PASSAIC RIVER BASIN
LOWER HUDSON RIVER AREA

HILLBURN RESERVOIR DAM LEVEL II
ROCKLAND COUNTY, NEW YORK
INVENTORY NO. N.Y. 974

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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NEW YORK DISTRICT CORPS OF ENGINEERS
JUNE 1981
National Dam Safety Program. Hillburn Reservoir Dam (Inventory Number NY 974), Passaic River Basin, Rockland County, New York.

Phase I Inspection Report.
Using the Corps of Engineers' screening criteria, it has been determined that the dam would be overtopped for all storms exceeding approximately 2.5 percent of the Probable Maximum Flood (PMF). The spillway is, therefore, adjudged as "seriously inadequate" and the dam is assessed as unsafe, non-emergency.

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.

On the basis of stability analyses of the masonry/concrete gravity portion of the dam performed for this investigation, the factors of safety against overturning are inadequate and the locations of the resultants fall outside of the middle 1/3. The factor of safety of the dam against sliding was determined to be less than the recommended guidelines for all loading conditions.

The three piping holes at the toe of the dam should be investigated to find the cause and effect on the structural stability of the dam. An in-depth engineering study should be conducted to determine the actual stability conditions of the dam. The results of these investigations and analyses will determine the appropriate remedial measures which will be required to achieve a spillway capacity adequate to discharge the outflow from at least the 1/2 PMF. In the interim, a detailed emergency action plan must be developed and implemented during periods of unusually heavy precipitation. Also, around-the-clock surveillance must be provided during these periods.

It is therefore recommended that, within three months of notification of the owner, detailed hydrologic and hydraulic investigations of the structure should be undertaken to more accurately determine the site-specific characteristics of the watershed and their effects upon the overtopping potential of the dam.

Formal inspection and maintenance procedures should be developed with records maintained for future reference of inspection and maintenance completed.
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.
# PHASE I INSPECTION REPORT
## NATIONAL DAM SAFETY PROGRAM
### HILLBURN RESERVOIR DAM
  **I.D. No. NY 974**  
  **DEC Dam No. 196A-934 PASSAIC RIVER BASIN**  
  **ROCKLAND COUNTY, NEW YORK**

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Name of Dam: Hillburn Reservoir Dam (I.D. No. NY 974)
State: New York
County: Rockland
Stream: Unnamed Tributary of Ramapo River
Dates of Inspection: 9 January 1981
10 March 1981

ASSESSMENT

Examination of available documents and a visual inspection of the dam and appurtenant structures did not reveal conditions which constitute an immediate hazard to human life or property.

Using the Corps of Engineers' screening criteria, it has been determined that the dam would be overtopped for all storms exceeding approximately 2.5 percent of the Probable Maximum Flood (PMF). The spillway is, therefore, adjudged as "seriously inadequate" and the dam is assessed as unsafe, non-emergency.

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.

On the basis of stability analyses of the masonry/concrete gravity portion of the dam performed for this investigation, the factors of safety against overturning are inadequate and the locations of the resultants fall outside of the middle 1/3. The factor of safety of the dam against sliding was determined to be less than the recommended guidelines for all loading conditions.

The three piping holes at the toe of the dam should be investigated to find the cause and effect on the structural stability of the dam. An in-depth engineering study should
be conducted to determine the actual stability conditions of the dam. The results of these investigations and analyses will determine the appropriate remedial measures which will be required to achieve a spillway capacity adequate to discharge the outflow from at least the 1/2 PMF. In the interim, a detailed emergency action plan must be developed and implemented during periods of unusually heavy precipitation. Also, around-the-clock surveillance must be provided during these periods.

It is therefore recommended that, within three months of notification of the owner, detailed hydrologic and hydraulic investigations of the structure should be undertaken to more accurately determine the site-specific characteristics of the watershed and their effects upon the overtopping potential of the dam.

Formal inspection and maintenance procedures should be developed with records maintained for future reference of inspection and maintenance completed.

The following remedial measures must be completed within one year:

1. The seeps in the downstream face of the dam should be monitored to determine if seepage quantities are increasing.
2. The blow-off pipes should be made operable.
3. The mortar in the masonry joints in the downstream face should be repaired.
4. The valve house should be repaired.
5. The downstream channel below the spillway should be cleared of all obstructions to flow.
6. The three trees should be removed from the downstream face of the dam.
7. The concrete wing wall at the right abutment should be repaired.
8. The spalling on the upstream face of the concrete cap should be repaired.
9. All trees and brush at the downstream toe of the dam should be cut at ground level. The root systems of all trees with a trunk diameter greater than 3 inches should be removed. All resultant areas of erosion and cavities should be filled, compacted, and seeded.
SUBMITTED: Granville Kester, Jr., P.E.
Vice-President
MICHAEL BAKER, JR. of New York, INC.

APPROVED: Colonel W.M. Smith, Jr.
New York District Engineer

DATE: 30 JUN 1981
Overall View of Dam
Hillburn Reservoir Dam
I.D. No. NY 974
10 March 1981
PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
HILLBURN RESERVOIR DAM
I.D. No. NY 974
DEC No. 196-934
PASSAIC RIVER BASIN
ROCKLAND COUNTY, NEW YORK

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 - This inspection was conducted to evaluate the existing conditions of the dam, to identify deficiencies and hazardous conditions, to determine if these deficiencies constitute hazards to life and property, and to recommend remedial measures where required.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam - Hillburn Reservoir Dam is a concrete capped masonry structure with a height of 26.0 feet and a length of 476 feet. The dam is formed by two sections of nearly equal length. The right section is situated normal to the stream valley. The left section is situated at an angle of 115°+ from the other, nearly parallel to the stream valley. The crest of the left section is approximately 0.5 to 1.0 foot higher than the crest of the right section.

There is an earth embankment along the downstream face of the left section of the dam. This embankment extends up to the crest of the dam and has 1V:3H (Vertical to Horizontal) side slopes and a maximum height of approximately 6 feet.

The spillway consists of three adjacent, shallow (0.7 foot) notches in the crest of the right section of the dam, each 8 feet wide. The notches will accept flashboards, although the owner's representative reported that none have been used.
for several years. Discharges through the notches cascade down the masonry face of the dam to a boulder-lined discharge area.

A valve house is located on the upstream side of the dam just to the left of the spillway. A 12-inch cast iron water supply pipe leads from the valve house to a chlorinator building situated approximately 100 feet downstream of the dam. Two additional 8-inch cast iron pipes lead from the valve house to just below the dam and serve as outlets. There are valves for the 8-inch pipes at the valve house and at the outlet end. None of the valves have been operated for 7-9 years.

b. Location - Hillburn Reservoir Dam, located on an unnamed tributary of the Ramapo River, is 0.8 mile west of Hillburn, New York. The reservoir and dam are in Rockland County, New York. The coordinates of the dam are N 41° 07.5' and W 74° 11.0'. The dam can be found on the Sloatsburg and Ramsey, New York, USGS 7.5 minute topographic quadrangles.

c. Size Classification - Hillburn Reservoir Dam is 26.0 feet high, based on the maximum section in the stability calculations, and the reservoir storage capacity at the crest of the dam (elevation 594.3 feet M.S.L.) is 28 acre-feet. Therefore, the dam is in the "small" size category as defined by the Recommended Guidelines for Safety Inspection of Dams (Reference 15, Appendix E).

d. Hazard Classification - Nine houses are located downstream from the dam; one at 700 feet, one at 1400 feet, and seven at 2500 feet. There is possible loss of life in all of the homes in the event of dam failure. Hillburn Reservoir Dam is therefore considered in the "high" hazard category as defined by the Recommended Guidelines for Safety Inspection of Dams.

e. Ownership - The dam and reservoir are owned and operated by the Village of Hillburn, 31 Mountain Avenue, Hillburn, New York 10931. The contact person is Mr. Allan Garfinkel, Village Engineer (Telephone 914-357-0999).

f. Purpose of the Dam - Hillburn Reservoir was originally used as a water supply for the Village of Hillburn, New York, but was abandoned two years ago because the flow quantity and quality were unreliable.
**Design and Construction History** - Hillburn Reservoir Dam was constructed about 1906. The original designer and contractor are unknown. In 1931 the dam was raised 1 foot by the addition of a concrete cap. The design was by Bogart and Pohl Engineers of New York City. The contractor is unknown.

