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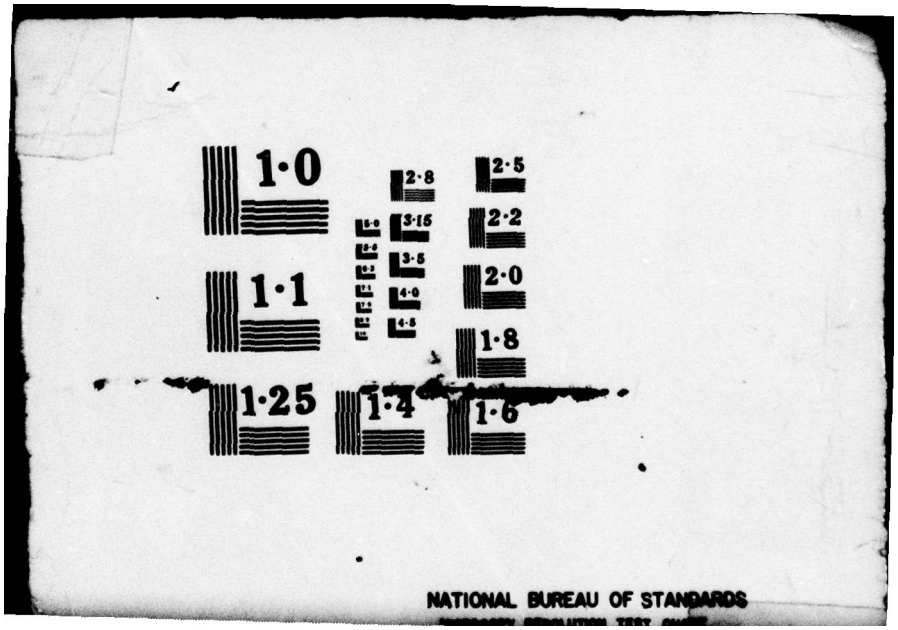
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DELAWARE RIVER BASIN
SWIFTWATER CREEK, MONROE COUNTY
PENNSYLVANIA
NDS ID PA. 00776
DER ID 45-134

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LAKE SWIFTWATER DAM

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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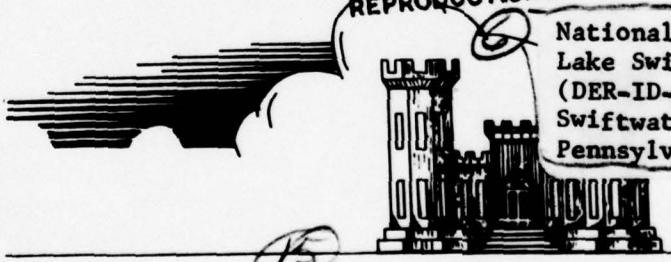

National Dam Inspection Program. Lake Swiftwater Dam (NDS-ID-00776), (DER-ID-45-134), Delaware River Basin, Swiftwater Creek, Monroe County, Pennsylvania. Phase I Inspection Report.

Contract No. DACW31-79-C-0017

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Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

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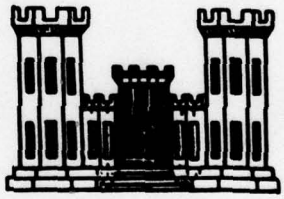
DELAWARE RIVER BASIN

SWIFTWATER CREEK, MONROE COUNTY
PENNSYLVANIA

LAKE SWIFTWATER DAM

NDS I.D. NO. PA 00776
DER I.D. NO. 45-134

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

APRIL 1979

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams for Phase I Investigations. Copies of these guidelines may be obtained from the Office of the Chief of Engineers, Washington, D. C., 20314. The purpose of a Phase I investigation is to expeditiously identify 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 investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify the need for more detailed 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 design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid 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 INSPECTION PROGRAM

Name of Dam:	Lake Swiftwater Dam
County Located:	Monroe County
State Located:	Pennsylvania
Stream:	Swiftwater Creek
Coordinates:	Latitude 41° 5.9'
	Longitude 75° 16.6'
Date of Inspection:	7 November 1978

Lake Swiftwater Dam is owned and maintained by Lake Swiftwater Club, Inc., and was completed in May 1930. The spillway was reconstructed in 1955 at its present location. The overall condition of the dam and appurtenant structures is considered fair but the pond drain discharge system is considered to be in poor condition. The dam is classified as a "High" hazard structure consistent with its potential to cause extensive property damage and possible loss of life in the event of failure. The dam is also classified as a "Small" size structure consistent with its 31-foot height and 346 acre-foot total storage capacity.

Hydrologic and hydraulic calculations presented in Appendix C and discussed in Section 5 indicate that the dam will only pass 35 percent of the Probable Maximum Flood (PMF) without overtopping. At 0.5 PMF, the embankment would be overtopped and most likely fail. Since failure as a result of overtopping (at storms less than 50 percent of the PMF) will most likely result in a significant increase in damage downstream, the spillway is classified as "Seriously Inadequate" and is considered unsafe non-emergency in accordance with Corps of Engineers' Guidelines.

Based on the findings presented in this report, the following recommendations should be executed immediately. All work should be performed under the direction of a registered professional engineer experienced in the design of dams.

(1) A study should be performed to determine the best method of increasing the spillway capacity so at least 0.5 PMF can pass through the reservoir without overtopping. Subsequently, the discharge capacity of the spillway should be increased in accordance with the engineer's recommendations.

(2) The embankment crest should be raised to design elevation of at least 863.

(3) The pond drain valve should be greased, thoroughly checked for servicability, and rehabilitated, as necessary.

(4) The downstream slope should be cleared of dense vegetation and reinspected for any unacceptable erosion or seepage.

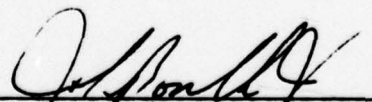
(5) Test borings should be performed, piezometers installed and samples tested to determine engineering properties of the embankment. Subsequently, a stability analysis should be performed under supervision of a registered professional engineer.

The following recommendations should be performed as soon as practical or on a periodic basis, which should not exceed once a year.

(1) The spillway chute should be monitored at least annually and after every severe storm.

(2) If deterioration of the spillway continues, it should be assessed by a registered professional engineer and rehabilitated as required.

Because of the "High" hazard classification, a formal procedure of observation and warning during periods of high precipitation should be developed and implemented. This procedure should include a method of warning and possibly evacuating residents along the creek. The Owner should develop an operation and maintenance procedure to be used to insure that the dam is operated in a safe manner and maintained in the best possible condition.



