BIRDSBORO RESERVOIR

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

SEPTEMBER 1978
SCHUYLKILL RIVER BASIN

BIRDSBORO RESERVOIR
BERKS COUNTY, PENNSYLVANIA
NATIONAL I.D. NO. PA 00713

National Dam Safety Program, Birdsboro Reservoir (PA-00713), Schuylkill River Basin, Indian Run Creek, Berks County, Pennsylvania. Phase I Inspection Report.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

Prepared by:
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Submitted to:
DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

September 1978

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Name of Dam: Birdsboro Reservoir  
County Located: Berks County  
State Located: Pennsylvania  
Stream: Indian Run Creek  
Coordinates: Latitude 40° 14.4' Longitude 75° 49.2'  
Date of Inspection: 29 August 1978

Birdsboro Reservoir is owned by the Birdsboro Municipal Authority in Birdsboro, Pennsylvania. The dam serves as a principal source of water for the town and surrounding areas. Limited records indicate that the dam was constructed in the 1880's but failed in 1892 due to a break in the water supply pipe buried in the embankment. It was reconstructed in that same year, and the reservoir has been in operation ever since.

The facility is judged to be in good condition in that there were no unusual embankment or crest distortions, misalignment, evidence of slope instability or other features to indicate that the dam is unstable. The spillway was also assessed to be in good condition with some minor erosion occurring at the end of the spillway. The intake tower could not be inspected but has been in operation for the past 64 years without incident.

Hydrologic and hydraulic calculations indicate that the end of the spillway wall would be overtopped at approximately 25 percent of the PMF, and the dam would be overtopped at about 61 percent of the PMF. Although the spillway would be overtopped first, the end of the spillway is founded on erosion resistant materials, and erosion incurred by overtopping is not expected to cause catastrophic failure. Overtopping of the dam is judged to cause failure of the embankment. Based on these calculations, the spillway is considered to be "Inadequate" but not "Seriously Inadequate".

The dam is classified as an "Intermediate" size structure by virtue of its 40 foot height and is also classified as a "High" hazard dam consistent with its potential for extensive property damage and loss of life downstream along Hay Creek and in Birdsboro. The following recommended remedial work is considered necessary and should be performed immediately.
1. The pond drain system should be checked to insure that the reservoir can be drained in the event of an emergency.

2. The water at the base of the dam is considered undesirable and should be checked by a registered professional engineer to determine if it is a natural marsh area or seepage through the dam or foundation. This can be accomplished by regrading the toe of the dam and evaluating the seepage locations. If underseepage is determined to be occurring, an inverted filter blanket should be installed.

3. The intake structure should be inspected for debris and integrity.

4. The water supply pipe should be fitted with a valve at the control tower. This will enable the flow to be cut off in the event the pipe develops a leak within the embankment.

The Owner should develop an inspection checklist together with an inspection and maintenance procedure to insure that all items are properly and periodically inspected and maintained. Because of the downstream population, a formal procedure of observation and warning during periods of high precipitation should be developed and implemented.

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Pennsylvania Registration 4302E
Woodward-Clyde Consultants

APPROVED BY:

C. W. Withers
Colonel, Corps of Engineers
District Engineer

28 Sep 78
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
BIRDSBORO RESERVOIR
NATIONAL ID #PA 00713
DER ID #6-6

SECTION I
PROJECT INFORMATION

1.1 General.

   a. Authority. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

   b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

   a. Dam and Appurtenances. Birdsboro Dam is an approximately 40-foot high rolled earth embankment constructed across Indian Run Creek. The 430-foot long dam impounds an 8-acre reservoir. Very limited data exists regarding physical features of the dam. However, it is known that local borrow material from within the reservoir area was used for the construction. The downstream slope is a 1.5H:IV slope, and the upstream slope is covered with hand-placed riprap on a slope of approximately 2.5H:IV. It is not known if there is a cutoff wall, nor is it known if a grout curtain was installed.
As shown on Plate 3, Appendix E, the intake structure is a masonry tower with a water intake approximately 6.5 feet high and 5.5 feet wide, protected by a grating. It is reported that a 12-inch water supply intake pipe is located at the base of the tower which supplies the town of Birdsboro. A branch in the 12-inch line serves as a pond drain. As noted on Plate 3, there is also an upstream intake orifice and valve at the base of the tower. It is reported by the Owner's representatives that this valve is no longer operable.

The spillway is located along the right abutment, and was reconstructed in 1916 to its present configuration. The spillway is 20 feet wide with 4-foot high retaining walls. The spillway channel is constructed of hand-placed rock approximately 12 inches square and 2 feet long. The oblong rocks were placed vertically to line the channel bottom. The retaining walls on both sides of the channel are masonry. The spillway is a simple channel containing no control section or weir.

b. **Location.** The dam is located across Indian Run Creek approximately 0.5 miles above the mouth of Hay Creek. Hay Creek discharges into the Schuylkill River approximately 2.5 miles below the confluence of Indian Run and Hay Creek. The dam is located near Birdsboro, Berks County, Pennsylvania. The dam site and reservoir are shown on USGS Quadrangle entitled, "Elverson, Pennsylvania", at coordinates N 40° 14.4' W 75° 49.2'. A regional location plan is enclosed as Plate 1, Appendix E.

c. **Size Classification.** The dam is classified as "Intermediate" by virtue of its 40-foot height.

d. **Hazard Classification.** A "High" hazard classification is assigned consistent with the potential for extensive property damage and loss of life downstream along Hay Creek and in the town of Birdsboro, Pennsylvania.

e. **Ownership.** The dam is owned by the Birdsboro Municipal Water Authority. All correspondence should be addressed to Mr. Nicholas J. DeSantis,
f. **Purpose of Dam.** The dam was designed to supply water to the foundries. In 1910, the reservoir became the water supply source for the town of Birdsboro, Pennsylvania.

g. **Design and Construction History.** The dam was built in the 1880's, and was designed by Mr. Isaac S. Cassin, of Philadelphia, Pennsylvania. The original owner of the structure was Mr. George Brooke, owner of the E. and G. Brooke Iron Company of Birdsboro, Pennsylvania. The purpose of the dam was to supply water to the foundry and to distribute water to the workers of the plant. In 1910, the Birdsboro Water Company was organized, and the reservoir was taken over by the city water company and the supply area was extended to include the entire Borough of Birdsboro. In 1914, an inspection/evaluation report prepared by the State of Pennsylvania indicated that the dam was constructed without either a core wall or cutoff wall. The embankment materials were reported to be a mixture of sand and red clay.