**Normal Operating Procedures** - The reservoir level is normally maintained at the spillway crest. According to the owner, the dam is visited daily. All valves on the blow-off pipes and water supply line are closed and have not been operated for 7-9 years.

### 1.3 PERTINENT DATA

**a.** Drainage Area (Acres) - 340

**b.** Discharge at Dam (c.f.s.)

- Spillway Capacity (at Pool Elev. 595.0 ft. M.S.L.) 37.0
- Reservoir Drain at Normal Pool Level 12.2

**c.** Elevation (Feet Above M.S.L.)*

- Minimum Top of Dam 595.0
- Normal Pool (Spillway Crest) 594.3
- Streambed at Toe of Dam 572.7

**d.** Reservoir Surface Area (Acres) -

- Top of Dam (Elev. 595.0 ft. M.S.L.) 3.2
- Spillway Crest (Elev. 594.3 ft. M.S.L.) 2.8

**e.** Reservoir Storage Capacity (Acre-Feet) -

- Top of Dam (Elev. 595.0 ft. M.S.L.) 28.0
- Spillway Crest (Elev. 594.3 ft. M.S.L.) 26.0

**f.** Dam -

- Type: Masonry gravity with concrete cap
- Length (Feet) 476.0
- Height (Feet) 22.3
- Crest Width (Feet) 4.0
- Side Slopes - Upstream Vertical
  - Downstream 3V:1H

*All elevations are referenced to the crest of the dam, elev. 595.0 ft. M.S.L., estimated from the 7.5 minute USGS topographic quadrangle, Sloatsburg, New York.*
g. Spillway -

Type: 3-section, concrete, broad-crested weir
Total Crest Length Perpendicular to Flow (Feet) 24.0
Crest Width Parallel to Flow (Feet) 4.0
Crest Elevation (Feet M.S.L.) 594.3

h. Reservoir Drain -

Type: Two 8-inch cast iron pipes to the stream 50 feet downstream from the toe of the dam.
Control: There are two manually controlled gate valves in the gatehouse on the crest of the dam and two gate valves on the downstream end of the two 8-inch pipes.
SECTION 2: ENGINEERING DATA

2.1 GEOLOGY

The Hillburn Reservoir Dam is located in the southern end of the "New England Uplands" physiographic province of New York State. This province is geologically complex and composed of characteristically diverse metamorphic and igneous rock. Bedrock occurring in the immediate vicinity of the dam, as indicated on the Geologic Map of New York (J. G. Broughton and others, 1970), consists of Precambrian (greater than 600 million years ago) amphibolite and hornblende granitic gneiss. A northeast-southeast trending normal fault plane, as shown on the Geologic Map of New York, lies approximately two miles east of the dam and represents the only major fault within this area. This entire area has been repeatedly glaciated by the major ice advances which occurred during the Pleistocene Epoch. The most recent ice advance ended approximately 11,000 years ago.

2.2 SUBSURFACE INVESTIGATIONS

No records of any subsurface investigations performed for this structure could be located. The available plans and an application for permission to rehabilitate the dam in 1931 indicate that the structure is founded on sand, clay and boulders. A visual observation indicates that the valley floor appears to be covered by glacial debris in the form of silty soil and sub-rounded boulders.

According to the available soils report for Rockland County, prepared by the USDA Soil Conservation Service, most of the local foundation materials consist of "Charlton extremely stony loam". These soils are relatively deep (4 to 10 feet), moderately coarse textured, stony soils formed in acid glacial till. The foundation materials in the vicinity of the northeastern border of the structure consist of "Hollis fine sandy loam". The Hollis soils are shallow (10 to 20 inches), moderately coarse textured soils formed also in acid glacial till.

2.3 DAM AND APPURTEAN T STRUCTURES

The dam was originally built around 1906 as a water supply for the community of Hillburn, situated less than a mile to the east of the facility. The dam is a concrete capped masonry structure formed by two sections of nearly equal length. The right section is situated
normal to the stream valley. The left section is situated at an angle of $115^\circ$ from the other, nearly parallel to the stream valley. There is an earth embankment along the downstream face of the left section of the dam. This embankment extends up to the crest of the dam and has $1V:3H$ side slopes and a maximum height of approximately 6 feet. The spillway consists of three adjacent, shallow (0.7 foot) notches, each 8 feet wide, in the right wall. Discharges through the notches cascade down the masonry face of the dam to a boulder-lined discharge area. The original spillway openings are believed to have been approximately 20 feet deep (refer to Plate 2, Appendix F). It is unknown if the masonry walls are founded on bedrock or the local loamy soils.

A valve house is located on the upstream side of the dam just to the left of the spillway. A 12-inch cast iron water supply pipe leads from the valve house to a chlorinator building situated approximately 100 feet downstream of the dam. Two additional 8-inch cast iron pipes lead from the valve house to just below the dam and serve as outlets. There are valves for the 8-inch pipes at the valve house and at the outlets. None of the valves have been operated for 7-9 years.

2.4 CONSTRUCTION RECORDS

Construction records are not available. Records relating to 1931 rehabilitation measures (raising the dam 1 foot with a concrete cap) are included in Appendices F and G.

2.5 OPERATION RECORDS

No operation records were found during this investigation.

2.6 EVALUATION OF DATA

The background information collected during this investigation was obtained primarily from files of the New York State Department of Environmental Conservation. Supplementary information was acquired through conversations with Mr. Allan Garfinkel, Hillburn Village Engineer. The available data are considered adequate and reliable for Phase I Inspection purposes.
SECTION 3: VISUAL INSPECTION

3.1 FINDINGS

a. General - The inspection was performed on 9 January 1981. The weather was cloudy and the temperature was 10°-20°F. with 2-4 inches of snow on the dam; 2 inches of snow on the crest of the dam; and 4 inches of snow on the ground. The water surface was 6.1 feet below the spillway crest. Deficiencies found during the inspection will require remedial treatment. A Field Sketch of conditions found during the inspection is included in Appendix F. The complete Visual Inspection Checklist is presented as Appendix B. Because there was a snow cover on the dam during the initial inspection, a follow-up inspection was carried out on 11 March 1981.

b. Spillway - The spillway is located approximately 100 feet from the right abutment. The spillway consists of 3 separate 8 foot notches, each 0.7 foot deep, in the concrete cap on the dam. Each spillway section has notches for flashboards to be installed, but the owner's representative reported that flashboards have not been used for some time. The spillway was in good condition at the time of inspection. The spillway discharges over the downstream face of the dam and into the discharge channel.

c. Dam - Hillburn Reservoir Dam is a masonry structure formed by two walls, 476 feet in total length and 22.3 feet high. The entire masonry structure has a concrete cap that is in good condition, with a small amount of spalling present on the upstream face of the cap.

The mortar in masonry joints is generally deteriorated with many cracks and gaps, especially from the spillway to the right abutment. Two seeps (0.5 gpm) are located on the downstream face of the dam beneath the spillway. There are also several smaller seeps located beneath the spillway. What appeared to be a piping hole was observed at the downstream toe of the dam at Station 0-55. After clearing material away from the hole and allowing approximately 45 minutes to elapse to allow for the removal of material pushed into the hole, a steady flow rate of approximately 2-3 gpm was observed. At the surface, a well-defined hole 1
inch in diameter was visible. This hole tapered down to 0.5 inch in diameter at a depth of 4-5 inches. Fine material (silt and/or sandy particles) was being carried out of the hole. At no time was the flow colored or significantly turbid. The exact depth of the hole could not be determined. There are three trees, 2-5 inches in diameter, growing in the downstream masonry face of the dam between the spillway and right abutment. There are many trees, ranging from 4-24 inches in diameter, growing along the downstream toe of the dam. The concrete wing wall at the right abutment has collapsed.

d. 10 March 1981 Inspection - This inspection was conducted with representatives present from the New York District, Corps of Engineers, and the New York Department of Environmental Conservation.