27 Apr. 1979

John Boschuk, Jr., P.E.
Pennsylvania Registration 27450E
Woodward-Clyde Consultants

Date

April 27, 1979
Date

John H. Frederick, Jr., P.E.
Maryland Registration 7301
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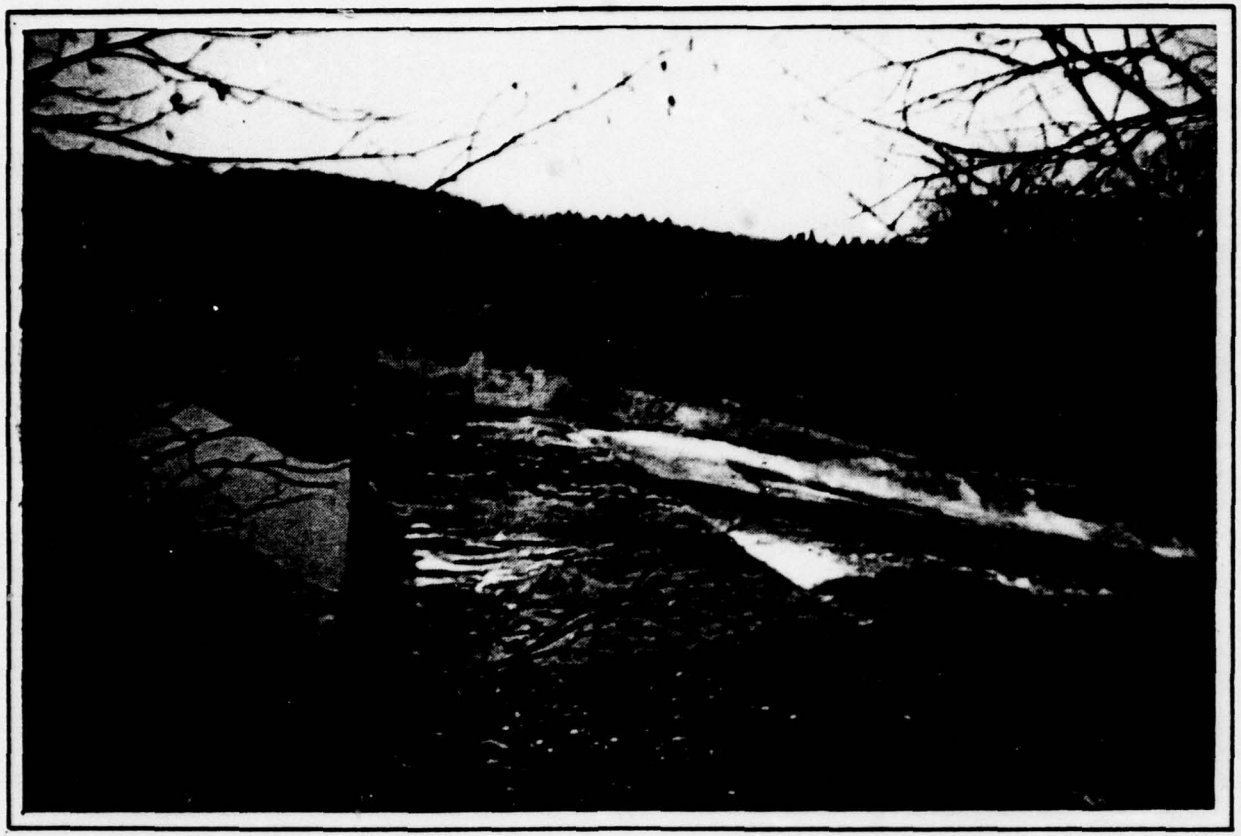
APPROVED BY:

19 May 79
Date

G. K. WITHERS
Colonel, Corps of Engineers
District Engineer



OVERVIEW
LAKE SWIFTWATER DAM, MONROE COUNTY, PENNSYLVANIA

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
LAKE SWIFTWATER DAM
NATIONAL ID #PA 00776
DER #45-134

SECTION 1
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. Lake Swiftwater Dam is a 31± foot high zoned embankment containing an impervious core founded in hardpan. The embankment has upstream and downstream slopes of 2.5H:1V and a crest width of 10 feet. When the old spillway was relocated to the right abutment, the embankment section was reconstructed ~~as shown on Plate 4~~ and is a homogeneous embankment with an eight foot wide cutoff trench founded on impervious materials. The upstream and downstream slopes were both constructed at 2.5H:1V with a 10 foot crest width. The upstream slope of the whole embankment is protected with riprap, minimum thickness being 18 inches on the new embankment and 12 inches on the old embankment. The embankment impounds a 21-acre reservoir, ~~and typical embankment sections are shown on Plates 3 and 4~~, Appendix E.

The embankment also contains a gatehouse tower located near the crest of the dam approximately midway along the length of the embankment, ~~as shown on Plate 2.~~ The gatehouse tower contains a steel sluice gate manufactured by the Caldwell-Wilcox Company. Documentation in the files indicates that the intake pipe is 42 inches in diameter, located at the base of the embankment, and encased in concrete with anti-seep collars. Similarly, the discharge pipe is also noted as 42 inches and discharges at the downstream toe of the dam. The end of the discharge pipe, shown in Photograph 2,

Appendix D, measured 36 inches and not the 42 inches mentioned in previous documents. Furthermore, the Wilcox gate valve sluice gate is 36 inches, which infers that the entire system is a 36-inch pipe and not a 42-inch pipe, as recorded in the files.

The spillway is located at the right abutment and a plan view is shown on Plate 5 of Appendix E. The 100 foot wide spillway controls the reservoir level, with all discharge passing through the structure. The gatehouse is used only to drain the reservoir as needed.

b. Location. The dam is located on Swiftwater Creek in Paradise Township, Monroe County, Pennsylvania. The dam site is located approximately 2.6 miles east of Swiftwater, south of Route 314. The dam site and reservoir are shown on USGS Quadrangle entitled "Mount Pocono, Pennsylvania" at coordinates N 41° 5.9' W 75° 16.6'. A regional location plan of Lake Swiftwater Dam and reservoir is enclosed as Plate 1, Appendix E.

c. Size Classification. The dam is classified as a "Small" size dam by virtue of its 31 foot height and 346 acre-foot total storage capacity.

d. Hazard Classification. A "High" hazard classification is assigned consistent with the potential to cause extensive property damage and loss of life downstream along the creek and along Paradise Creek, into which Swiftwater Creek flows.

e. Ownership. Lake Swiftwater Dam is owned and maintained by Lake Swiftwater Club, Inc. All correspondence should be addressed to Mr. Carl Lilius, Auditor, Lake Swiftwater Club, Inc., RD Box 381, Cresco, Pennsylvania 18326.

f. Purpose. The purpose of this dam is for recreation.

g. Design and Construction History. The dam was first proposed in 1928 by Messrs. G. A. Hulbert, H. S. Dickey and W. T. Hunter. They submitted their initial application for a permit on 13 March 1928, together with design drawings prepared by Mr. George P. Stowitts, the design engineer. The "Report Upon the Application" was revised on 4 May 1928, in which the State's recommendations for changes to the spillway and pond drain systems were reflected. Construction began in the fall of 1928, under Mr. Gabe Cannon, construction superintendent. It is reported that in October 1928, the discharge pipe was increased from 30 inches to 42 inches. However, measurements made in the field and other evidence in the files indicate that the actual pipe size is 36 inches.

Excavation in November 1928, encountered a pocket of boulders, sand and gravel. The State directed that excavation be continued until satisfactory foundation was reached. Work was suspended 30 November 1928, for the winter. Work began again 1 May 1929. By June, there was difficulty in finding suitable impervious material for fill.

In mid-1929, ownership changed to the Pohopoco Lakes, Inc. In August 1929, spillway excavation encountered a "water vein". This was hillside seepage from the left side of spillway excavation. Construction progress reports during 1929, occasionally note sandy material being included in the impervious core and difficulty locating suitable core material. Due to a lack of suitable impervious materials, a request was made during a State inspection on 16 September 1929, requesting that the last six to eight feet of impervious material be deleted and that other materials, considered suitable by the engineer, be allowed to top out the embankment. This was agreed upon and it is believed that the core area shown on Plate 2 extends to a somewhat higher elevation than was actually constructed. Work was suspended for the winter on 22 November 1929, when the embankment was one to three feet below design. In January 1930, permission was granted to impound water until 15 February, for ice harvesting. The official completion date by the engineer is recorded as 16 May 1930.