On 6 July 1892, a breach occurred in the dam and a wedge-shaped portion of the embankment failed, washing out approximately 150 feet of crest. This failure was attributed to a break in the water supply pipe. The pipe was installed in the dam without antiseepage collars or a cradle. Shortly thereafter, the dam was repaired under the supervision of Mr. George Brooke.

On 22 December 1913 and 6 May 1914, the structure was examined by Mr. G. F. Wieghardt, Assistant Engineer for the State of Pennsylvania. As a result of this investigation, Mr. Wieghardt concluded that the spillway was poorly designed and should be repaired and strengthened. His recommendations included the straightening of the spillway entrance and increasing the height of the spillway walls to their present height of 4 feet. He also recommended that the embankment be graded to the same elevation as the spillway walls. These recommendations were presented to the Owner by Mr. S. Seelye, Division Engineer for the State of Pennsylvania. In 1916, the spillway entrance was enlarged under the direction of
Mr. William H. Dechant and Sons, Civil Engineers of Reading, Pennsylvania. This enlargement commenced on 16 October 1916 and was completed before the end of the year.

h. Normal Operating Procedures. Water enters the distribution system through a 12-inch pipe located at the base of the intake tower. Water is fed by gravity to a water treatment plant and distributed to the town on demand. Excess water overflows the spillway and discharges into Indian Run Creek immediately below the toe of the dam. It is understood that all valves in the 12-inch line remain in the open position and that water supply is controlled at the pumphouse.

1.3 Pertinent Data.

A summary of pertinent data for Birdsboro Reservoir is presented as follows.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Drainage Area (sq. miles)</td>
<td>0.8</td>
</tr>
<tr>
<td>b. Discharge at Dam Site (cfs)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Max. Known (June 1972)</td>
</tr>
<tr>
<td></td>
<td>Top of Dam</td>
</tr>
<tr>
<td>c. Elevation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Top of Dam</td>
</tr>
<tr>
<td></td>
<td>Spillway Crest</td>
</tr>
<tr>
<td></td>
<td>Normal Pool</td>
</tr>
<tr>
<td></td>
<td>Water Supply Inlet Invert</td>
</tr>
<tr>
<td>d. Reservoir</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Length at Normal Pool</td>
</tr>
<tr>
<td></td>
<td>Fetch at Normal Pool</td>
</tr>
<tr>
<td></td>
<td>Area at Normal Pool</td>
</tr>
</tbody>
</table>
e. Storage (acre-feet)
   Normal Pool 70
   Top of Dam 92

f. Dam Data
   Type Rolled earth
   Length 420 feet
   Height 40 feet
   Crest Width 12 feet
   Side Slopes (H:V)
     Upstream 2.5:1
     Downstream 1.5:1
   Cutoff None (2)
   Grout Curtain None (2)

  g. Diversion Unknown

h. Outlet Works
   Water Supply
     Type Masonry intake tower
     Pipe Size 12 inches

i. Spillway
   Type Rectangular channel, no control section
   Width 20 feet

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(1) Elevations based on 1914 drawing (Plate 2, Appendix E).

(2) As reported in Reference 1, Section 2.1.
SECTION 2
ENGINEERING DATA

2.1 Design.

a. Data Available. A summary of engineering data is presented on the checklist attached as Appendix A. Principal documents containing pertinent data used for this report are as follows.


3. One blueprint prepared by Mr. William H. Dechant and Son, Civil Engineers, Reading, Pennsylvania, dated 1914, enclosed herein as Plate No. 2.

4. One drawing prepared by Mr. Isaac S. Cassin, dated April 1883, and presented herein as Plate No. 3.

5. Miscellaneous letters, correspondence, memos, and 11 black and white photographs of the structure.

Documents regarding the design could not be located and are believed to no longer exist. The principal source of the data presented herein is obtained from Reference No. 1 above.
b. **Design Features.** The principal design features have been obtained from post-construction reports, Reference No. 1, and from results of the visual inspection performed on 29 August 1978. A plan view of the dam and cross-section of the intake tower are enclosed as Plates 2 and 3, Appendix E, respectively. No cross-sections of the embankment are available. The upstream and downstream slopes presented in Section 1.3 of this report were confirmed in the field by use of an Abney level.

2.2 **Construction.**

Construction history data is very limited and is presented in Section 1.2.

2.3 **Operation Data.**

The only operational records maintained for this dam are consumption quantities used by Birdsboro customers.

2.4 **Evaluation.**

a. **Availability.** All information presented in this report was obtained from the Department of Environmental Resources (DER) files in Harrisburg, Pennsylvania or from conversations with the Owners and a review of their available files. Design and construction data could not be located. The sole source of information was obtained from Reference No. 1 of Section 2.1, paragraph a.

b. **Adequacy.** The available data included in the DER files and presented in this report is not adequate to evaluate the engineering aspects of this dam.
c. Validity. There is no reason to question the validity of the limited available data. The external physical features of the dam and appurtenant structures were checked in the field and agreed with the available data.
SECTION 3
VISUAL INSPECTION

3.1 Findings.

a. General. The observations and comments of the field inspection team are contained in the checklist enclosed herein as Appendix B, and are summarized and evaluated as follows. In general, the appearance of the facility indicates that the dam is currently in good condition. The dam was inspected on 29 August 1978, by a five-man team of specialists. During this inspection, Mr. Nicholas DeSantis, Chairman of the Municipal Authority, and Mr. Laverne Henry, Water Superintendent for Birdsboro Municipal Authority, were present and provided assistance.

b. Dam. There were no indications or evidence of movement of the dam observed with the exception of several small undulations of the downstream slope both vertically and horizontally. These undulations were also noted in a photograph of the downstream slope taken on 27 April 1970 by State of Pennsylvania inspectors. There appears to have been no noticeable changes in the downstream slope since then. There were no unusual movements at or beyond the toe of the dam. The 3-foot high rock wall along the downstream toe is in a state of disrepair. This same condition was shown on a 6 May 1914 photograph. Therefore, it is concluded that there have been no noticeable changes in the downstream slope to indicate an unstable condition.