The reservoir was full with approximately 2 inches of flow over the spillway crest during the inspection. Seepage was observed under a majority of the concrete cap on the dam. Two additional piping holes (each 1 inch in diameter) were observed at the downstream toe of the left section of the dam. Flow from the holes was about 2-3 gpm and was clear. There is an abandoned water line in the vicinity of these holes, and it is suspected that a leak in this line is the likely source of the flow. This is not believed to be a serious problem at this time because the height of the embankment at the location of these holes is only a few feet, and because the source of the flow is probably the abandoned water line.

e. Outlet Works - The valve house is located on the upstream face of the dam at the crest. Three pipes exit the valve house. One 12-inch pipe is a water supply line that extends to the chlorinator building 100 feet from the toe of the dam. Two 8-inch cast iron blow-off pipes exit the valve house and discharge into the downstream channel. The valves in the valve house and the valves on the downstream end of the blow-off pipes have not been operated for the last 7-9 years. In the valve house, the mortar in the masonry joints of the foundation is deteriorating. The majority of the boards from the wood plank floor in the valve house are missing.

f. Downstream Channel - The downstream channel below the spillway is full of large boulders and debris.
The downstream channel below the blow-off pipes has a moderate to steep slope, full of large boulders and debris.

Nine houses are located downstream from the dam; one at 700 feet, one at 1400 feet, and seven at 2500 feet.

Reservoir - The slopes of the reservoir are moderate to steep, rock covered and wooded. There were no signs of instability and sedimentation was not reported to be a significant problem.

3.2 EVALUATION

The visual inspection revealed several deficiencies in this dam. The following items were noted:

1. Three small piping holes, flowing at 2-3 gpm, were observed at the toe of the dam.

2. Two seeps are located on the downstream face of the dam beneath the spillway. Also, there are several smaller seeps located beneath the spillway.

3. The mortar in the masonry joints is generally deteriorated with many cracks and gaps, especially from the spillway to the right abutment;

4. The valves for the blow-off pipes have not been operated for 7 to 9 years;

5. The downstream channel below the spillway is full of large boulders and debris.

6. There are three trees growing in the masonry face of the dam, and many trees growing at the toe of the dam.

7. The masonry joints in the foundation, and the entire valve house is in a deteriorated condition.

8. The concrete wing wall at the right abutment has collapsed.

9. There is some spalling present on the upstream face of the concrete cap.
SECTION 4: OPERATION AND MAINTENANCE PROCEDURES

4.1 PROCEDURES

There are no formal written instructions for operating the reservoir. The normal water surface elevation is at the spillway crest, but because of the water shortage in the area, the water surface at the time of inspection was 6.1 feet below the spillway crest. Water can be released to the downstream area by the two 8-inch cast iron blow-off pipes. The blow-off pipes have valves in the gate house and also on the downstream end.

4.2 MAINTENANCE OF THE DAM

Maintenance of the dam is the responsibility of the Village of Hillburn. The maintenance of the dam is not considered adequate, as evidenced by the general deterioration of the dam. The valves on the blow-off pipes have not been operated for 7-9 years. The valve house is in poor condition, the mortar in the masonry joints is deteriorating, and the majority of the boards from the wood plank floor in the valve house are missing. Mr. Winter, Superintendent of Public Works, visits the dam daily, while inspecting a water storage tank at the dam site.

4.3 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

At the time of the inspection, there was no warning system or emergency action plan in operation.

4.4 EVALUATION

The dam and appurtenant facilities have not been maintained in a satisfactory condition. A checklist should be compiled by the owner's representative to document the findings made during the periodic inspections and the maintenance items completed. A warning system and emergency action plan should be developed and put into operation.
SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 DRAINAGE AREA CHARACTERISTICS

Delineation of the watershed of Hillburn Reservoir Dam was made using the USGS 7.5 minute topographic quadrangles for Sloatsburg and Ramsey, New York. The drainage basin has moderate to steep slopes which are well covered by forests and ground vegetation. Some storage exists in the form of a large swampy area located upstream of Hillburn Reservoir. There has been no significant development within the 340 acre drainage area.

5.2 ANALYSIS CRITERIA

An hydrologic analysis of the watershed and an hydraulic analysis of dam was conducted using the U.S. Army Corps of Engineers' Flood Hydrograph Package HEC-1 DB computer program (Reference 12, Appendix E). The unit hydrograph was defined using the Snyder Unit Hydrograph Method. Estimates of the Snyder's unit hydrograph coefficients were based upon average coefficients from the Hydrologic Flood Routing Model for the Lower Hudson River Basin (Reference 16, Appendix E). Precipitation data was taken from Hydrometeorological Report No. 33 (Reference 8, Appendix E). Rainfall losses were estimated at an initial loss of 1.0 inch and a constant loss rate of 0.1 inch per hour thereafter. The hydraulic capacity of the dam, reservoir, and spillway was determined by incorporating the Modified Puls Routing Method. All flood routings were begun with the reservoir at normal pool level. Outlet discharge capacity was computed by hand. The Probable Maximum Flood (PMF) and 1/2 Probable Maximum Flood (1/2 PMF) were developed and routed through the reservoir.

5.3 SPILLWAY CAPACITY

The spillway capacity at the minimum top of dam is 37 cubic feet per second (c.f.s.). There is no auxiliary or emergency spillway at Hillburn Dam.

5.4 RESERVOIR CAPACITY

The storage capacity of Hillburn Reservoir at normal pool is 26 acre-feet. The storage capacity of the reservoir at the minimum top of dam is 28 acre-feet. Therefore, flood control storage of the reservoir between the spillway crest and top of dam is 2 acre-feet. This volume represents a total of 0.70 inch of runoff from the watershed.
5.5 FLOODS OF RECORD

No information concerning the effects of significant floods on the dam is available.

5.6 OVERTOPPING POTENTIAL

The maximum capacity of the spillway is 37 c.f.s. before overtopping would occur. The peak outflows of the PMF and 1/2 PMF are 1664 c.f.s. and 831 c.f.s., respectively. Therefore, the spillway is capable of passing 2.5 percent of the PMF before overtopping would occur.

5.7 RESERVOIR EMPTYING POTENTIAL

The reservoir can be drawn down by means of two 8-inch cast iron pipes controlled by gate valves on the upstream and downstream ends. Neglecting inflow, the reservoir can be drawn down from normal pool in approximately 33 hours. This is equivalent to an approximate drawdown rate of 0.65 feet per hour, based on the hydraulic height measured from normal pool divided by the time to dewater the reservoir.

5.8 EVALUATION

Hillburn Reservoir Dam is a "small" size - "high" hazard dam requiring the spillway to pass a flood in the range of the 1/2 PMF to PMF. The PMF and 1/2 PMF were routed through the watershed and dam. It was determined that the spillway is capable of passing 2.5 percent of the PMF before overtopping the dam. The spillway is, therefore, judged to be "seriously inadequate."

Conclusions pertain to present conditions and the effect of future development on the hydrology has not been considered.
SECTION 6: STRUCTURAL STABILITY

6.1 EVALUATION OF EMBANKMENT STABILITY

a. Visual Observations - A number of significant deficiencies related to the stability of the structure were noted during the visual inspection. These include:

1. Much of the mortar between individual stones of the masonry walls is badly deteriorated, cracked, or completely weathered away (particularly right of the spillway). Also, several stones are missing.

2. Two leaks (up to 0.5 gpm each) and numerous smaller leaks are occurring through the bottom courses of masonry wall immediately below the spillway (the level at which the leaks occur may represent the level of the original spillway crest).

3. What appeared to be a piping hole was observed at the downstream toe of the dam at Station 0+55. A steady flow of 2-3 gpm was observed exiting the hole. At the surface, a well-drained hole 1 inch in diameter was visible which tapered to 0.5 inch in diameter at a depth of 4-5 inches. Fine material was being carried out of the hole but at no time was the flow colored or significantly turbid.

4. Three trees, ranging from 2-5 inches in diameter, are growing on the downstream face of the masonry wall between the spillway and the right abutment.

5. The valves for the 8 inch outlets ("blow-off" pipes) have not been operated for 7 to 9 years.

b. Design and Construction Data - No design information was available regarding the stability of the structure.

c. Operating Records - Operating records are not available.

d. Post Construction Changes - A 12-inch concrete cap was placed on the masonry walls during 1931. The
facility was generally abandoned for water supply purposes approximately 2 years ago because the quantity and quality of water available was unreliable.