On 6 September 1933, Messrs. E. Weed, H. Heller and T. Straub inspected the dam after the flood of 23 and 24 August. This inspection revealed the reservoir level had been 2 to 2.5 feet below the crest, but high flows through the spillway caused the lower sections and the left and right walls of the spillway to fail. The wooden sluice gate was opened and the reservoir drained. The gate could not be closed and was replaced. The spillway was also reconstructed.

As a result of Tropical Storm Diane, August 1955, the spillway and adjacent embankment washed out. Mr. Edward C. Hess of Stroudsburg, Pennsylvania, was engaged to reconstruct the dam. The spillway was moved from the left abutment to its current position at the right abutment. The existing spillway was removed and rebuilt with earth in accordance with Mr. Hess' criteria. A typical embankment section of this reconstructed area is shown on Plate 4, Appendix E. This section shows that a cutoff trench was constructed and the upstream face protected with 18 inches of riprap over a six-inch gravel layer. Upstream and downstream slopes were similar to those of the existing dam, being 2.5H:1V on both the upstream and downstream sides. In 1956, Swiftwater Lake, Inc. became Lake Swiftwater Club, Inc., which is the name of

the present Owner. By October 1956, all repairs to the dam were completed.

During the summer of 1969, a severe storm dislodged the spillway sill and the resulting movement collapsed the downstream walls together with portions of the spillway chute. As a result, in May 1970, the Owners engaged Mr. Heikki Elo of Easton, Pennsylvania, to prepare drawings to repair the spillway. These drawings were submitted to the State of Pennsylvania, approved, and a typical spillway section is enclosed herein as Plate 5. Spillway reconstruction was completed on 24 May 1971, and since that date there have been no modifications made to this structure.

h. Normal Operating Procedures. Reservoir overflow is controlled by the spillway, which discharges water into the downstream channel, Swiftwater Creek. The reservoir can be lowered or drained through the 36-inch diameter concrete pipe, discharging at the downstream toe. There are no minimum discharge requirements for this structure.

1.3 Pertinent Data.

A summary of pertinent data for Lake Swiftwater Dam is presented as follows.

a.	Drainage Area (sq miles)	9.68
b.	Discharge at Dam Site (cfs)	
	Maximum Known Flood	Unknown
	At Top of Dam (at low point)	5,011
c.	Elevation (feet above MSL)*	
	Top of Dam	
	Average and Design	863.0±
	Minimum	862.2
	Top of Spillway Wall	863.4
	Spillway Crest	856
	Pond Drain Invert	Unknown
	Pond Drain Outlet Invert	Unknown
d.	Reservoir (feet)	
	Length at Normal Pool	1,200
	Fetch at Normal Pool	1,200

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* Note: All elevations are based on a spillway elevation of 856 taken from the USGS map.

e.	Storage (acre-feet)	
	Normal Pool	188
	To Top of Dam (low point)	346
f.	Reservoir Surface (acres)	
	Normal Pool	21
g.	Dam Data	
	Type	Zoned earth embankment with a newer homogeneous earth fill.
	Length	730 ft
	Maximum height	31± ft
	Top Width	10 ft
	Side Slopes	2.5H:1V
	Cutoff	Cutoff trench only under new embankment.
	Grout Curtain	None
h.	Spillway	
	Type	Concrete weir, chute and slotted bucket.
	Width	100 ft
i.	Pond Drain	
	Location	Gatehouse at upstream toe.
	Gates	One sluice gate on discharge pipe.
	Discharge	36 inch

SECTION 2
ENGINEERING DATA

2.1 Design.

a. Data Available. A summary of engineering data for Lake Swiftwater Dam is presented in the checklist attached as Appendix A. Principal documents containing pertinent data used for this report include the "Report Upon the Application of G. A. Hulbert, Harry S. Dickey and William T. Hunter", dated 26 April and 4 May 1928. Other documents include the "Report Upon the Application of Swiftwater Lake, Inc.", dated 29 February 1956, the "Report Upon the Application of Lake Swiftwater Club, Inc.", dated 7 October 1970, specifications prepared by Mr. Edward C. Hess for reconstruction in 1956, and specifications prepared by Mr. Heikki Elo for reconstruction in 1970. DER files and records supplied by Mr. Heikki Elo include letters of correspondence, memos, inspection reports and other miscellaneous documentation, which were also vital to the engineering evaluation of this structure.

Available data were sufficient to evaluate the principal features of the dam and appurtenant structures in accordance with Phase I Inspection criteria. Select portions of drawings are included in Appendix E of this report.

b. Design Features. The principal design features are illustrated on plan, profile and cross-section plates of the embankment and appurtenant structures that are enclosed in Appendix E as Plates 2 through 5. These plates are reproduced from available drawings supplied by the files of DER and Mr. Heikki Elo. A description of the design features is presented in Section 1.2, entitled "Description of Project".

2.2 Construction.

A description of the construction history is presented in Section 1.2. The dam was designed by Mr. George P. Stowitts of New York and constructed under the supervision of Messrs. Gabe Cannon and H. Hill, construction superintendents. The 1956 reconstruction work was designed by Mr. Edward C. Hess, Stroudsburg, Pennsylvania. The contractor for this 1956 work could not be determined. The 1970 spillway reconstruction was designed by Mr. Heikki Elo of Easton, Pennsylvania, and the contractor was Leroy Shoesmith & Son, Inc.

2.3 Operational Data.

There are no operational records maintained. There are no minimum flow requirements for the downstream channel. There are no water level or rainfall records maintained for this structure.

2.4 Evaluation.

a. Availability. All engineering data reproduced in this report, described herein and studied for this investigation were provided by DER, the Owner and the Owner's engineer.

b. Adequacy. Data available for review from DER files, the Owner and the Engineer were sufficiently adequate to evaluate the dam and appurtenant structures in accordance with the Phase I criteria.

c. Validity. With the exception of the size of the pond drain pipe, which is discussed in Section 1.2, "Dam and Appurtenances", there is no reason to question the validity of 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 dam and its appurtenant facilities are in fair condition and for the most part reasonably maintained.

b. Dam. During the visual inspection, there were no indications of distortion in alignment or grade that would be indicative of movement of the embankment or foundation. Inspection of the downstream slope and adjacent downstream areas disclosed some marshy areas located along the old spillway channel, as shown on sheet 5a. A pool of stagnant water was also noted at the pond drain outlet, but there was no evidence observed of seepage into the pool from the edge of the pond or surrounding area. The upstream slope was inspected and found to be in reasonably good condition with extensive vegetation between the riprap. The location of the original spillway, which was replaced with an embankment, was clearly defined by a difference in vegetation. The junction between these two areas is assessed to be excellent. The upstream slope of the original embankment shows signs of undulation, which is not considered to be significant but rather expected for a structure of this age. The crest has a measured width of 10 feet, and a level profile along the crest showed the maximum difference in elevation was 14 inches. The low point is at the junction of the embankment and left abutment, as shown on Plate 5a, Appendix B.

The junction between the spillway wall and the embankment was eroded up to 13 inches, but the anti-seep fins were in good condition with an elevation equal to the height of the embankment. The downstream slope is covered with dense vegetation, predominantly grassy in nature. It was reported by the Owner's representatives that woody vegetation has been removed from the slope on several occasions. There were no signs of significant erosion, settlement, or other indications of surface or deep-seated slides.

c. Appurtenant Structures. Exposed portions of the gatehouse tower were inspected and assessed to be in fair condition. The control gears of the Wilcox gate hoist were rusted and not lubricated, and appeared to be poorly maintained. Since the condition of this hoist was questionable, it was decided not to exercise the gate. The Owner reports

that this gate is rarely exercised. The tower was filled with water and could not be evaluated. Exposed portions of the concrete, including the end of the pipe, were assessed to be in fair condition.