There were no unusual movements observed along the crest of the dam, nor were there any visual signs of riprap failures on the upstream slope above the water line. The junction between the embankment and the abutment, the embankment and the spillway were carefully assessed and there were no unusual conditions observed. An area, as shown on Sheet 5a, is marshy and contains standing water. The seepage rate was judged to be on the order of 4 to 5 gpm. Apparently it has not changed since the 1940 State inspection. During this inspection, the same conditions were cited.
c. Appurtenant Structures.

1. Spillway. Since the reservoir was about 2 feet below normal pool, the entire approach channel, spillway and discharge channel could be inspected. There are no bridges or piers across the 20-foot wide spillway. The mortared hand-placed rock was inspected and observed to be in good condition. The sides of the channel are protected by a 4-foot high mortared wall, which was observed to be in good condition. It is noted that the end of the channel was damaged during Tropical Storm Agnes, June 1972, and was repaired with poured concrete in lieu of the hand-placed rock. Currently, water discharges along the left side of the channel where minor erosion is occurring.

2. Outlet Works. The tower could not be inspected as it is located in the reservoir at the upstream toe. The Owner reported that the tower has functioned satisfactorily since they assumed ownership in 1963. Approximately 15 years ago, divers entered the tower to check the condition of the intake grating and the 12-inch pipe. The Owners reported that this inspection revealed that the tower bottom and the grating were in exceptionally good condition with no accumulation of silt. Since the 12-inch pipe is completely buried between the dam and the treatment plant, the pipe could not be inspected.

d. Reservoir. Reconnaissance of the reservoir disclosed no evidence of significant siltation, slope instability, or other features that would significantly affect the flood storage capacity of the reservoir. The slopes range from flat to steep with the flat slopes at the edge of the reservoir. Recently, the edges of the reservoir have been filled in to eliminate the marshy zones along the water's edge. There are 7 active springs feeding this reservoir.

e. Downstream Channel. The valley below the dam is narrow, approximately 50 feet wide, with steep sides, and has a 20-foot drop in 550 feet. The area is densely wooded, with an access road up the valley along the creek. The first obstruction below the dam is a bridge under Hay Creek Road, approximately
0.4 miles below the dam. The culvert beneath the bridge is 9 feet deep and 7.5 feet wide. It is noted that this road was flooded during Tropical Storm Agnes. Tropical Storm Agnes is also the storm of record for this area.

There are no homes between the dam and Hay Creek Road. There are homes downstream along Hay Creek near Birdsboro. Abrupt failure of the dam would damage significant portions of Birdsboro and result in possible loss of life to many residents. It is noted that Tropical Storm Agnes destroyed 60 homes in Birdsboro.

3.2 Evaluation.

In summary, the visual survey of the dam disclosed no evidence of existing instability of the dam. However, without further investigation, an assessment of the embankment stability could not be determined.
SECTION 4
OPERATION PROCEDURES

4.1 Procedures.

Normal operating procedures do not require a dam tender. However, personnel from the Birdsboro Municipal Authority visit the site at least twice and normally three times per day. During periods of exceedingly heavy rainfall, personnel frequently inspect the dam. Under normal conditions, water is fed by gravity through an inlet at the base of the inlet tower, through a 12-inch pipe line at the base of the dam and downstream to the treatment facility. Excess water is discharged through the spillway and into Indian Run Creek.

4.2 Maintenance of the Dam.

The dam is maintained by the Birdsboro Municipal Authority and is periodically inspected by the State Department of Environmental Resources. There is no maintenance manual and maintenance is generally limited to clearing vegetation and cleaning the drainage basin adjacent to the reservoir.

4.3 Maintenance of Operating Facilities.

The maintenance of the operating facilities is performed by the Birdsboro Municipal Authority. Maintenance normally consists of clearing debris and other trash from the spillway. They also check the water from the discharge pipe to insure that it is clean and that the flow is unobstructed. The intake tower has not been inspected for approximately 15 years. It is not known if there is any debris or trash at the base of the tower which could possibly clog the system.
4.4 **Warning Systems in Effect.**

There are no formal warning systems or procedures established to be followed during periods of exceedingly heavy rainfall. Personnel from the water authority inspect the facility daily and are available if potentially hazardous conditions develop. The chairman of the water authority indicated that the local police would be notified in the event that an emergency condition develops.

4.5 **Evaluation.**

Since no written operating procedures exist at this time, a procedure should be developed. Maintenance procedures should also be developed and incorporated into the operating procedures. The procedures should include a checklist of items to be inspected during the inspection of the dam and outlet works.

Since a formal warning procedure does not exist, a formal procedure should be developed and implemented during periods of extreme rainfall. This procedure should consist of a detailed method of notifying residents along Hay Creek and further downstream in Birdsboro.
SECTION 5
HYDROLOGY/HYDRAULICS

5.1 Evaluation of Features.

a. Design/Evaluation Data. No original design data exists and only a few statements concerning the spillway capacity are included in the inspection/investigation report prepared by the State of Pennsylvania in 1914.

The watershed is small, about 0.8 miles long and 1.1 miles wide, having a total area of 0.8 square miles. Elevations range from about 830 feet to 360 at normal pool elevation. The average watershed slope is about 12 percent. The reservoir is fed by seven springs. The watershed is 100 percent wooded and is entirely owned by the Water Authority. Runoff characteristics are not expected to change in the foreseeable future.

