
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</table>
PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS
RUNOFF HYDROGRAPH AT 1
ROUTE HYDROGRAPH TO 1
RUNOFF HYDROGRAPH AT 2
COMBINE 2 HYDROGRAPHS AT 3
ROUTE HYDROGRAPH TO 3
END OF NETWORK
### Peak Flow and Storage (End of Period) Summary Form

**Plan-Ratio Economic Computations**

**Flows in Cubic Feet Per Second (Cubic Meters Per Second)**

**Area in Square Miles (Square Kilometers)**

<table>
<thead>
<tr>
<th>Operation</th>
<th>Station</th>
<th>Area</th>
<th>Plan Ratio</th>
<th>Ratio 1</th>
<th>Ratio 2</th>
<th>Ratio 3</th>
<th>Ratio 4</th>
<th>Ratio 5</th>
<th>Ratio 6</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.20</td>
<td>0.40</td>
<td>0.50</td>
<td>0.60</td>
<td>0.80</td>
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</tr>
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<td>2.88</td>
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<td>2914</td>
<td>3497</td>
<td>4662</td>
<td>5829</td>
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</tr>
<tr>
<td></td>
<td>(15091.13)</td>
<td></td>
<td>33.00</td>
<td>66.01</td>
<td>82.51</td>
<td>99.01</td>
<td>132.62</td>
<td>165.02</td>
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<td>Route</td>
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<td>2.88</td>
<td>241</td>
<td>265</td>
<td>270</td>
<td>361</td>
<td>358</td>
<td>5377</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(15091.13)</td>
<td></td>
<td>6.82</td>
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<td>7.66</td>
<td>8.34</td>
<td>101.61</td>
<td>152.25</td>
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<td>163</td>
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<td>7.78</td>
<td>10.37</td>
<td>12.97</td>
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<tr>
<td>2 Combined</td>
<td>3</td>
<td>3.04</td>
<td>288</td>
<td>408</td>
<td>463</td>
<td>438</td>
<td>370</td>
<td>562</td>
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<td></td>
<td>(15091.13)</td>
<td></td>
<td>8.14</td>
<td>11.55</td>
<td>13.12</td>
<td>13.05</td>
<td>38.89</td>
<td>106.84</td>
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<td>3</td>
<td>3.04</td>
<td>286</td>
<td>406</td>
<td>461</td>
<td>1378</td>
<td>3718</td>
<td>5827</td>
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</tr>
<tr>
<td></td>
<td>(15091.13)</td>
<td></td>
<td>8.11</td>
<td>11.49</td>
<td>13.05</td>
<td>38.89</td>
<td>106.84</td>
<td>164.99</td>
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</tr>
<tr>
<td>PLAN 1</td>
<td>ELEVATION</td>
<td>INITIAL VALUE</td>
<td>SPILLWAY CREST</td>
<td>TOP OF DAM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------</td>
<td>-----------</td>
<td>---------------</td>
<td>----------------</td>
<td>------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
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<td>143.00</td>
<td>0.0</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>OUTFLOW</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>272.0</td>
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<td></td>
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</table>

<table>
<thead>
<tr>
<th>RATCF</th>
<th>MAXIMUM RESERVOIR</th>
<th>MAXIMUM DEPTH</th>
<th>MAXIMUM STORAGE</th>
<th>MAXIMUM OUTFLOW</th>
<th>DURATION</th>
<th>TIME OF MAX OUTFLOW</th>
<th>TIME OF FAILURE</th>
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<tr>
<td>0.20</td>
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<td>1361</td>
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<td>3588</td>
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</table>
## SUMMARY OF DAM SAFETY ANALYSIS

**PLAN 1**

<table>
<thead>
<tr>
<th>ELEVATION</th>
<th>INITIAL VALUE</th>
<th>SPILLWAY CREST</th>
<th>TCP OF DAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>STORAGE</td>
<td>92.00</td>
<td>92.00</td>
<td>111.38</td>
</tr>
<tr>
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<td>0.0</td>
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</table>

<table>
<thead>
<tr>
<th>RATIO</th>
<th>MAXI UM CF</th>
<th>MAXIMUM DEPTH</th>
<th>MAXIMUM STORAGE</th>
<th>MAXIMUM OUTFLOW</th>
<th>DURATION OVER TOP</th>
<th>TIME OF MAX OUTFLOW</th>
<th>TIME OF FAILURE</th>
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</thead>
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<td>2.00</td>
<td>42.75</td>
<td>0.0</td>
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</table>
APPENDIX D

REFERENCES


2) U.S. Department of Commerce, Hydrometeorological Report No. 33, Seasonal Variation of the Probable Maximum Precipitation East of the 105th Meridian for Areas from 10 to 1,000 Square Miles and Durations of 6, 12, 24, and 48 Hours; April 1956.


Inforcement in Floor of Tower
vertically & horizontally

Inforcement in Shell of Tower
1 bars 3/4" sq.
1 bars 5/8" sq.

Section A-B
6" granite Curbing 3'-6" inside radius, dressed all over, except on back.

Section A-B
Vent hole for 2" galv. iron pipe. Pipe to be laid to drain into Tower.
Detail of Window Grating.
5 Required.
Detail of Tower Roof.
Detail of Top Windows & Grating
12 Required
Vent hole for 2' gage iron pipe. Pipe to be laid to drain into Tower.
Development of Window Openings on inside diameter of Shell.

- longitudinal Bars 12 c.c
- vertical Bars 12 c.c

3'-2''

5/8 x 2'' Plate built into Concrete

Padlock

5/8 wrought iron
Part Section and Elevations

Section E - P

Note: To be high elastic limit corrugated steel. Do not place not less than 2 inches from face.
Elevation showing Connection of Bars into Tower.
Detail of Grating for Intake B
To be used also on Intake Box of Lower Towe

WATER

Item 10
INTAKE AND CONDUIT
UPPER DAM.
ERVLIET STORM SEWER C

SCALE 3/8 & 3/4 "= 1 FOOT. NOV. 1911.
SOLOMON, NORCROSS & KEIS.
ENGINEERS.
Detail of Normal Flow Inlet Pipe.

AND CONDUIT.

ER DAM.

M SEWER COMMISSION.

1 FOOT. NOV 1911.

OR CROSS & KEIS.

ENGINEERS.
6" Concrete Core Wall
reinforced with #8 square iron bars 2 1/2" horizontally, 12" vertically, wrapped with 1/8" steel wire at each intersection.
DEVELOPMENT OF PROFILE ALONG

ALIGNMENT OF CONDUIT

scale
Profile along Φ of Conduit.

I H G F

Core Wall

T of Conduit.

0 30 40 50 feet

Scale
MAP
OF
UPPER DAM SI
DRY RIVER BASIN
WATERVLIET STORM SEW
SCALE 1 INCH = 20 FEET; OCT 19
SOLOMON, NOBRE CROSS & K
ENGINEERS
WATERVLIET
MAP OF DAM SITE VER BASINS FROM SEWER COMMISSION 20 FEET; OCT 1911 ACROSS & KEIS ENGINEERS EVILLET