An inspection of the spillway disclosed that the spillway crest was in good condition. The downstream section of the discharge channel was in fair condition with several areas of spalled or deteriorated concrete. This cracking and spalling at the present time are minor. However, in the event of relatively large flows, such as those from Tropical Storm Agnes or Hurricane Diane, channel deterioration would be expected.

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 reservoir side slopes are flat to steep, stable and well vegetated to the water's edge. There is some debris on the reservoir slopes which will float into the spillway, but the spillway is large enough to pass the items of debris noted around the reservoir.

e. Downstream Channel. As shown on Photograph 5, Appendix D, the downstream channel is quite rocky, stable, with vegetation to the water's edge. The first bridge across the creek is shown in Photograph 9, Appendix D, and is located approximately 500 feet downstream, halfway between the dam and the point where Swiftwater Creek enters Forest Hills Run. From this intersection, discharge from Swiftwater Lake flows almost directly into Paradise Creek, which flows through the community of Parkside. Along this creek, there are several homes which would be subject to damage in the event of sudden failure of Lake Swiftwater Dam.

3.2 Evaluation.

Inspection of the dam disclosed no evidence of apparent past or present movement that would indicate existing instability of the structure. The seepage and standing water noted along the old spillway discharge channel appear to be stable and apparently have been stable for many years. The observed seepage was clear with no signs of piping. The spillway is in fair condition with some spalling, which should be monitored yearly and after each severe storm and repaired as necessary. The pond drain gate is considered to be in poor condition and should be rehabilitated. The low point on the dam is shown on sheet 5a, Appendix B, which is the first point of overtopping.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures.

Operational procedures are discussed in Section 1.2. Operation of the dam does not require a dam tender. Under normal conditions, all flow is discharged over the spillway. There are no formal operational or maintenance procedures for this structure.

4.2 Maintenance of the Dam.

The dam is maintained by the Lake Swiftwater Club, Inc., who periodically mow the grass on the crest and perform minor repairs as required. It is believed that the last major maintenance work on the dam consisted of removing the woody vegetation from the slopes.

4.3 Maintenance of Operating Facilities.

Maintenance of the pond drain and spillway are poor.

4.4 Warning Systems In Effect.

There are no formal warning systems or procedures established to be followed during periods of heavy rainfall.

4.5 Evaluation.

Operation and maintenance procedures should be formalized and an inspection list developed to insure that all items are periodically inspected and maintained in the best possible condition. Routine maintenance would insure that the sluice gate hoist would be lubricated and operational and prevent woody vegetation from being established on the downstream slope. Woody vegetation may mask erosion and/or possibly seepage.

Since there are no formal warning procedures, it is recommended that a formal procedure be developed so downstream residents may be excavated if high flows are expected or potentially hazardous conditions develop.

SECTION 5
HYDROLOGY/HYDRAULICS

5.1 Evaluation of Features.

a. Design Data. There are no original design data available for the existing spillway. An evaluation of the spillway was made later, most likely by Mr. John Adams, of Lehigh University. Additional calculations for this 1979 investigation are presented in Appendix C.

The watershed is long and narrow, about 7.8 miles long and 0.8 to 2.1 miles wide, having a total area of 9.68 square miles. Elevations range from 2,000 in the upper reaches to 856 at normal pool elevation. The watershed is about 95 percent wooded with about 20 percent residential development. The residential development is continuing, but at a slow rate.

There is one upstream dam, Lake Minausin, which controls about three square miles of drainage area. The spillway of this dam and part of the downstream embankment have been washed away, as shown on Photograph 8.

At the time the existing spillway was installed in 1956, the State evaluated the capacity to be 6,130 cfs, or 625 cfs per square mile of drainage area, greater than desired. An undated, unsigned "Hydraulic Study of the Spillway for Swiftwater Lake" was obtained from Heikki Elo, the Owner's engineers. From a letter in State files, it appears that the study was made by Mr. John Adams of Lehigh University in 1969. The study concluded that the Spillway Design Storm was 0.5 PMF (Probable Maximum Flood). The peak PMF value was determined to be 9,800 cfs for a six-hour, 20-inch rainfall. The maximum spillway capacity was computed to be 5,190 cfs with the reservoir level at the top of the dam. The purpose of the study was to design the energy dissipater at the end of the spillway chute.

In accordance with criteria established by the Federal (OCE) Guidelines, the recommended Spillway Design Flood for this "Small" size dam and "High" hazard potential classification is 0.5 to 1.0 PMF.

b. Experience Data. There are no records of reservoir water levels or rainfall within this watershed. There are no estimates or records of previous high water levels since the existing spillway was constructed.

c. Visual Observations. On the date of inspection, the only condition observed that would indicate a reduction in spillway capacity during an extreme event is the low point of the embankment at the junction of the embankment and left abutment. The abutment is approximately at this elevation for 100 feet or more. If overtopping occurs, some flow will go down the highway along the left side of the reservoir, but most will flow down the junction of the embankment and abutment; see Appendix B, sheet 5a. The low point is about 14 inches below the maximum embankment crest and reduces the maximum capacity of the reservoir and spillway. Observations regarding the condition of the downstream channel, spillways and reservoir are located in Appendix B.

d. Overtopping Potential. The overtopping potential of this dam was estimated using the "HEC-1, Dam Safety Version", computer program. A brief description of the program is included in Appendix C. Failure of the upstream 17 foot high, concrete gravity dam has been conservatively neglected. If Lake Minausin Dam fails completely, the many highway embankments will attenuate the discharge from its small capacity (approximately 21.5 acre-feet).

Calculations for this investigation estimate spillway discharge of about 4,650 cfs or about 0.35 PMF with the reservoir at the level of the low point of the embankment and abutment. The HEC-1 program computed the peak PMF inflow to be 13,097 cfs. As shown in Appendix C, maximum reservoir water surface elevation of 0.5 PMF is 863.04 feet, or about eight inches over the embankment.

e. Spillway Adequacy. A spillway that will not pass 0.5 PMF without overtopping the dam is rated as "Seriously Inadequate", provided two other conditions are present. One is failure of the dam by overtopping. The portion of the embankment that is overtopped is the new part, for which there are no available construction records. As shown in Appendix B, sheet 5a, most of the water that overtops the abutment will flow down the junction of the embankment and abutment; a small portion will flow toward the roadway and away from the dam. Failure may be precipitated by erosion at the junction of embankment and abutment during the 0.5 PMF event.