The 1914 report evaluated the spillway capacity to be about 300 cfs with a depth of flow of 3 feet, and 425 cfs with a depth of flow of 4 feet. The report also stated that the spillway capacity was not adequate to meet the then existing standards. The State directed that the entrance to the channel be enlarged and the spillway wall repaired, which increased the capacity of the channel.

In accordance with the criteria established by the Federal (OCE) Guidelines, the recommended spillway design flood for this "Intermediate" size dam and "High" hazard potential classification is the probable maximum flood (PMF).

b. Experience Data. No reservoir water level records or precipitation records are kept. It is reported that the depth of flow in the spillway channel during Tropical Storm Agnes, June 1972, was about 3 feet, an estimated discharge of 680 cfs. Weather Bureau Publications indicate about 6.6 inches of rain in a two day period for this general area.
c. Visual Observations. On the date of the inspection, there were no conditions observed that would indicate a reduced spillway capacity during a flood occurrence. Spillway dimensions were checked and noted that the minimum height of the spillway wall is 27 inches at the point where the spillway floor ends and discharge falls into the wasteway channel. The wall gradually increases in height to 4 feet at the crest of the dam. Other observations regarding the condition of the downstream channel, spillway and reservoir are located in Appendix B.

d. Overtopping Potential. The overtopping potential of this dam was estimated from approximate methods, as shown in Appendix C. Calculations indicate that the maximum spillway capacity is 440 cfs when the depth of flow is 27 inches, the minimum height of the spillway wall. The estimated peak PMF inflow is 1,830 cfs. It is estimated that the spillway can pass 25 percent of the PMF storm without overtopping the spillway wall.

The right spillway wall is cut into the abutment and an access road is adjacent to the spillway. Flow over the wall and road is not expected to result in failure of the wall although some erosion is expected. The left spillway wall is cut into erosion resistant materials. Flow over this wall would result in some erosion, but the risk of failure of the dam as a result of this overtopping is considered to be low. The spillway discharge is estimated to be 1,050 cfs with the reservoir level at the top of the dam. The spillway would then be capable of discharging 61 percent of the PMF storm without overtopping the structure.

e. Spillway Adequacy. The spillway system is "Inadequate", but not "Seriously Inadequate", as the dam will pass more than 50 percent of the PMF storm without overtopping the embankment. The tailwater is estimated to be 30 feet or more below the top of the dam with a minimum spillway discharge of 1,050 cfs.

f. Downstream Conditions. The dam is located on Indian Run about 0.5 miles above its confluence with Hay Creek. There are no houses or buildings between the dam and Hay Creek. About 400 feet before entering Hay Creek, Indian Run passes under Hay Creek Road. The bridge is estimated to have a capacity of
430 cfs. Potential damage sites are located downstream along Hay Creek, particularly in Birdsboro.

The treatment plant is located near the confluence of Indian Run with Hay Creek and would be damaged in the event of failure. There are homes along Hay Creek above Birdsboro and many more along the creek in Birdsboro. Failure of the dam would cause damage in Birdsboro and result in possible loss of life. Therefore, a "High" hazard potential classification is justified.
6.1 **Evaluation of Structural Stability.**

a. **Visual Observations.** The visual observations did not indicate any existing embankment stability problems. There were downstream slope undulations and seepage noted at the downstream toe. However, these slope undulations were noted in the photograph taken in 1970. The downstream slope seepage was noted in 1914, and from the description of the seepage, there has apparently been no change in flow rates for approximately 64 years. Therefore, the seepage is not judged to be associated with piping or potential foundation failure.

The spillway is judged to be in fairly good condition with stable side channels and chute. The exit channel, which was repaired in 1972 after Tropical Storm Agnes, is in good condition but should be inspected after passage of large discharges. Since the access tower was inaccessible, this system could not be evaluated. However, it has apparently operated satisfactorily since 1884 and, therefore, it is assumed that it is in a stable condition. The base of the tower should be checked for trash and debris. The structural integrity of the tower should be checked.

b. **Design and Construction Data.** There was no design or construction data available. All data concerning physical features of the dam have been determined from a 1914 report or from miscellaneous letters and correspondence in the Department of Environmental Resources (DER) files. The Owner's files were reviewed and no additional data could be found.

c. **Operating Procedures.** There are no written operating procedures for this dam.
d. Post-Construction Changes. The only post-construction change reported was the reconstruction of the spillway in 1914. The spillway channel walls were raised from 3 to 4 feet. The spillway channel entrance was straightened. Several stepping stones across the channel were removed because they collected trash.

e. Seismic Stability. The dam is located in Seismic Zone I. Normally, it can be considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake conditions. Since the static factor of safety for this dam is unknown, a seismic stability evaluation could not be made.
7.1 Dam Assessment.

a. Evaluation. The visual inspection indicates that the dam is in good condition. There is no engineering or construction data available, other than information contained in a post-construction investigation and that obtained from conversations with the current owners. The downstream slope, although it is relatively steep, 1.5H:1V, appears to be stable with no movement occurring. The outlet works are approximately 94 years old and have apparently been operating satisfactorily since completion, with the exception of the failure that occurred in 1892. This failure was judged to have resulted from pipe failure due to poor construction.

The spillway capacity is judged to be "Inadequate" using Corps of Engineers criteria, as the dam will be overtopped by the PMF. Overtopping of the embankment would occur at approximately 61 percent of the probable maximum flood. Therefore, the spillway is not judged "Seriously Inadequate", as it will pass 0.5 PMF.