6.2 STRUCTURAL STABILITY ANALYSIS

The results of any previous stability analysis were unavailable for reference during this evaluation. A structural stability analysis has been conducted for the maximum masonry section of the dam situated near the spillway. The cases analyzed and respective results are as follows:

<table>
<thead>
<tr>
<th>Case</th>
<th>Description of Loading Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Normal operating conditions with reservoir at the spillway crest, full uplift and no tailwater.</td>
</tr>
<tr>
<td>2</td>
<td>Same as Case 1 with the addition of ice loading of 5000 pounds per lineal foot.</td>
</tr>
<tr>
<td>3</td>
<td>Reservoir level during 1/2 PMF (elev. 596.2 T.B.M.), with full uplift, and a tailwater of 4.5 feet.</td>
</tr>
<tr>
<td>4</td>
<td>Reservoir level during the PMF (elev. 596.74 T.B.M.), with full uplift, and a tailwater of 6.0 feet.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Case</th>
<th>Factor of Safety</th>
<th>Location of Resultant from Toe (ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Overturning</td>
<td>Sliding</td>
</tr>
<tr>
<td>1</td>
<td>1.04</td>
<td>3.7</td>
</tr>
<tr>
<td>2</td>
<td>0.72</td>
<td>2.9</td>
</tr>
<tr>
<td>3</td>
<td>0.85</td>
<td>3.1</td>
</tr>
<tr>
<td>4</td>
<td>0.83</td>
<td>3.1</td>
</tr>
</tbody>
</table>

Notes: Location of middle 1/3 is 5.0 to 10.0 feet from the downstream toe.

A negative sign above indicates that the resultant falls downstream of the toe.

A value of .19 KSF was used as a conservative approximation of the shear strength of sandy silt.

Hillburn Reservoir Dam is situated in Seismic Zone 1. Seismic loading evaluations are not necessary for dams in this seismic zone.
In all cases analyzed, the factors of safety against overturning are low and the locations of the resultants fall outside of the middle 1/3. Therefore, the dam is considered unsafe against overturning. However, the structure has withstood normal loading conditions in the past without apparent damage, and the analyses may not indicate the true field conditions or proper loading conditions. Therefore, it is recommended that an in-depth engineering study of the structure be conducted to determine actual stability conditions prior to initiating any remedial measures.
SECTION 7: ASSESSMENT/RECOMMENDATIONS

7.1 ASSESSMENT

a. Safety - Examination of available documents and visual inspections of Hillburn Reservoir Dam did not reveal any conditions which are considered to be hazardous.

Using the Corps of Engineers' screening criteria for review of spillway adequacy, it has been determined that the dam would be overtopped for all storms exceeding approximately 2.5 percent of the PMF. The overtopping of the dam could result in dam failure, increasing the hazard to loss of life downstream. The spillway is, therefore, adjudged as "seriously inadequate" and the dam is assessed as unsafe, non-emergency.

The "unsafe" classification 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 of the dam.

The stability analyses of the structure performed for this investigation indicate that the factors of safety against overturning and sliding are inadequate. The factor of safety against sliding was less than the recommended guidelines for one unloading condition.

b. Adequacy of Information - Available information and the observations and measurements made during the visual inspection are considered sufficient for this Phase I Inspection Report.

c. Need for Additional Investigation - Detailed hydrologic and hydraulic investigations of the watershed and reservoir area are considered necessary to more accurately determine the overtopping potential of the dam. After the in-depth hydrologic/hydraulic investigations have been completed, remedial measures must be initiated to provide spillway capacity sufficient to discharge the outflow from the 1/2 PMF event.
The three piping holes at the toe of the dam should be investigated to determine the cause of and needed remedial action, immediately. A detailed stability analysis of the dam is considered necessary to determine actual stability conditions.

d. Urgency - The detailed hydrologic and hydraulic investigations must be initiated within three months of notification to the owner. Within one year, remedial measures resulting from these investigations must be initiated, with completion of these measures during the following year. In the interim, a detailed emergency action plan must be developed and implemented during periods of unusually heavy precipitation. Also, around the clock surveillance must be provided during these periods.

7.2 RECOMMENDED MEASURES

Formal inspection and maintenance procedures should be developed with records maintained for future reference of inspection and maintenance completed. A thorough checklist should be compiled by the owner's representative and completed during each inspection. Maintenance items should be completed annually.

The following remedial measures must be completed within one year:

1. The seeps in the downstream face of the dam should be monitored to determine if seepage quantities are increasing.

2. The blow-off pipes should be made operable.

3. The mortar in the masonry joints in the downstream face should be repaired.

4. The valve house should be repaired.

5. The downstream channel below the spillway should be cleared of all obstructions to flow.

6. The three trees should be removed from the downstream face of the dam.

7. The concrete wing wall at the right abutment should be repaired.

8. The spalling on the upstream face of the concrete cap should be repaired.
9. All trees and brush at the downstream toe of the dam should be cut at ground level. The root systems of all trees with a trunk diameter greater than 3 inches should be removed. All resultant areas of erosion and cavities should be filled, compacted, and seeded.
CONTENTS

Photo 1: Upstream Face of Dam (Looking Toward Left Side of Dam) - 10 March 1981

Photo 2: Downstream Face of Dam from Right Abutment - 10 March 1981

Photo 3: Seep on Downstream Face of Dam Below Spillway (Seep Obscured by Flow Over Spillway During 10 March 1981 Inspection) - 9 January 1981

Photo 4: Downstream Face of Dam from Below the Right Side of Spillway (Seepage Area Obscured by Flow Over Spillway During 10 March 1981 Inspection) - 9 January 1981

Photo 5: 8-inch Valves on Blow-off Pipes (Looking Upstream) - 10 March 1981

Photo 6: Downstream Face of Dam Showing Deterioration of Mortar Joints in Dam and Seepage Under Concrete Cap - 10 March 1981

Photo 7: Piping Hole at the Downstream Toe of Dam - 9 January 1981
HILLBURN RESERVOIR DAM

Photo 1. Upstream Face of Dam (Looking Toward Left Side of Dam)  
10 March 1981

Photo 2. Downstream Face of Dam from Right Abutment  
10 March 1981
HILLBURN RESERVOIR DAM

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(Seep Obscured by Flow Over Spillway
During 10 March 1981 Inspection)
9 January 1981

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(Seepage Area Obscured by Flow Over Spillway
During 10 March 1981 Inspection)
9 January 1981
HILLBURN RESERVOIR DAM

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(Looking Upstream)  
10 March 1981

Photo 6. Downstream Face of Dam Showing Deterioration  
of Mortar Joints in Dam and Seepage Under Concrete Cap  
10 March 1981
Photo 7. Piping Hole at the Downstream Toe of the Dam
9 January 1981
APPENDIX B

VISUAL INSPECTION CHECKLIST
VISUAL INSPECTION CHECKLIST

1) Basic Data

   a. General

      Name of Dam       Hillburn Reservoir Dam
      Fed. I.D. #        NY 974
      DEC Dam No.        196-934
      River Basin       Passaic River
      Location: Town     Hillburn
                        County     Rockland
      Stream Name       Unnamed
      Tributary of      Ramapo River
      Latitude (N)       41°07.53'  Longitude (W) 74°11.03'
      Type of Dam        Gravity masonry dam with a concrete cap
      Hazard Category    High
      Date(s) of Inspection  9 January 1981
      Weather Conditions  Cloudy, 15°F.
      Reservoir Level at Time of Inspection   588.3 ft. M.S.L.

   b. Inspection Personnel     Wayne D. Lasch, Gary W. Todd, Rory L. Galloway

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

      Allan Garfinkel, Village Hall
      31 Mountain Avenue
      Hillburn, NY 10931
      914/357-0999

   d. History:

      Date Constructed       Approx. 1906
      Date(s) Reconstructed  1931
      Designer               Unknown
      Constructed By         Unknown
      Owner                  Village of Hillburn, NY
2) **Embankment** - Note: Embankment only occurs on the downstream side of the left 219 ft. of the dam.

a. Characteristics

(1) **Embankment Material** The left 219 ft. of the dam consists of an embankment with a masonry wall on the upstream face.