The second requirement for a "Seriously Inadequate" spillway is that the downstream damage occurring after failure is significantly greater than that which would occur from high flows just before failure. At the confluence of Swiftwater Creek with Forest Hills Run, are at least two houses built in the flood plain, which will be flooded or damaged by large flows. Considering discharge from Swiftwater Creek alone,

about one-third of the drainage area, failure of Swiftwater Lake Dam during 0.5 PMF would increase the stage by about three feet. This increase in stage, when added to flood flows in Paradise Creek from the uncontrolled drainage area, is expected to significantly increase downstream damage. Therefore, the spillway is rated as "Seriously Inadequate".

f. Downstream Condition. About 1,800 feet below the dam, Swiftwater Creek enters Forest Hills Run and, shortly thereafter, enters Paradise Creek. At the confluence there are two houses subject to flooding from high flows. About 1.8 miles farther downstream is the community of Henryville where businesses and homes are built in the flood plain.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations. Visual observations detected no evidence of existing embankment stability problems. The upstream slope appears to be stable, with some minor undulations and displacement. The downstream slopes are covered with dense vegetation which may mask erosion, minor surface slides and seepage. There are no exterior signs or evidence indicating that seepage through the dam is occurring that would have an adverse effect on embankment stability. Stagnant water areas noted along the downstream channel of the original spillway contain no evidence of seepage and are considered minor. Since the condition of the sluice gate hoist is questionable and the gate was not inspected, servicability of this pond drain system could not be assessed. The spillway showed some signs of spalling and concrete deterioration which, at this time, do not have a serious affect on the stability of the structure. The spillway should be monitored through annual inspections supplemented by special inspections after severe storms. If deterioration or failure of the discharge chute or weir is noted, they should be repaired immediately.

b. Design and Construction Data. There was no design documentation and limited construction data available for review. Since design documentation was not available and existing records could not confirm the type and placement of embankment material, an assessment of the static stability could not be made. Therefore, the stability evaluation was based on an assessment of the geometric configuration of the embankment and the long history of satisfactory performance of this structure. This assessment indicates that the embankment, at least at this time, is stable. Recommendations pertaining to field investigations necessary to complete records on the stability of this embankment and appurtenant structures are presented in Section 7.

c. Operating Records. There are no operational records for this structure.

d. Post-Construction Changes. The only modifications or post-construction changes made to this dam and its appurtenant structures are described in Section 1.2.

e. Seismic Stability. The dam is located in Seismic Zone 1. Normally it can be considered that if a dam in this zone is stable under static conditions, it can be assumed safe for any expected earthquake conditions. Since there are no static stability calculations available, an assessment of the seismic stability of the dam could not be made.

SECTION 7
ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment.

a. Evaluation. The visual inspection and review of the very limited design and construction documentation indicate that the dam and appurtenant structures are in overall fair condition, with a poor condition being assigned to the pond drain discharge system. Seepage noted along the existing discharge channel is not considered to be critical and minor spalling noted in the spillway is not considered critical but should be monitored on a regular basis.

The hydrologic and hydraulic computations presented in Appendix C indicate that the dam will only pass 35 percent of the Probable Maximum Flood (PMF) without overtopping. As the 0.5 PMF storm has been assessed to overtop the dam, this overtopping is judged to cause failure, significantly increasing damage downstream. Thus, the spillway is rated "Seriously Inadequate" and should be considered unsafe non-emergency in accordance with Corps of Engineers' Guidelines.

In the event of failure not resulting from overtopping, property damage between the dam along Swiftwater Creek, Forest Hills Run and farther down along Paradise Creek is expected to be excessive and loss of life is probable. Therefore, a "High" hazard classification is clearly justified.

b. Adequacy of Information. The information available for this investigation was sufficiently adequate to evaluate the major features of the dam and appurtenant structures in accordance with Phase I Inspection criteria. Additional studies are recommended in paragraph d, below.

c. Urgency. It is recommended that the recommendations presented in Section 7.2 be implemented in accordance with the criteria provided in that section.

d. Necessity for Additional Studies. It is judged that additional investigations pertaining to the stability of the structure are necessary. These recommendations are described in Section 7.2.

7.2 Remedial Measures.

a. Facilities. It is recommended that the following steps be taken immediately. All work should be performed under the direction of a registered professional engineer experienced in the design of dams.

(1) A study should be performed to determine the best method of increasing the spillway capacity so at least 0.5 PMF can pass through the reservoir without overtopping. Subsequently, the discharge capacity of the spillway should be increased in accordance with the engineer's recommendations.

(2) The embankment crest should be raised to design elevation of at least 863.

(3) The pond drain valve should be greased, thoroughly checked for servicability, and rehabilitated, as necessary.

(4) The downstream slope should be cleared of dense vegetation and reinspected for any unacceptable erosion or seepage.

(5) Test borings should be performed, piezometers or observation wells installed and samples tested to determine engineering properties of the embankment. Subsequently, a stability analysis should be performed under supervision of a registered professional engineer.

The following recommendations should be performed as soon as practical or on a periodic basis, which should not exceed once a year.

(1) The spillway chute should be monitored at least annually and after every severe storm.

(2) If deterioration of the spillway continues, it should be assessed by a registered professional engineer and rehabilitated as required.

b. Operation and Maintenance Procedures. Because of the location and "High" hazard classification of this dam, a formal procedure of observation and warning during periods of high precipitation should be developed and implemented. This procedure should include a method of warning and possibly evacuating residents along the creek.

The Owner should develop an operation and maintenance procedure to be used to insure that the dam is operated in a safe manner and maintained in the best possible condition. Such a procedure would help prevent the pond drain gate from being in such poor condition.

APPENDIX

A

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM *Lake Swiftwater Dam*

ID # *PA 00776*

ITEM	REMARKS
AS-BUILT DRAWINGS	*Some drawings were avaiable. See Appendix E for pertinent drawings.*
REGIONAL VICINITY MAP	*See Plate 1, Appendix E.*
CONSTRUCTION HISTORY	*See Section 1.2g of the text.*
TYPICAL SECTIONS OF DAM	*See Appendix E.*
OUTLETS - PLAN	*See Appendix E.*
DETAILS	
CONSTRAINTS	
DISCHARGE RATINGS	*- None available.*
RAINFALL/RESERVOIR RECORDS	*- None available.*

ITEM	REMARKS
DESIGN REPORTS	*None available.*
GEOLOGY REPORTS	*No pre-or early post-construction reports available. Data collected for this report is presented in Appendix F.*
DESIGN COMPUTATIONS	*See Appendix C.*
HYDROLOGY & HYDRAULICS	*See Appendix C.*
DAM STABILITY	*None Available.*
SEEPAGE STUDIES	*None Available.*
MATERIALS INVESTIGATIONS	*Data not available.*
BORING RECORDS	*Data not available.*
LABORATORY	*Data not available.*
FIELD	*Data not available.*
POST-CONSTRUCTION SURVEYS OF DAM	*None known except for the reconstruction surveys performed by E.C. Hess when they reconstructed and moved the spillway in 1956.*
BORROW SOURCES	*Unknown.*

ITEM	REMARKS
MONITORING SYSTEMS	*None.*
MODIFICATIONS	*The spillway was reconstructed again in 1970. The work was designed by Heikki K. Elo, Consulting Engineer, Easton, Pennsylvania.*
HIGH POOL RECORDS	*None.*
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	*None.*
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	*The original spillway failed in 1933 and was rebuilt. The spillway was later (1956) moved to it's present location but it failed and was eventually reconstructed in 1970 to it's present configuration.*
MAINTENANCE OPERATION RECORDS	*None.*

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	*See Appendix E.*
OPERATING EQUIPMENT PLANS & DETAILS	*See Appendix E.*
MISCELLANEOUS	1. *"Report Upon the Application of G.A. Hulbert, H.S. Dickely and W.T. Hunter", April 26, 1928.* 2. *"Report Upon the Application of G.A. Hulbert, H.S. Dickely and W.T. Hunter", May 4, 1928.* 3. *"Report Upon the Application of Swiftwater Lake, Inc.", Feb. 29, 1956.* 4. *"Report Upon the Application of Lake Swiftwater Club, Inc.", Oct. 7, 1970.* 5. *"Report Upon the Request of G.A. Hulbert et al", Oct. 19, 1928.* 6. *Miscellaneous letter, memorandums and inspection reports.* 7. *25 (1928-1930) black and white photographs.*

APPENDIX

B

CHECK LIST
VISUAL INSPECTION
PHASE I

Name Dam *Lake Swiftwater Dam* County *Monroe* State *Pennsylvania* National ID # *PA 00776*

Type of Dam *Earth* Hazard Category *I (High)*

Date(s) Inspection *7 Nov. 1978*
8 Nov. 1978 Weather *Cloudy & Humid* Temperature *50's*

Pool Elevation at Time of Inspection *99.6*(1) M.S.L. Tailwater at Time of Inspection *N/A* M.S.L.