The seepage noted at the downstream slope has been there since at least 1914 and, based on the descriptions in existing DER files, seepage has remained unchanged for the past 64 years. Based on this assessment, it is concluded that the seepage is not evidence of an imminent failure. It is also noted from local geologic evaluations, and the results of a 1914 inspection, that this particular area is riddled with local springs, which often produce small, localized marshy zones. This seepage could be associated with local springs.

b. Adequacy of Information. There was insufficient engineering construction data available to adequately evaluate the stability of the dam or the
The service life of the outlet works. Specifically, there is no substantial data delineating the types of materials used for construction. It is reported that sand and red clay was probably used. The interior features of the dam including the existence of drainage systems is unknown. It is believed that there are no drainage systems, cutoff trenches or grout curtains incorporated in this embankment.

c. Urgency. It is concluded that the recommendations presented in Section 7.2 be implemented as soon as practical.

7.2 Remedial Measures.

a. Facilities. The following recommendations are presented in order of priority and should be undertaken by the Owner as soon as practical.

1. The pond drain system should be checked to insure that the reservoir can be drained in the event of an emergency.

2. The water at the base of the dam is considered undesirable and should be checked to determine if it is a natural marsh area or seepage through the dam. This can be accomplished by regrading the toe of the dam and evaluating the seepage locations. If underseepage is determined to be occurring, an inverted filter blanket should be installed.

3. The intake structure should be inspected for debris and stability.

4. A valve should be installed in the tower to enable emergency closure of the water supply pipe in the event a leak develops in the pipe beneath the embankment.

b. Operation and Maintenance Procedures. Formal operation, maintenance and warning procedures should be developed. The warning procedures should
include a method of warning downstream residents when high flows are expected. Evacuation procedures should also be developed.

The Owner should develop an inspection checklist as an amendment to the maintenance procedure to insure that all critical items are inspected and maintained on a periodic basis.
APPENDIX

A
CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

ITEM

AS-BUILT DRAWINGS

REMARKS

NAME OF DAM

Birdsboro Reservoir
(Indian Run Dam)

ID #

PA 00713

Sheet 1 of 4

REGIONAL VICINITY MAP
See Plate 1, Appendix E of this report.

CONSTRUCTION HISTORY
Some limited construction history was found in the files principally
in Document No. 1 under the heading entitled "Miscellaneous". See
Sheet 4 of 4. A description of construction is located in the text
of this report.

TYPICAL SECTIONS OF DAM
None.

OUTLETS - PLAN

DETAILS

None.

CONSTRAINTS

DISCHARGE RATINGS

RAINFALL/RESERVOIR RECORDS
No rainfall records in the area.
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<tr>
<td></td>
<td>2. No other reports are available.</td>
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<td>GEOLOGY REPORTS</td>
<td>None. However, a description of the local geology is presented in Appendix E of this report.</td>
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<td>DESIGN COMPUTATIONS</td>
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<td>HYDROLOGY &amp; HYDRAULICS</td>
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<td>DAM STABILITY</td>
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<td>SEEPAGE STUDIES</td>
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<td>MATERIALS INVESTIGATIONS</td>
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<td>BORING RECORDS</td>
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<td>LABORATORY FIELD</td>
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<td>MONITORING SYSTEMS</td>
<td>None.</td>
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<td>MODIFICATIONS</td>
<td>In 1914 a request was made to increase the storage capacity by one foot. This was denied because of the leakage through the downstream embankment.</td>
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<td>HIGH POOL RECORDS</td>
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<td>POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS</td>
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<td>PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS</td>
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<td>MAINTENANCE OPERATION RECORDS</td>
<td>None.</td>
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<tr>
<td>ITEM</td>
<td>REMARKS</td>
</tr>
<tr>
<td>------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>SPILLWAY PLAN</strong></td>
<td>A 1914 plan of the spillway was located in the DER files.</td>
</tr>
<tr>
<td>SECTIONS</td>
<td>None.</td>
</tr>
<tr>
<td>DETAILS</td>
<td>None.</td>
</tr>
<tr>
<td><strong>OPERATING EQUIPMENT</strong></td>
<td>None.</td>
</tr>
<tr>
<td>PLANS &amp; DETAILS</td>
<td></td>
</tr>
</tbody>
</table>

**MISCELLANEOUS**

3. Application dated September 1914 to enlarge the spillway.
4. Inspection reports from 1914 through 1970 prepared by the State.
<table>
<thead>
<tr>
<th>CHECK LIST</th>
</tr>
</thead>
<tbody>
<tr>
<td>VISUAL INSPECTION</td>
</tr>
<tr>
<td>PHASE I</td>
</tr>
<tr>
<td><strong>Name Dam</strong></td>
</tr>
<tr>
<td><strong>County</strong></td>
</tr>
<tr>
<td><strong>State</strong></td>
</tr>
<tr>
<td><strong>ID #</strong></td>
</tr>
<tr>
<td><strong>Type of Dam</strong></td>
</tr>
<tr>
<td><strong>Hazard Category</strong></td>
</tr>
<tr>
<td><strong>Date(s) Inspection</strong></td>
</tr>
<tr>
<td><strong>Weather</strong></td>
</tr>
<tr>
<td><strong>Temperature</strong></td>
</tr>
</tbody>
</table>

Pool Elevation at Time of Inspection 368.6 M.S.L.
Tailwater at Time of Inspection N/A M.S.L.
Assumed from city drawings.

Inspection Personnel:
Mary Beck (Hydrologist)
Ray Lambert (Geologist)
John H. Frederick, Jr. (Geotechnical)
Vince McKeever (Hydrologist)
John Boschuk, Jr. (Civil/Civil)

_________________________________________

John Boschuk, Jr. Recorder

Remarks:
Mr. Nicholas DeSantis - Chairman of Municipal Authority were on site and provided assistance during the inspection.
Mr. LaVerne Henry - Water Superintendent