(2) **Cutoff Type**

(3) **Impervious Core** Masonry wall with concrete cap on upstream side of embankment.

(4) **Internal Drainage System** None

(5) **Miscellaneous** Embankment only occurs on the downstream side of the left 219 ft. of the dam.

b. **Crest - N.A.**

(1) **Vertical Alignment**

(2) **Horizontal Alignment**

(3) **Surface Cracks**

(4) **Miscellaneous**

c. **Upstream Slope - N.A.**

(1) **Slope (Estimate) (V:H)**

(2) **Undesirable Growth or Debris, Animal Burrows**
(3) Sloughing, Subsidence, or Depressions


(4) Slope Protection


(5) Surface Cracks or Movement at Toe


d. Downstream Slope

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


(2) Undesirable Growth or Debris, Animal Burrows None observed at time of inspection.


(3) Sloughing, Subsidence or Depressions None observed at time of inspection.


(4) Surface Cracks or Movement at Toe None observed at time of inspection.


(5) Seepage None observed at time of inspection.


(6) External Drainage System (Ditches, Trenches, Blanket) None


(7) Condition Around Outlet Structure N/A
(8) Seepage Beyond Toe  None observed at time of inspection.

(e) Abutments - Embankment Contact  No problems observed at time of inspection.

(1) Erosion at Contact

(2) Seepage Along Contact

3) Drainage System
   a. Description of System  None

   b. Condition of System

   c. Discharge from Drainage System

4) Instrumentation (Monumentation/Surveys, Observation Wells, Weirs, Piezometers, Etc.)  None
5) **Reservoir**
   a. Slopes Reservoir slopes are moderate to steep, rock covered, and wooded.
   
   b. Sedimentation Owner's representative reported the depth of the reservoir at the spillway to be 18 ft., reduced from the original depth of 22 ft.
   
   c. Unusual Conditions Which Affect Dam None observed at time of inspection.

6) **Area Downstream of Dam**
   a. Downstream Hazard (No. of Homes, Highways, etc.) Nine houses within 2500 ft.
   
   b. Seepage, Unusual Growth None observed at time of inspection.
   
   c. Evidence of Movement Beyond Toe of Dam None observed at time of inspection.
   
   d. Condition of Downstream Channel The channel has a moderate to steep slope with large boulders and debris in the channel.

7) **Spillway(s) (Including Discharge Conveyance Channel)**
a. General Three section concrete weir, 4 ft. breadth. Each weir section approximately 8 ft. long. Freeboard is only 0.7 ft.

b. Condition of Service Spillway Fair to good general condition. No deterioration observed. Two seeps, approximately 1/2 g.p.m. each, from bottom courses of masonry walls immediately below left and right edges of spillway. Numerous other minor seeps along bottom of masonry wall between the major seeps below the spillway.

c. Condition of Auxiliary Spillway None

d. Condition of Discharge Conveyance Channel Rocky, trees present, channel not well defined.

8) Reservoir Drain/Outlet

Type: Pipe 2 Conduit Other

Material: Concrete Metal cast iron Other

Size: 8 in. Length 68 ft.

Invert Elevations: Entrance Not observable

Exit 567.95 ft.

Physical Condition (Describe): Unobservable
Material: Cast iron pipe.

Joints: Tight Alignment Good

Structural Integrity: Appears to be in good condition.

Hydraulic Capability: One blow-off pipe is questionable since valve appears frozen.

Means of Control: Gate Valve 8 in. Uncontrolled

Operation: Operable X Inoperable Other

Present Condition (Describe): On downstream end, 1 valve is operable and the other appears to be frozen. Last operated 7–9 years ago.

9) Structural
   a. Concrete Surfaces Concrete cap in good condition, small amount of spalling present on upstream face of cap.
   b. Structural Cracking Mortar in masonry joints is generally deteriorated with many cracks and gaps, especially from spillway to right abutment.
   c. Movement - Horizontal & Vertical Alignment (Settlement) None noted, good condition at time of inspection.
   d. Junctions with Abutments or Embankments The wing wall at the extreme right end of the dam has collapsed.
e. Drains - Foundation, Joint, Face: None

f. Water Passages, Conduits, Sluices: None

g. Seepage or Leakage: An apparent one inch piping hole was observed at the toe of the dam, at Sta. 0+55. Approximate flow 2-3 g.p.m. Removal of fines occurring. Also seepage below spillway (see 7b).

h. Joints - Construction, etc.: Mortar joints in poor condition, holes penetrate up to 12 in. into dam. (Average penetration 4 in.). Local masonry loose.

i. Foundation: Bedrock in vicinity of dam is reported to consist of pre-cambrian mixed gneisses, however foundation appears to be glacially deposited silt, sand, clay and boulders. A complete discussion will be addressed in the Geology Section.

j. Abutments: No problems observed at time of inspection.

k. Control Gates: None
1. Approach & Outlet Channels  Outflow from spillway splashes over downstream face of dam to large boulders at base of spillway.

m. Energy Dissipators (Plunge Pool, etc.) Large boulders at base of spillway.

n. Intake Structures Unobservable at time of inspection.

o. Stability The stability is questionable, considering the poor condition of the structure.

p. Miscellaneous Three trees (2 in. to 5 in. diameter) are growing on the downstream masonry wall right of the spillway. Dam was snow covered at time of inspection (2-12 in.)

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

a. Description and Condition Valve house (11 ft. x 13 ft.) located on upstream side of dam at Sta. 1+30. Foundation blocks, mortar is deteriorating with some missing. Building is in poor condition, wood plank floor has majority of boards missing.
CHECK LIST FOR DAMS
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

AREA-CAPACITY DATA:

<table>
<thead>
<tr>
<th></th>
<th>Elevation * (ft.)</th>
<th>Surface Area (acres)</th>
<th>Storage Capacity (acre-ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Top of Dam</td>
<td>595.0</td>
<td>3.2</td>
<td>28.0</td>
</tr>
<tr>
<td>2) Design High Water (Max. Design Pool)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3) Auxiliary Spillway Crest</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4) Pool Level with Flashboards</td>
<td>N/A</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5) Service Spillway Crest</td>
<td>594.3</td>
<td>2.8</td>
<td>26.0</td>
</tr>
</tbody>
</table>

DISCHARGES

<table>
<thead>
<tr>
<th>Volume (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Average Daily</td>
</tr>
<tr>
<td>2) Spillway @ Maximum High Water - Top of Dam -</td>
</tr>
<tr>
<td>3) Spillway @ Design High Water</td>
</tr>
<tr>
<td>4) Spillway @ Auxiliary Spillway Crest Elevation</td>
</tr>
<tr>
<td>5) Low Level Outlet</td>
</tr>
<tr>
<td>6) Total (of all facilities) @ Maximum High Water</td>
</tr>
<tr>
<td>7) Maximum Known Flood</td>
</tr>
<tr>
<td>8) At Time of Inspection</td>
</tr>
</tbody>
</table>

*All elevations are referenced to the spillway crest, elevation 594.3 ft. M.S.L., estimated from the USGS topographic quadrangle for the area.
CREST:  
Type: Concrete
Width: 4 ft.  Length: 476 ft.
Spillway Type: 3 section, broad-crested weir.
Location on Dam: 100 ft. from right abutment.

<table>
<thead>
<tr>
<th>SPILLWAY:</th>
<th>SERVICE</th>
<th>AUXILIARY</th>
</tr>
</thead>
<tbody>
<tr>
<td>594.3 ft.</td>
<td>Elevation</td>
<td>-</td>
</tr>
<tr>
<td>Broad-crested weir</td>
<td>Type</td>
<td>-</td>
</tr>
<tr>
<td>24 ft. (total)</td>
<td>Width</td>
<td>-</td>
</tr>
<tr>
<td>Type of Control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>Uncontrolled</td>
<td>-</td>
</tr>
<tr>
<td>Controlled:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>Type</td>
<td>-</td>
</tr>
<tr>
<td>(Flashboards; gate)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size/Length</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Invert Material</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anticipated Length of Operating Service</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chute Length</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N.A</td>
<td>Height Between Spillway Crest &amp; Approach Channel Invert (Weir Flow)</td>
<td></td>
</tr>
</tbody>
</table>
HYDROMETEROLOGICAL GAGES:

Type: None
Location: ____________________________
Records:
  Date: ____________________________
  Max. Reading: _______________________

FLOOD WATER CONTROL SYSTEM:

Warning System: None

Method of Controlled Releases (mechanisms):
  Two 8-in. cast iron blow-off pipes located beyond the toe of the dam.
DRAINAGE AREA: 0.53 sq.mi.