(1) Based on a B.M supplied by H. Elo, Owner's Engineer

Inspection Personnel:

Mary Beck (Hydrologist)
Raymond Lambert (Geologist)
John H. Frederick, Jr. (Geotechnical)
John Boschuk, Jr. (Geotechnical/Civil)
Vincent McKeever (Hydrologist)

John Boschuk, Jr. Recorder

Remarks:

Mr. Richard Dempewolff, Mr. Carl Lilius and Mr. Heikki Elo were on site and provided assistance.

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	*N/A*	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	*N/A*	
DRAINS	*N/A*	
WATER PASSAGES	*N/A*	
FOUNDATION	*N/A*	

CONCRETE/MASONRY DAMS

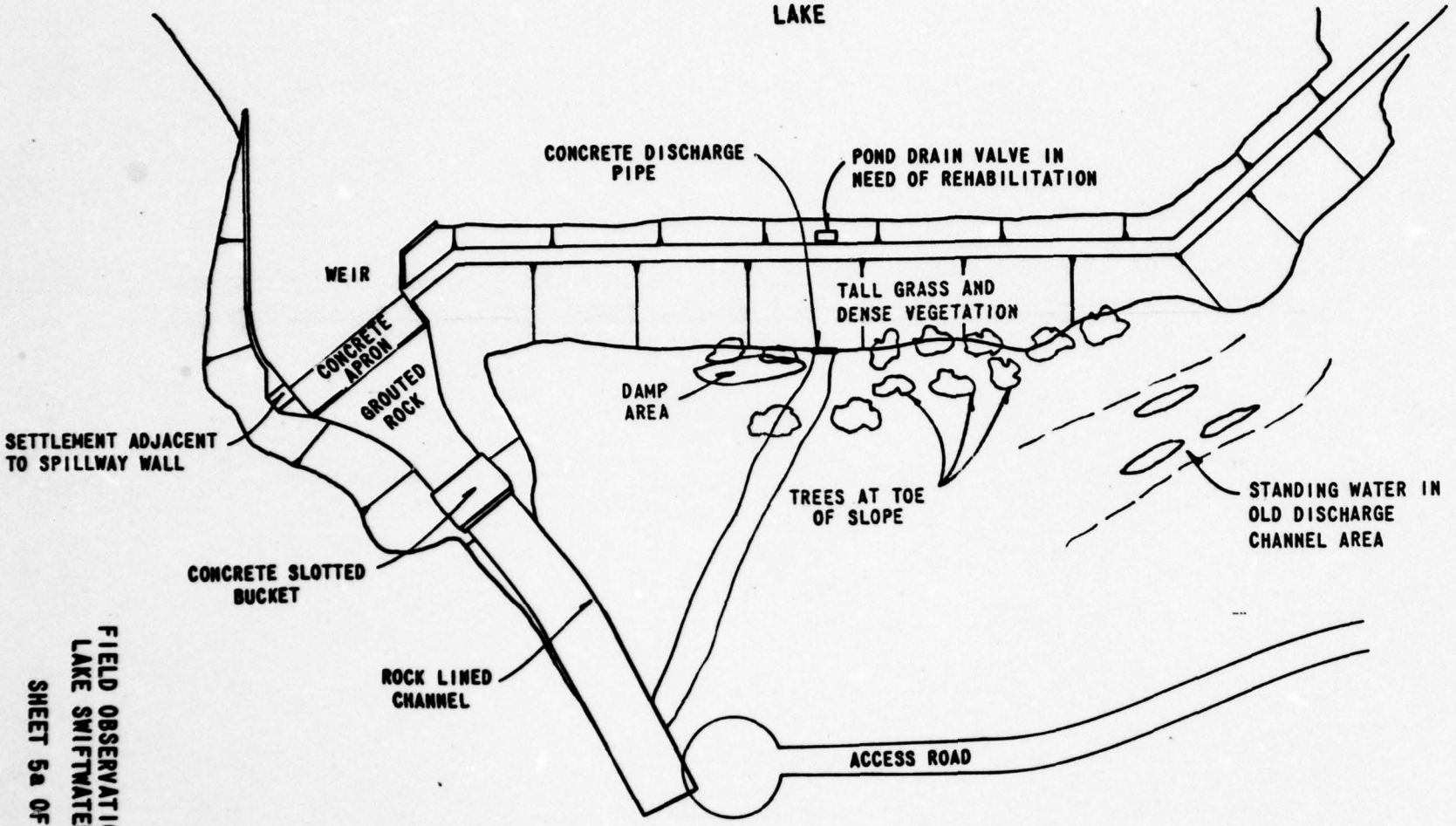
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	*N/A*	
STRUCTURAL CRACKING	*N/A*	
VERTICAL AND HORIZONTAL ALIGNMENT	*N/A*	
MONOLITH JOINTS	*N/A*	
CONSTRUCTION JOINTS	*N/A*	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	*None observed.*	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	*None observed.*	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	*None observed.*	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	*The alignment looks good.*	
RIPRAP FAILURES	*None observed. However, minor undulations were observed along the upstream slope which are not believed to have any affect for wave protection.*	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	*The junctions between the spillway walls and ground were eroded up to 13 inches but the anti seepage fins were in good condition. All other junctions are in good condition.*	
ANY NOTICEABLE SEEPAGE	*A marshy area containing cattails was noted along the original spillway channel. See Sheet 5a. A pool of stagnent water was also noted at the pond drain outlet but there was no evidence of seepage observed in the pool.*	
STAFF GAGE AND RECORDER	*None*	
DRAINS	*None observed.*	



FIELD OBSERVATION PLAN
LAKE SWIFTWATER DAM

SHEET 5a OF 11

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	*The exposed portion of concrete intake riser is in good condition but the metal top and door are in poor condition.*	
INTAKE STRUCTURE	*Condition unknown, underwater and embedded in the embankment.*	
OUTLET STRUCTURE	*Only the end of the three foot diameter pipe was exposed and the end was assessed to be in good condition. The base of the pipe contains 4± inches of debris.*	
OUTLET CHANNEL	*Good condition but there is a stagnent pool of water at the end of the discharge pipe. There were no signs of seepage into the pool.*	
EMERGENCY GATE	*The valve was not exercised. It was reported by the Owner's representative that the valve is rarely exercised. It is not greased and appears to be poorly maintained. It was decided not to open the gate. (Manufacture: Coldwell-Wilcox-36").*	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	*Good condition, little spalling noted on the weir.*	
APPROACH CHANNEL	*The approach channel, however, overhanging trees and brush at the right end of the weir reduce the effective length of the weir, reducing the discharge capacity.*	
DISCHARGE CHANNEL	*The gunited channel between the weir and stilling basin is in fair condition with some spalling.*	
BRIDGE AND PIERS	*None*	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	*None*	
APPROACH CHANNEL	*None*	
DISCHARGE CHANNEL	*None*	
BRIDGE AND PIERS	*None*	
GATES AND OPERATION EQUIPMENT	*None*	