_________________________________________
## CONCRETE/MASONRY DAMS

**Sheet 2 of 11**

<table>
<thead>
<tr>
<th>VISUAL EXAMINATION OF</th>
<th>OBSERVATIONS</th>
<th>REMARKS OR RECOMMENDATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANY NOTICEABLE SEEPAGE</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>DRAINS</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>WATER PASSAGES</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>FOUNDATION</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Visual Examination of</td>
<td>Concrete/Masonry Dams</td>
<td>Remarks or Recommendations</td>
</tr>
<tr>
<td>-----------------------</td>
<td>------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>Surface Cracks</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Structural Cracking</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Vertical and Horizontal Alignment</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Monolith Joints</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Construction Joints</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>EMBANKMENT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>VISUAL EXAMINATION OF OBSERVATIONS REMARKS OR RECOMMENDATIONS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SURFACE CRACKS</strong></td>
<td><strong>None observed.</strong></td>
<td></td>
</tr>
<tr>
<td><strong>UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE</strong></td>
<td><strong>No unusual movement but the rock wall at the toe (three feet high) showed evidence of very minor downslope movements.</strong></td>
<td></td>
</tr>
<tr>
<td><strong>SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES</strong></td>
<td><strong>Some vertical and horizontal undulations were noted on the downstream side of the slope and the lower one third was damp but no seepage was observed through the embankment. See sheet 5a.</strong></td>
<td></td>
</tr>
<tr>
<td><strong>VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST</strong></td>
<td><strong>No unusual movements were observed along the crest.</strong></td>
<td></td>
</tr>
<tr>
<td><strong>RIPRAP FAILURES</strong></td>
<td><strong>None</strong></td>
<td></td>
</tr>
</tbody>
</table>
## EMBANKMENT

<table>
<thead>
<tr>
<th>JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM</th>
<th>OBSERVATIONS</th>
<th>REMARKS OR RECOMMENDATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No unusual conditions observed.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ANY NOTICEABLE SEEPAGE</th>
<th>An area as shown on sheet 5a is marshy and contains standing water. Seepage flow was judged to be on the order of four to five gpm. The pond drain valve stem was located at the base of the dam in the marshy area. As discussed on sheet 4, dampness was noted on the downstream slope of the embankment.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>STAFF GAGE AND RECORDER</th>
<th>None</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>DRAINS</th>
<th>None known.</th>
</tr>
</thead>
</table>
SEEPAGE LOCATION PLAN
INDIAN RUN DAM
(BIRDSBORO RESERVOIR)

SHEET 5a OF 11
**OUTLET WORKS**

<table>
<thead>
<tr>
<th>VISUAL EXAMINATION OF</th>
<th>OBSERVATIONS</th>
<th>REMARKS OR RECOMMENDATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT</td>
<td>Could not be observed.</td>
<td></td>
</tr>
<tr>
<td>INTAKE STRUCTURE</td>
<td>No access to the structure but two feet of the tower was exposed above the water level and this was judged to be in good condition.</td>
<td></td>
</tr>
<tr>
<td>OUTLET STRUCTURE</td>
<td>Buried pipe to town of Birdsboro and could not be inspected.</td>
<td></td>
</tr>
<tr>
<td>OUTLET CHANNEL</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>EMERGENCY GATE</td>
<td>None. The low intake pipe at the base of the intake tower serves as a water supply pipe but can be used as a pond drain.</td>
<td></td>
</tr>
</tbody>
</table>
### Unigated Spillway

<table>
<thead>
<tr>
<th>Visual Examination of</th>
<th>Observations</th>
<th>Remarks or Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete Weir</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Approach Channel</td>
<td>None. The reservoir discharges directly into a channel of hand placed riprap. The sides of the channel are protected by a mortar wall.</td>
<td></td>
</tr>
<tr>
<td>Discharge Channel</td>
<td>The hand placed rock channel is in good condition. The end of the channel was damaged during Tropical Storm Agnes (June 1972) and was repaired using concrete in lieu of the hand placed rock. Currently, discharge passes along the left side of the the channel where minor erosion is occurring. This area should be inspected after severe storms.</td>
<td></td>
</tr>
<tr>
<td>Bridge and Piers</td>
<td>None.</td>
<td></td>
</tr>
</tbody>
</table>
## Gated Spillway

<table>
<thead>
<tr>
<th>Visual Examination of</th>
<th>Observations</th>
<th>Remarks or Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete Sill</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Approach Channel</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Discharge Channel</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Bridge and Piers</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Gates and Operation Equipment</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Instrumentation</td>
<td>Visual Examination</td>
<td>Observations</td>
</tr>
<tr>
<td>-----------------</td>
<td>--------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>Monumentation/Surveys</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Observation Wells</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Weirs</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Piezometers</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Other</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>SLOPES</td>
<td>Observations</td>
<td></td>
</tr>
<tr>
<td>-----------------------------</td>
<td>------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Moderate to steep with more moderate slopes at the edge of the reservoir. The edge of the reservoir has been filled to remove the marshy area. There are seven active springs feeding into the reservoir.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SEDIMENTATION</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sedimentation is judged to be very slight. There is no effect on flood storage.</td>
<td></td>
</tr>
</tbody>
</table>
## DOWNSTREAM CHANNEL

<table>
<thead>
<tr>
<th>CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)</th>
<th>OBSERVATIONS</th>
<th>REMARKS OR RECOMMENDATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>The valley below the dam narrows with steep sides and has a 20 foot drop in 550 feet. Densely woody with an access road up the valley to the dam. The first obstruction is the bridge across Hay Creek Road approximately .75 miles below the dam. The culvert is nine feet deep and seven and a half feet wide. This road was flooded during Tropical Storm Agnes.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| SLOPES | Side slopes adjacent to the stream range from near vertical to one and a half to one. The flood plain width averages 50 feet wide with variable side slopes. The valley is densely wooded. |

| APPROXIMATE NO. OF HOMES AND POPULATION | There are no homes between the dam and Hay Creek Road. Closer to Birdabro, there are homes along Hay Creek. Approximately 3600 water customers in Birdabro. Abrupt failure of the dam would damage Birdabro and result in possible loss of life. Tropical Storm Agnes destroyed 60 homes in Birdabro. |
APPENDIX

C
BIRDSBORO RESERVOIR
CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 100% wooded, no residential development.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 360.0' (70 Acre-Feet).

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 364.0' (92 Acre-Feet).