DRAINAGE BASIN RUNOFF CHARACTERISTICS:

Land Use - Type: Wooded

Terrain - Relief: Moderate to steep slopes.

Surface - Soil: Well drained.

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

There were no known plans for altering the existing runoff patterns at the time of the inspection.

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

None observed, all slopes well vegetated.

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

None observed at the time of the inspection.

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

Location: None

Elevation:

Reservoir:

Length @ Maximum Pool 400 ft.

Length of Shoreline (at Spillway Crest) 1450 ft. (0.27 Mi.)
### Storage Data

**Elevation vs. Surface Area**

<table>
<thead>
<tr>
<th>Elevation (ft)</th>
<th>Area (Acres) (measured from USGS Quad)</th>
</tr>
</thead>
<tbody>
<tr>
<td>594.3</td>
<td>2.8 (Normal Pool)</td>
</tr>
<tr>
<td>600.0</td>
<td>6.4</td>
</tr>
<tr>
<td>620.0</td>
<td>10.1</td>
</tr>
</tbody>
</table>

Normal Pool Storage is 8.5 M.G. (24.09 ac.-ft) obtained from the records of the Hillburn Water Dept.

\[
\Delta E = \frac{35}{\text{RArea} (2)}
\]

From HEC-1 Flood Hydrograph Package, Users Manual, 1973


\[ \Delta E = 27.9 \text{ ft.} \]

\[ \text{RArea}(2) = \text{area corresponding to Relev}(2). \]

\[ \text{Relev}(1) = 594.3 - 27.9 = 566.4 \]

\[ \text{Relev}(1) = \text{elevation where storage is zero} \]

\[ \text{Relev}(1) = \text{Relev}(2) - \Delta E \]

\[ \text{RArea}(1) = 0 \]

\[ \Delta E = \text{change in elevation} \]

\[ S = \text{known storage at Relev}(2) \]

\[ \text{and RArea}(2) \]

**Top of Dam Storage**

28 ac.-ft. (from HEC-1 analysis)

**Drainage Area** - 0.53 sq. mi.

**Watershed Lengths**

- \[ L = 5125 \text{ ft.} = 0.97 \text{ mi.} \]
- \[ L_{x}= 1275 \text{ ft.} = 0.24 \text{ mi.} \]

\[ T_p = C_p \left( L \times L_{x} \right)^{3} \]

\[ C_p = 0.63 \quad C_f = 2.0 \]

\[ T_p = 2.0 \left[ L \times 0.97 \times 0.24 \right]^{3} \]

\[ = 1.29 \]
Subject: Hillburn Reservoir Dam  

Spillway Rating  

Sheet No. B of 26  

Drawing No.  

Composed by: JWT  
Checked by: WD  
Date: 11/15/81  

Spillway Profile

Spillway Elevation: 594.3 ft.  
Crest Elevation: 595.0 ft.  

595  
590  
580  
570  
560  
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10  
0

Spillway profile

Spillway is a broad-crested weir 3 feet wide.  

Q = CLH^1.5  
Handbook of Hydraulics, Brater & King, pg. 5-23.  

C = 2.6  
Pg. 5-40 Brater & King  

L = Total Weir Length = 24 ft.  

H = Measured Head in Feet
Spillway Crest Elevation - 594.3 ft.
Inlet Elevation 8" Pipe - 573.0 ft. (Estimated)
Outlet Elevation 8" Pipe - 567.9 ft.
Length of 8" Cast Iron Pipe - 68 ft.
"Design of Small Dams" Pg. 558-559

\[ D = \text{Dia. Pipe} \]
\[ d = \text{Depth of Water} \]
\[ S = \text{Pipe Slope} \]

\[ S = \frac{572.0 - 567.9}{68} = 0.071 \]

\[ Q = 3.94 \text{ CF}^3 \]

\[ \frac{d}{D} = \frac{0.33}{0.66} = 0.5 \text{ Table B-2} \]

\[ Q = \frac{Q_e}{(0.66)^{1/4}} \]

\[ Q = 3.94 \text{ CF}^3 \]

\[ \frac{d}{D} = \frac{0.35}{0.66} = 0.5 \text{ Table B-3} \]

\[ Q = \frac{Q_e}{(0.66)^{1/4} (0.0823)^{1/4}} \]

\[ Q = 1.69 \text{ CF}^3 \]

\[ \frac{d}{D} = \frac{0.5}{0.66} = 0.76 \text{ Table B-2} \]

\[ Q = 0.89 \text{ CF}^3 \]

\[ \frac{d}{D} = \frac{0.5}{0.66} = 0.76 \text{ Table B-3} \]

\[ Q = 0.89 \text{ CF}^3 \]
Drifice Flow

\[ Q = C A (2.9 H)^{0.5} \]

\[ = 0.60 \times 0.74 \times 3.0 \times 2.1 \times (2.9 H)^{0.5} \]

\[ = 1.642 H^{0.5} \]

\[ A = \pi R^2 = \pi (3.3)^2 = 0.342 \text{ sq. ft.} \]

\[ V = 32.2 \text{ ft/sec} \]

\[ H \text{ varies from 0.3 ft to 2.1 ft and is measured to the center of the pipe} \]

\[ C = 0.60 \text{ from Table 4-6, p. 4-32, Capen & King} \]

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Pipe Flow

\[ Q = \frac{A (2gH)^{1/2}}{U + K_e + K_h (L)^{1/2}} \]

\[ = \frac{(3.342)(64.4 H)^{1/2}}{[1.78 + 0.353L(8)]^{1/2}} \]

\[ = 1.1776 \text{ ft}^3 \text{/sec} \]

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\[ A = \pi R^2 = \pi (3.3)^2 = 34.2 \text{ sq. ft.} \]

\[ g = 32.2 \text{ ft/sec} \]

\[ H \text{ varies and is measured from the top of the pipe at the outlet.} \]

\[ L = 68 \text{ ft}. \]

\[ K_e(K_h) = 0.78 \text{ ft.} \]

\[ K_h(K_h) = 0.013 \text{ ft.} \]

Top of 8" Cast Iron Pipe at outlet elev. 567.5 ft.
### HILLBURN RESERVOIR DATA

#### 8" DIP. PIPE RATING SUMMARY

**Subject:** HILLBURN RESERVOIR DATA  
**S.O. No.:**  
**8" Dip. Pipe Rating Summary:**  
**Sheet No.:** 13 of 26  
**Drawing No.:**  
**Computed by:**  
**Checked by:**  
**Date:** 1-30-81

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Subject: HILBURN RESERVOIR DAM
Spillway Capacity Analysis

S.O. No. ____________________________ Sheet No. 14 of 26

Drawing No. ____________________________ Date 2-11-81

Computed by GWT Checked by

Michael Baker, Jr., Inc.
The Baker Engineers
Box 280
Beaver, Pa. 15009

% P.M.F.