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	*None*	
OBSERVATION WELLS	*None*	
WEIRS	*None*	
PIEZOMETERS	*None*	
OTHER	*None*	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	*The reservoir side slopes are flat to moderate, well vegetated with grass and timber to the waters edge. There is some debris on the reservoir slopes which will float into the spillway.*	
SEDIMENTATION	*Some sedimentation at upper end of reservoir has no effect on flood water storage.*	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	*The downstream meanders slightly through a flat wooded flood plain with light underbrush. The channel slopes (approximately 3H:1V) and bottom are stoney. There was little or no debris in the channel.*	
SLOPES	*The valley gradient is approximately 0.04.*	
APPROXIMATE NO. OF HOMES AND POPULATION	*About 2,000 feet below the dam, Swiftwater Creek enters Paradise Creek. At the confluence one, possibly two, homes are subject to damage, including loss of life. About two miles further downstream are several homes/buildings built in the floodplain subject to damage in the event of failure.*	

APPENDIX

C

SWIFTWATER LAKE DAM

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: *90% wooded, with about 20% residential development.*

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): *856 feet * (188 Acre-Feet)*

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): *862.2 feet (346 Acre-Feet)*

ELEVATION MAXIMUM DESIGN POOL: ------

ELEVATION TOP DAM: *863± feet.*

SPILLWAY:

a. Elevation *856.0 feet minimum elevation.*

b. Type *Concrete weir, chute and slotted bucket.*

c. Width *100 feet.*

d. Length *120± feet.*

e. Location Spillover *Right abutment.*

f. Number and Type of Gates *None.*

POND DRAIN:

a. Type *Concrete gate tower on crest with u/s intake and d/s outlet.*

b. Location *At upstream toe.*

c. Entrance inverts *Unknown.*

d. Exit inverts *Unknown.*

e. Emergency draindown facilities *36 inch pipe.*

HYDROMETEOROLOGICAL GAGES:

a. Type *None.*

b. Location *N/A.*

c. Records *N/A.*

MAXIMUM NON-DAMAGING DISCHARGE: ------

* *Note: All elevations based on spillway elevation 856 from USGS Map.*

HEC-1, REVISED
FLOOD HYDROGRAPH PACKAGE

The original "Flood Hydrograph Package" (HEC-1), developed by the Hydrologic Engineering Center, Corps of Engineers, has been modified for use under the National Dam Inspection Program. The "Flood Hydrograph Package (HEC-1), Dam Safety Version", hereinafter referred to as, HEC-1, Rev., has been modified to require less detailed input and to include a dam breach analysis. The required input is obtained from the field inspection of a dam, any available design/evaluation data, relatively simple hydraulic calculations, or information from the USGS Quandrangle maps. The input format is flexible in order to reflect any unique characteristics of an individual dam.

HEC-1, Rev. computes a reservoir inflow hydrograph based on individual watershed characteristics such as: area, percentage of impervious surface area, watershed shape, and hydrograph characteristics determined from regional correlation studies by the Corps of Engineers, Baltimore District. The inflow is routed through the reservoir using spillway discharge data obtained from the field inspection or design data. Flood storage capacity is determined from USGS maps or design information and verified by the field inspection. In the event a spillway cannot discharge 0.5 PMF without overtopping and failure of the dam, downstream channel characteristics obtained from the field inspection and USGS maps are inputed and flows are routed downstream to the damage center and a dam breach analysis is performed.

Included in this Appendix are the HEC-1, Rev. pertinent input values and a summary print-out tables.

BY MEB DATE 4/5/79 SUBJECT Swiftwater Lake Dam SHEET 3 OF 12
CHKD. BY DATE 4/5/79 Hydrology / Hydraulics JOB No.

Classification (Ref. - Recommended Guidelines for Safety Inspections of Dams)

1. The hazard potential is rated as "High" as there would be loss of life if the dam failed suddenly not as a result of overtopping.

2. The size classification is "Small" based on its 31± ft. height and total capacity of 344 Ac-Ft.

3. The spillway design flood, based on size and hazard classification, is 0.5 to 1.0 PMF (Probable Maximum Flood).

Hydrology and Hydraulic Analysis

1. Original Data for Existing Spillway. See Section 5 of the test.

2. Evaluation of present structure was by use of the computer program. Computer input as follows:

Inflow hydrograph
drainage area - measured from current USGS maps - Mount Pocono, Pa. (1973)
Pocono Pines, Pa. (1973)
rainfall - ref. Hydrometeralogical Report No. 33 (see sh. 6)
Snyder's hydrograph parameters, t_p & C_p
$t_p = C_t (L \cdot L_{ca})^{0.3}$ ✓

$C_t = 1.23$ Information received from Corps ✓
$C_p = 0.45$ of Engineers, Balt. for Zone I ✓

$L = 8.33$ miles from USGS ✓
$L_{ca} = 4.78$ miles maps

$t_p = 1.23(8.33 \cdot 4.78)^{0.3} = 3.716$ ✓

Reservoir routing
elevation - storage, shown on sheet 7
based on 1927 drawing

BY MEB DATE 4/6/79 Rev 9/25/79 SUBJECT Swiftwater Lake Dam Hydrology / Hydraulics SHEET 4 OF 12

CHKD. BY DATE 9/25/79 JOB No.

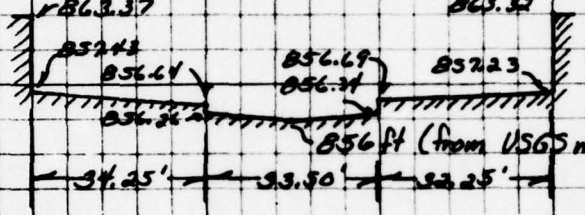
elevation - discharge, shown sheet 7

$Q = C L H^{3/2}$

C = 3.6 estimated from Table 5-13, King & Brater, Handbook of Hydraulics

L = 100 ft } field checked

H



Water Surface	H (effective)	L	Q	H (effective)	L	Q	total Q
856	0						
856.6	0.45	33.5	36.4				36.
857.6	1.45	33.5	210.6	0.60	66.5	111.3	322
858.6	2.45	33.5	462.5	1.60	66.5	484.5	947

for Q = 947, C = 3.6 & L = 100; the equivalent H = 1.90

860.0	3.3	100	2158
861.0	4.3	100	3210
866.0	9.3	100	10210

Overtopping Potential - as shown on Sheet 12, the spillway passes about 0.3% PMF without overtopping. The 0.5 PMF is assessed to cause failure.

Spillway Adequacy - the spillway is rated as "Seriously Inadequate". The increase in stage in Paradise Creek as a result of failure is estimated to be 3 ft., which, when added to flow from the uncontrolled area, would, most likely, significantly increase damage along the creek.

MFB 4/6/79
Rev. 4/24/79

Swift Water Lake Dam
Hydrology / Hydraulics

SH. 5 OF 12

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	IN
ROUTE HYDROGRAPH TO	OUT
ROUTE HYDROGRAPH TO	DS
ROUTE HYDROGRAPH TO	PC
END OF NETWORK	

1**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
****

RUN DATE= 79/04/26.
TIME= 09.18.37.