ELEVATION MAXIMUM DESIGN POOL: __________

ELEVATION TOP DAM: 364.0'

SPILLWAY
a. Elevation 360.0'
b. Type Rectangular channel with drop off at end.
c. Width 20'
d. Length 84'
e. Location Spillover Right abutment.
f. Number and Type of Gates None.

OUTLET WORKS:
a. Type Macoun tower.
b. Location Upstream toe about midway along the center line.
c. Entrance inverts Base of tower - 12 inch pipe.
d. Exit inverts N/A
e. Emergency draindown facilities Same pipe as water supply outlet works.

HYDROMETEOROLOGICAL GAGES:
a. Type None.
b. Location ____________________________
c. Records ____________________________

MAXIMUM NON-DAMAGING DISCHARGE: 430 cfs-estimated capacity of downstream bridge.

*Elevations based on a 1914 drawing.
<table>
<thead>
<tr>
<th>ITEM/UNITS</th>
<th>Permit/Design Files (A)</th>
<th>Calc. from Files/Other (B)</th>
<th>Calc. from Observations (C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Freeboard, ft.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Spillway&lt;sup&gt;(1)&lt;/sup&gt; Crest Elev., ft.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3a. Secondary&lt;sup&gt;(2)&lt;/sup&gt; Crest Elev., ft.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Max. Outflow&lt;sup&gt;(3)&lt;/sup&gt;, cfs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Drainage Area, mi&lt;sup&gt;2&lt;/sup&gt;</td>
<td>0.8</td>
<td></td>
<td>0.85</td>
</tr>
<tr>
<td>7. Max. Inflow&lt;sup&gt;(4)&lt;/sup&gt;, cfs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Reservoir Surf. Area, Acre</td>
<td></td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>9. Flood Storage&lt;sup&gt;(5)&lt;/sup&gt;, Acre-Feet</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Inflow Volume, ft&lt;sup&gt;3&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Reference all figures by number or calculation on attached sheets:


NOTES:

(1) Main emergency spillway.
(2) Secondary ungated spillway.
(3) At maximum pool, with freeboard, ungated spillway only.
(4) For columns B, C, see PMF.
(5) Between lowest ungated spillway and maximum pool.
<table>
<thead>
<tr>
<th>Item (from Sheet 2)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>6A</td>
<td>Inspection/Evaluation Report dated Aug. 15, 1914, prepared by State</td>
</tr>
<tr>
<td>6A</td>
<td>Letter from Birdsboro Water Co. to State, dated Jan. 21, 1949</td>
</tr>
</tbody>
</table>
Classification (Ref: Recommended Guidelines for Safety Inspection of Dams)

1. The hazard potential is rated as "High" as there would be loss of life if the dam failed.

2. The size classification is "Intermediate" based on its 40 ft height.

3. The spillway design flood, based on size and hazard classification, is the probable maximum flood (PMF).

Hydrology and Hydraulic Analysis

1. Original/Evaluation Data - Statements contained in a Aug. 15, 1914 inspection/evaluation of the dam by the State.

| Drainage area | 0.8 sq. mile |
| Spillway capacity - based on open channel flow |
| Q: 256 cfs, w/ normal depth (d_n) = 3.4 ft (considered inadequate) |
| Q: 185 cfs w/ d_n = 4.4 ft |
| Spillway width = 20 ft |
| Length = 84 ft |
| Slope = 1/84 = 0.012 |
| Spillway bottom - cement rubble |
| Walls - dry rubble |

2. Evaluation

| Drainage area | 0.8 sq. mile supported by current USGS Map |
| Spillway capacity, Qo |

Dimensions: field checked

width = 20 ft; length = 84 ft; slope = 0.012
n = coefficient of roughness = 0.025
Depth of spillway channel.
- The minimum depth is on the left channel wall at the point of drop-off - 27" (2.25 ft).
- Depth of wall at 5 ft. of dam is 7 ft.

Assume critical flow at drop-off.
Critical depth, \(d_c = 2.25 \text{ ft} \).

\[
Q_c = \frac{V^2}{g} = b \cdot d_c \cdot V^2
\]
- Brahmer & King, Handbook of Hydraulics, Eq. 8-29.

\[
V_1 = \sqrt{20.2 \cdot 2.25} \text{ ft/s}
\]

\[
Q_c = 383 \text{ cfs}
\]

\[\text{dn for } Q = 383 \text{ cfs} \]
- Manning's Eq.

\[
Q = 6.94 \cdot d_n \cdot n \left( \frac{b+2d_n}{3} \right)^{5/3}
\]

if \(d_n = 2.05 \text{ ft} \).

\[
383 = 20.2 \cdot 0.045 \left( 20.2 + 2 \cdot 2.05 \right) ^{5/3}
\]

\[383 \sim 380\]

Therefore, \(d_n = 2.05 \text{ ft} < d_c = 2.25 \text{ ft} \), and flow is supercritcal (just barely) and discharge capacity of spillway can be approximated by Manning's Eq.

\[
Q \text{ for } d_n = 2.25 \text{ ft}
\]

\[
= 20.2 \cdot 2.25 \cdot 0.045 \left( 20.2 + 2 \cdot 2.25 \right) ^{5/3} \cdot 0.012 \text{ ft/s}
\]

\[
= 440 \text{ cfs}
\]

If spillway wall was increased to 4 ft.

\[Q = 20.4 \cdot 0.045 \left( 20.4 \cdot 2.25 \right) ^{5/3} \]

\[Q \sim 1050 \text{ cfs}\]
Peak PMF Inflow, Qt:
Information from Corps of Engineers, Salt District indicates a comparable watershed is on Allegheny Creek, D.A. = 10 sq.mile. Est. peak PMF at 13,980 cfs.

\[ Q_t = \left( \frac{Q_0}{12} \right) \cdot 0.8 \]

\[ Q_t = 13,980 = 1807 \quad \text{say 1830 cfs} \]

Volume at Inflow, Vt:

\[ PMF = 25.5 \text{ in.} \quad \text{from Weather Service Paper TP-40} \]

Assume 90% runoff.

\[ V_t = \frac{Q_0 \cdot 25.5}{12} \cdot 0.8 \cdot 640 = 980 \text{ Ac.-ft} \]

Available flood storage, Vf:

Is surface area of reservoir x height

\[ 8 \times 225 = 18 \text{ Ac.-ft under existing conditions} \]

\[ 8 \times 4 = 32 \text{ Ac.-ft if spillway wall height increased to 4 ft} \]

Overtopping potential - see sheets 8 & 9.