2.5% P.M.F. TOPT OF DAM ELEV. - 595.0 FT

ELEVATION (FT)

594 595 596 597

0 25 50 75 100
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The SDF is 1/2 PMF.
### Analysis

**Hill VAUFOG HYDROGRAPH TO DAM**

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**Core Studies**

- Natural Program for Inspection of Non-Federal Dams
- Hydraulic and Hydrologic Analysis of Hillburn Reservoir Dam
- Sealing Analysis of Hillburn Reservoir Dam

---

**FLUID HYDROGRAPH PACKAGE**

- Sinking Analysis
- Hydraulic and Hydrologic Analysis of Hillburn Reservoir Dam
- Sealing Analysis of Hillburn Reservoir Dam
### Sub-Area Runoff Computation

#### HEC-RAS Runoff Computation

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**Hydrograph Routing**

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**Hydrograph Routing**

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### PLAN FLOW AND STATION LEVEL OF PERIOD SUMMARIES FOR MULTIPLE PAIR-RATIO EQUATION COMPUTATIONS

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<tr>
<th>OPERATION</th>
<th>STATION</th>
<th>AREA</th>
<th>PLAN RATIO</th>
<th>1.02</th>
<th>RATIO APPLIED TO FLOWS</th>
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<td>1.00</td>
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APPENDIX D

STABILITY COMPUTATIONS
MASONRY WALL STABILITY

%0\text{Elevation (ft-m.)} %0\text{Sec.} %0\text{Spillway Crest} %0\text{Normal Pool} %0\text{Top of Dam}

\begin{center}
\begin{tabular}{|c|c|c|c|c|c|}
\hline
\text{El.} & 569.1 & 568.0 & 567.5 & 565.0 & 560.0 & 555.0 \\
\hline
\text{Sec} & & & & & & \\
\hline
\text{Spillway Crest} & & & & & & \\
\hline
\text{Normal Pool} & & & & & & \\
\hline
\text{Top of Dam} & & & & & & \\
\hline
\end{tabular}
\end{center}

\begin{itemize}
\item \text{Masonry Wall}
\item \text{Sandy Soil}
\item \text{Grass}
\end{itemize}

\text{Date: Feb 1981}
EMA Masonry Wall Structure

Area

1. 4' x 26' = 104 ft² @ .14 = 14.5 k 11' 161 k
2. 24' x 9' x ½ = 108 ft² @ .14 = 15.1 k 6' 91 k
3. 24' x 2' x ½ = 24 ft² @ .14 = 3.4 k 13.7' 47 k
   33.1 k

\[ \bar{x} = 299 \div 33.1 = 9' \]

Middle Third = 5' to 10' from a

For Soil Pressure

\[ e = 9 - \frac{15}{2} = 1.5 \sqrt{P = 33.1 k} \]

\[ p = \frac{P}{6} \left( 1 \pm \frac{6e}{b} \right) \]

\[ p = \frac{33.1}{15} \left( 1 \pm \frac{6 \times 15}{15} \right) \]

\[ p_{min} = 0.88 \text{ ksf} \quad p_{max} = 3.53 \text{ ksf} \]
Case 1: Normal Operating Conditions, Full Uplift, Water at Reservoir Level.

For dimensions and other details see associated drawing.

\[
P_1 = 5' \times 0.062' / 0' = 0.31\text{ k}\]
\[
P_2 = 25' \times 0.062' / 0' = 1.55' / 0'\text{ k}\]
\[
P_3 = 0.31' \times 15'(1.55 - 0.31) = 14'\text{ k}\]
\[
P_2 = 1.55' / 0' \times 25' \times \frac{2}{3} = 19.4'\text{ k}\]
\[
P_1 = 0.31' / 0' \times 25' \times \frac{2}{3} = 0.8'\text{ k}\]
Subject: Hillburn Reservoir Dam

Stability Analysis

Sheet No. 11

Ref.

Browning No. 17.5

Computed by JT

Checked by

Date Feb 1981

### Case 1

<table>
<thead>
<tr>
<th>W</th>
<th>Arm</th>
<th>m</th>
</tr>
</thead>
<tbody>
<tr>
<td>33.1k</td>
<td>25/3</td>
<td>299 k</td>
</tr>
<tr>
<td>19.4k</td>
<td>5/3</td>
<td>161 k</td>
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<tr>
<td>0.8k</td>
<td></td>
<td>1</td>
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<tr>
<td>5.0k</td>
<td>15/2</td>
<td>38k</td>
</tr>
<tr>
<td>9.0k</td>
<td>2x15/3</td>
<td>90 k</td>
</tr>
<tr>
<td>19.1k</td>
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<td>11k</td>
</tr>
<tr>
<td>18.6k</td>
<td></td>
<td></td>
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</tbody>
</table>

\[ \bar{x} \text{ from A} = \frac{11k}{19.1k} \approx 0.57 \text{, not in middle} \]

Third

FS against OT = \( \frac{300}{289} = 1.04 \)
Case 2  Case 1 with an ice load of 5k at operating level, see HR3 for ice location from A.

Case 1  19.1k  11.1k  18.6k

Ice Load  5k  25 -125k -144.1k

\[ \Sigma V = 19.1k \uparrow \]

\[ \Sigma H = 23.6k \downarrow \]

\[ \bar{X} = \frac{144.1k - 19.1k}{19.1k} = -6.0' \]

FS against OT = \[ \frac{300}{414} = 0.72 \]
Case 3: Reservoir Level during 1/2 PMF El 596.2 with full uplift and 45' tailwater.

\[ p_1 = (7.15 \times 0.0623/6) \times 75/2 = 1.84/2 \]

\[ p_2 = (27.2 \times 0.0623/10) \times 22.7/2 = 23.34/1 \]

Tailwater at 1/2 PMF Elev. 577'

See sheet HR4 for uplift, \( P_3 = 14k \).
Case 3 - Reservoir Level 1/2 PMF, Full uplift, and 4.5' tailwater.

\[ \begin{array}{ccc}
\text{EMA} & \text{W} & \text{am} & \text{M} \\
\text{0 to 3} & 33.1'k' & 299'k' & \\
\text{Uplift} & 14.0'k' & -128'k' & +304'k'
\end{array} \]

Water Fr.

\[ \begin{array}{ccc}
\text{P}_1 & 1.8'k' & +2.5' & 5'k' \\
\text{P}_2 & 23.3'k' & -9.1' & -212'k'
\end{array} \]

\[ \begin{aligned}
\Sigma V &= 19.1' + \\
\Sigma H &= 21.5' - \\
\Sigma &= -36' \div 19.1' = -1.9'
\end{aligned} \]

FS against 01 = \[ \frac{\text{304'k'}}{\text{340'k'}} = 0.9 \]
Case 4: Loading

\[ P_1 = (9 \times 0.063)^{\frac{1}{2}} = 2.6 \text{kf/l} \]
\[ P_2 = (27.7 \times 0.3)^{\frac{1}{2}} = 24 \text{kf/l} \]

See HR4 for uplift
\[ P_2 = 14 \text{kf/l} \]

Sandy soil

Goethite
Case 4 - PMF Reservoir El. Full Uplift and 6' tailwater

<table>
<thead>
<tr>
<th>EMA</th>
<th>W</th>
<th>arm</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>① to ③</td>
<td>33.1 ft</td>
<td>299</td>
<td></td>
</tr>
<tr>
<td>Uplift</td>
<td>14.0 ft</td>
<td>-128 + 307</td>
<td></td>
</tr>
</tbody>
</table>

Water Pt.

- P1 2.6 k → 3' 8' k
- P2 24 k → 9.2' -221' k

ΣV = 19.1 k
ΣH = 21.4 k

X = -42 ÷ 19.1 = -2.2

FS against OT = \(\frac{307}{3 \times 49} = 0.88\)
Sliding Resistance

\[ RR = V \tan \phi + cA \]

\[ = 19.1k \times \tan 23^\circ + 1.9k/ft^2 \times 15' \]

\[ = 8.02 + 2.9 = 10.92 \]

Passive Pressure from Dunstan Wedge

\[ P_p = \frac{W \tan (\phi + \alpha)}{cA} \times \cos \alpha (1 - \tan \phi \tan \alpha) \]

\[ = 130 \times 1.15k/ft^3 \times \tan (23^\circ + 45^\circ) \]

\[ + \frac{1.9k/ft^2 \times 19'}{\cos 45^\circ (1 - \tan 23^\circ \tan 45^\circ)} \]

\[ = 48.3k + 8.82 \]

\[ = 57k \]

Total Resistance = 57 + 10.92 = 68k

Factor of Safety against Sliding

Case 1  \[ \frac{\text{Resistance}}{2H} = \frac{68k}{18.6} = 3.7 \]

2  \[ = \frac{68k}{23.6} = 2.9 \]

3  \[ = \frac{68k}{21.5} = 3.2 \]

4  \[ = \frac{68k}{21.4} = 3.2 \]
Subject: HULLSVILLE RESERVOIR DAM
S.O. No. 13889

STABILITY ANALYSIS

MAX. 10 DAM SECTION AT SPILLWAY

Sheet No. 11 of 11

Drawing No. HR11

Computed by: A. ST
Checked by: 
Date: Feb 1981

Elevation (ft) 0 5 10 15 20 30 35

Pool During PER (elev. 596.74)
Pool During PER (elev. 593.33)

Top of Dam
Normal Pool (elev. 594.3)

Spillway Crest

Tailwater During PER
Tailwater During PER

Area of Downstream Wedge = 20 x 13 x L = 130 ft^2

\[ \alpha = 45^\circ \]

Sandy soil

Granite
REFERENCES


8. HMR 33, "Seasonal Variations of Probable Maximum Precipitation, East of the 105th Meridian for Areas 10 to 1000 Square Miles and Durations of 6 to 48 Hours," (1956).