Required storage

\[ V_R = (1 - \frac{Q_t}{Q_0}) V_t \]

(As a triangular inflow hydrograph is used, \( G_t = 0.5 \), \( V_t = 0.5 V_t \))

0.5 PMF

\[ Q_0 = 440 \text{ cfs w/o spilling over left wall} \]

\[ V_p = (1 - 0.5 \times 890) \cdot 0.5 \times 980 = 2.54 \text{ Ac.-ft} > V_t = 18 \]

\[ Q_0 = 1050 \text{ cts w/ discharge spilling over left wall} \]

\[ Q_0 > Q_t = 945 \text{ cts} \]
Percentage of PMF passed w/o spilling over 12ft wall

\[ 18 \times (1 - \frac{X}{1830}) \times 980 \]
\[ X = 23\% \]

Percentage of PMF passed w/o overtopping embankment

\[ 32 \times (1 - \frac{X}{1830}) \times 980 \]
\[ X = 61\% \]

Spillway Adequacy - see text for discussion

Downstream Conditions
First Downstream Bridge is 7.5ft x 9ft high
Distance between top & bottom of bridge is 1 foot
Capacity is estimated by use of an orifice eq.

\[ Q = C a V^2 H \]

Net Engineering Handbook,
Sec. 4, Eq.
\[ a = \text{area}, 7.5 \times 9 = 67.5 \text{ ft}^2 \]
\[ C = \text{coefficient - ranges between 0.7 to 0.9, average is 0.8} \]
\[ V = \text{head, distance between headwater & tailwater surfaces} \]
\[ H = \text{head, distance between headwater & tailwater surfaces} \]

As Tropical Storm Agnes is reported to have made the road impassable, use \[ H = 1 \text{ ft} \]

\[ Q = 0.8 \times 0.75 \times 67.5 \times 1 \]
\[ = 430 \text{ cfs} \]
PURPOSE: Establish relationship between maximum spillway discharge and storage required to pass flood hydrograph without exceeding maximum pool level.

\[ \frac{\Delta AOC}{\Delta AOB} = \frac{\Delta AOB - \Delta COB}{\Delta AOB} = 1 - \frac{\Delta COB}{\Delta AOB} \]

\[ \frac{\Delta AOC}{\Delta AOB} = 1 - \frac{T_0 Q_i \text{max} / 2}{T_0 Q_i \text{max} / 2} = 1 - \rho \]

\[ \Delta AOC = (1 - \rho) \Delta AOB \text{ where } 0 \leq \rho \leq 1.0 \]

REFERENCE

PRELIMINARY
ENGINEER TECHNICAL
LETTER NO. 1110-2-
25 January 1978
Steps to obtain required reservoir to pass inflow hydrograph without overtopping dam:

1. Obtain maximum spillway discharge
2. Develop inflow hydrograph
3. Compute relationship of maximum spillway capacity to peak inflow
4. Read relationship of required reservoir storage to volume of inflow hydrograph from curve
APPENDIX
VIEW LOOKING ALONG DAM CREST FROM THE SPILLWAY TOWARDS THE LEFT ABUTMENT.

PHOTOGRAPH NO. 1
Overview of lower portion of downstream slope looking towards left abutment.
PLAN AND PROFILE OF DAM & APPURTEANT STRUCTURES
INDIAN RUN DAM
(BIRDSBORO RESERVOIR)

NAT. ID NO. PA.00713

DATA OBTAINED FROM WM. H. DECHANT & SON CE
PLAN NO. 2860, DATED SEPT., 1914

SECTION B-B

PLATE 2
PROFILE OF INTAKE STRUCTURE
INDIAN RUN DAM
(BIRDSBORO RESERVOIR)

NAT. ID NO. PA.00713
BERKS COUNTY

DATA OBTAINED FROM DRAWING PREPARED BY
ISSAC S. CASSIN, DATED APRIL, 1883

PLATE 3
APPENDIX
F
SITE GEOLOGY
BIRDSBORO RESERVOIR

The Birdsboro Reservoir is located in the Triassic Low—
land section of the Piedmont Physiographic Province. The bed—
rock in the area where the dam is constructed is reported to
consist of Triassic diabase (see Plate F-1). The diabase is
bounded to the north by Triassic quartzose conglomerate and
by the shales, siltstones and sandstones of the Triassic
Brunswick Formation, and to the south again by Triassic
quartzose conglomerate (Hall, 1967). Bedding is relatively
undeformed with a regional strike to the northeast and a
gentle dip of 5° to 20° to the northwest (Willard, et al, 1959).
No significant faulting has been reported in the area around
the dam and no major concentration of joints has been re—
ported. The joints that are present in the Triassic rocks of
this area tend to be few in number, widely spaced, oriented
parallel to the strike of bedding and dipping nearly vertical
(Willard, 1959).

Downstream seepage should be minimal due to the imper—
vious nature of the rock, and due to a lack of prominent
jointing and faulting at the dam site.

References:

1. Glasser, J.D., 1966, Provenance, Dispersal, and
Depositional Environments of Triassic Sediments
in the Newark-Gettysburg Basin: Pennsylvania

Pennsylvania: Pennsylvania Geological Survey

3. Willard, B., Freedman, J., McLaughlin, D.S.,
Ryan, D.J., Wherry, E.T., Peltier, L.C., and
Gault, H.R., 1969, Geological and Mineral Re—
sources of Bucks County, Pennsylvania: Pennsyl—
C-9, 241 p.