APPENDIX F

DRAWINGS
CONTENTS

Location Plan
Watershed Map
Plate 1: Field Sketch
Plate 2: Plans for Increasing Dam Capacity (1931)
Plate 3: Cross Sections of Dam
HILLBURN RESERVOIR DAM

APPROXIMATE WATERSHED AREA

HILLBURN RESERVOIR DAM

SCALE 1:24000

WATERSHED MAP
HILLBURN RESERVOIR DAM

REFERENCES:
1. U.S.G.S. 7.5' DOATSBURG, N.Y. - N.J. QUADRANGLE. 1956
APPENDIX G

BACKGROUND DOCUMENTS
Hillburn Res. Dam

<table>
<thead>
<tr>
<th>Dam Number</th>
<th>River Basin</th>
<th>Town</th>
<th>County</th>
<th>Hazard Class</th>
<th>Date &amp; Inspector</th>
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<tbody>
<tr>
<td>196-434</td>
<td>L &amp; H</td>
<td>Ramapo</td>
<td>Rockland</td>
<td></td>
<td>4/5</td>
</tr>
</tbody>
</table>

Stream = unknown stream
Owner = City of Hillburn

**Type of Construction**

- [ ] Earth w/Concrete Spillway
- [ ] Earth w/Drop Inlet Pipe
- [ ] Earth w/Stone or Riprap Spillway
- [ ] Concrete
- [x] Stone w/Concrete Spillway
- [ ] Timber
- [ ] Other ______________________

**Use**

- [x] Water Supply
- [ ] Power
- [ ] Recreation - [ ] High Density
- [ ] Fish and Wildlife
- [ ] Farm Pond
- [ ] No Apparent Use-Abandoned
- [ ] Flood Control
- [ ] Other ______________________

**Estimated Impoundment Size** 2.5 Acres
**Estimated Height of Dam above Streambed** 26' Ft.

**Condition of Spillway**

- [x] Service satisfactory
- [ ] Auxiliary satisfactory
- [ ] In need of repair or maintenance
- [ ] In need of repair or maintenance

**Condition of Non-Overflow Section**

- [x] Satisfactory
- [ ] In need of repair or maintenance

**Condition of Mechanical Equipment**

- [ ] Satisfactory
- [ ] In need of repair or maintenance

**Siltation**

- [ ] High
- [ ] Low

**Remarks:**

- 6-12" pipes in stream bed with cement values
- Small leak near test cover - gatehouse appears to need minor repairs - some water might be pumped to storage tank on property

**Evaluation (From Visual Inspection)**

- [ ] Repairs req'd. beyond normal maint.
- [ ] No defects observed beyond normal maint.
Application for the Construction or Reconstruction of a Dam

Application is hereby made to the Superintendent of Public Works, Albany, N.Y., in compliance with the provisions of Section 948 of the Conservation Law (see last page of this application) for the approval of specifications and detailed drawings, marked, herewith submitted for the construction of a dam herein described. All provisions of law will be complied with in the erection of the proposed dam. It is intended to complete the work covered by the application about Dec. 1, 1931.

1. The dam will be on a small stream flowing into the Ramepo River in the town of Ramepo, County of Rockland and one and one-quarter miles from junction with Ramepo River.

2. Location of dam is shown on the Ramepo quadrangle of the United States Geological Survey.

3. The name of the owner is Mountain Spring Water Co.

4. The address of the owner is Hillburn, N.Y.

5. The dam will be used for domestic water supply.

6. Will any part of the dam be built upon or its pond flood any State lands? Yes.

7. The watershed above the proposed dam is 2 square miles.

8. The proposed dam will create a pond area at the spillcrest elevation of 294 feet and will impound 8500 cubic feet of water.
9. The maximum height of the proposed dam above the bed of the stream is 26 feet.
10. The lowest part of the natural shore of the pond is one foot vertically above the spillcrest, and everywhere else the shore will be at least one foot above the spillcrest.
11. State if any damage to life or to any buildings, roads or other property could be caused by any possible failure of the proposed dam.
12. The natural material of the bed on which the proposed dam will rest is (clay, sand, gravel, boulders, granite, shale, slate, limestone, etc.)
13. Facing down stream, what is the nature of material composing the right bank?
14. Facing down stream, what is the nature of the material composing the left bank?
15. State the character of the bed and the banks in respect to the hardness, perviousness, water bearing, effect of exposure to air and to water, uniformity, etc. The dam has been built from 25 feet with no Raise.
16. Are there any porous seams or fissures beneath the foundation of the proposed dam?
17. Wastes. The spillway of the above proposed dam will be 24 feet long in the clear; the waters will be held at the right end by an obstruction the top of which will be ! feet above the spillcrest, and have a top width of feet; and at the left end by an obstruction the top of which will be ! feet above the spillcrest, and have a top width of feet.
18. The spillway is designed to safely discharge 306 cubic feet per second.
19. Pipes, sluice gates, etc., for flood discharge will be provided through the dam as follows:
20. What is the maximum height of flash boards which will be used on this dam?
21. Apron. Below the proposed dam there will be an apron built of feet long across the stream, feet wide and feet thick.
22. Does this dam constitute any part of a public water supply?
SECTION 948 OF THE CONSERVATION LAW

§ 948. Structures for impounding water; inspection of docks; penalties. No structure for impounding water and no dock, pier, wharf or other structure used as a landing place on waters shall be erected or reconstructed by any public authority or by any private person or corporation without notice to the superintendent of public works, nor shall any such structure be erected, reconstructed or maintained without complying with such conditions as the superintendent of public works may by order prescribe for safeguarding life or property against danger therefrom. No order made by the superintendent of public works shall be deemed to authorize any invasion of any property rights, public or private, by any person in carrying out the requirements of such order. The superintendent of public works shall have power, whenever in his judgment public safety shall so require, to make and serve an order directing any person, corporation, officer or board, constructing, maintaining or using any structure herebefore referred to, remove, repair or reconstruct the same within such reasonable time and in such manner as shall be specified in such order, and it shall be the duty of every such person, corporation, officer or board, to obey, observe and comply with such order and with the conditions prescribed by the superintendent of public works for safeguarding life or property against danger therefrom, and every person, corporation, officer or board failing, omitting or neglecting so to do, or who hereafter erects or reconstructs any such structure herebefore referred to without submitting to the superintendent of public works and obtaining his approval of plans and specifications for such structures when required so to do by his order or who hereafter fails to remove, erect or to reconstruct the same in accordance with the plans and specifications so approved shall forfeit to the people of this state a sum not to exceed five hundred dollars to be fixed by the court for each and every offense; every violation of any such order shall be a separate and distinct offense, and, in case of a continuing violation, every day's continuance thereof shall be and be deemed to be a separate and distinct offense. This section shall not apply to a dam where the area draining into the pond formed thereby does not exceed one square mile, unless the dam is more than ten feet in height above the natural bed of the stream at any point or unless the quantity of water which the dam impounds exceeds one million gallons; nor to a dock, pier, wharf or other structure under the jurisdiction of the department of docks, if any, in a city of over one hundred and seventy-five thousand population. This section as hereby amended shall not impair the effect of an order heretofore made by the conservation commission or commissioner under this section prior to the taking effect of chapter four hundred and ninety-nine of the laws of nineteen hundred and twenty-one, nor require the approval by the superintendent of public works of plans and specifications theretofore approved by such commission or commissioner under this section.

The foregoing information and accompanying plans and specifications are correct to the best of my knowledge and belief.

Mountain Spring Water Co., Owner.

By...[Signature]...authorized agent of owner.

Address of signer...[Signature]...Date...[Date]...1931

New York