SWIFTWATER LAKE DAM
NAT ID NO. PA 00776 DER NO. 45-134
OVERTOPPING ANALYSIS

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	10	0	0	0	0	0	-4	0
			JOPER	NWT	LROPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 5 LRTIO= 1

RTIOS= .30 .40 .50 .80 1.00

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
IN	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	9.68	0.00	9.68	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.00	111.00	124.00	134.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 3.72 CP= .45 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG= 3.72 HOURS, CP= .45 VOL= .92

7.	26.	53.	87.	125.	167.	212.	260.	310.	362.
416.	472.	525.	574.	618.	658.	693.	723.	747.	766.
779.	784.	779.	763.	741.	721.	701.	681.	662.	643.
625.	608.	591.	575.	559.	543.	528.	513.	499.	485.
471.	458.	445.	433.	421.	409.	398.	387.	376.	365.
355.	345.	336.	326.	317.	308.	300.	291.	283.	275.
268.	260.	253.	246.	239.	232.	226.	219.	213.	207.
202.	196.	190.	185.	180.	175.	170.	165.	161.	156.
152.	148.	144.	139.	136.	132.	128.	125.	121.	118.
114.	111.	108.	105.	102.	99.	97.	94.	91.	89.

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
SUM			24.99	22.62	2.37	658426.							
			(635.)	(574.)	(60.)	(18644.55)							

MFB 4/4/79
Rev 4/26/79

Swift Water Lake Dam
Hydrology / Hydraulics

SH. 7 OF 12

HYDROGRAPH ROUTING

OUTFLOW HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
OUT	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-856.	-1

STAGE	856.00	856.60	857.60	858.60	860.00	861.00	862.00	863.00	866.00
FLOW	0.00	36.00	322.00	947.00	2158.00	3210.00	4393.00	5693.00	10210.00
CAPACITY=	0.	188.	340.	440.					
ELEVATION=	832.	856.	862.	865.					

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
856.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
862.2	0.0	0.0	0.

CREST LENGTH AT OR BELOW ELEVATION	100.	430.	755.	761.
	862.2	863.0	863.2	863.4

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
100.	1.50	832.00	.50	856.00	863.00

HYDROGRAPH ROUTING

MFB 11/24/79

Swiftwater Lake Dam
Hydrology / Hydraulics
SH. 8 OF 12

DOWNSTREAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
DS	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0500	.0350	.0450	835.0	860.0	600.	.03300

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 866.00 40.00 846.00 193.00 837.00 225.00 835.00 285.00 835.00
295.00 837.00 360.00 850.00 460.00 870.00

STORAGE	0.00	1.34	3.18	5.54	8.43	11.84	15.78	20.24	25.23	30.66
	36.29	42.08	48.05	54.17	60.47	66.93	73.56	80.36	87.32	94.45
OUTFLOW	0.00	803.39	2985.87	6688.16	11845.64	18546.87	26887.03	36963.44	48873.59	63249.11
	79822.00	98233.60	118451.52	140454.00	164226.81	189761.29	217053.03	246100.98	276906.76	309474.17
STAGE	835.00	836.32	837.63	838.95	840.26	841.58	842.89	844.21	845.53	846.84
	848.16	849.47	850.79	852.11	853.42	854.74	856.05	857.37	858.68	860.00
FLOW	0.00	803.39	2985.87	6688.16	11845.64	18546.87	26887.03	36963.44	48873.59	63249.11
	79822.00	98233.60	118451.52	140454.00	164226.81	189761.29	217053.03	246100.98	276906.76	309474.17

PARADISE CREEK

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
PC	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0500	.0350	.0400	792.0	810.0	1200.	.01230

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 810.00 100.00 800.00 125.00 795.00 150.00 792.00 250.00 792.00
275.00 795.00 300.00 800.00 600.00 810.00

STORAGE	0.00	2.82	6.04	9.68	13.68	17.92	22.41	27.15	32.14	37.49
	43.75	51.00	59.25	68.48	78.70	89.90	102.10	115.29	129.46	144.63
OUTFLOW	0.00	443.82	1454.83	2958.41	5150.71	7894.44	11141.00	14884.34	19122.06	23731.82
	28946.06	34900.93	41648.56	49252.36	57775.21	67277.82	77818.67	89454.17	102238.95	116226.07
STAGE	792.00	792.95	793.89	794.84	795.79	796.74	797.68	798.63	799.58	800.53
	801.47	802.42	803.37	804.32	805.26	806.21	807.16	808.11	809.05	810.00
FLOW	0.00	443.82	1454.83	2958.41	5150.71	7894.44	11141.00	14884.34	19122.06	23731.82
	28946.06	34900.93	41648.56	49252.36	57775.21	67277.82	77818.67	89454.17	102238.95	116226.07

MEB 4/26/79

Swift Reservoir Lake Dam
Hydrology / Hydraulics
SH. 9 OF 12

MFB Jpg Rev 4/4/79 4/12/79

Swift Water Lake Dam
Hydrology / Hydraulics

SH. 10 OF 12

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .30	RATIO 2 .40	RATIO 3 .50	RATIO 4 .80	RATIO 5 1.00
HYDROGRAPH AT	IN	9.68	1	3929.	5239.	6548.	10477.	13097.
	(	25.07)	(	111.26)(	148.34)(	185.43)(	296.68)(	370.85)(
ROUTED TO	OUT	9.68	1	3904.	5211.	19100.	19724.	19939.
	(	25.07)	(	110.54)(	147.57)(	540.86)(	558.53)(	564.61)(
ROUTED TO	DS	9.68	1	3903.	5211.	19196.	19824.	20040.
	(	25.07)	(	110.52)(	147.56)(	543.58)(	561.35)(	567.47)(
ROUTED TO	PC	9.68	1	3903.	5210.	19091.	19718.	19939.
	(	25.07)	(	110.52)(	147.52)(	540.61)(	558.35)(	564.62)(

MFB 4/24/79 Swift Water Lake Dam Hydrology / Hydraulics SH. 11 OF 12

SUMMARY OF DAM SAFETY ANALYSIS

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	856.00	856.00	862.20
STORAGE	188.	188.	346.
OUTFLOW	0.	0.	4653.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.30	861.59	0.00	329.	3904.	0.00	43.50	0.00
.40	862.55	.35	358.	5211.	2.67	43.50	0.00
.50	863.04	.84	374.	19100.	1.46	43.17	42.83
.80	863.02	.82	374.	20142.	.79	41.34	41.00
1.00	863.04	.84	375.	20366.	.80	40.84	40.50

PLAN 1 STATION DS

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.30	3903.	838.0	43.50
.40	5211.	838.4	43.50
.50	19196.	841.7	43.17
.80	19824.	841.8	41.33
1.00	20040.	841.8	40.83

PLAN 1 STATION PC

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.30	3903.	795.3	43.67
.40	5210.	795.8	43.50
.50	19091.	799.6	43.17
.80	19718.	799.7	41.33
1.00	19939.	799.7	40.83

MFB 4/24/79 Swift Hunter Lake Dam sh. 12 of 12
Hydrology / Hydraulics

SUMMARY OF DAM SAFETY ANALYSIS

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	856.00	856.00	862.20
STORAGE	188.	188.	346.
OUTFLOW	0.	0.	4653.

Assuming No Failure

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.30	861.59	0.00	329.	3904.	0.00	43.50	0.00
.40	862.55	.35	358.	5211.	2.67	43.50	0.00
.50	863.11	.91	377.	6535.	5.00	43.50	0.00
.80	863.97	1.77	406.	10472.	9.17	43.33	0.00
1.00	864.43	2.23	421.	13092.	10.17	43.33	0.00

PLAN 1 STATION DS

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.30	3903.	838.0	43.50
.40	5211.	838.4	43.50
.50	6535.	838.9	43.50
.80	10472.	839.9	43.33
1.00	13091.	840.5	43.33

PLAN 1 STATION PC

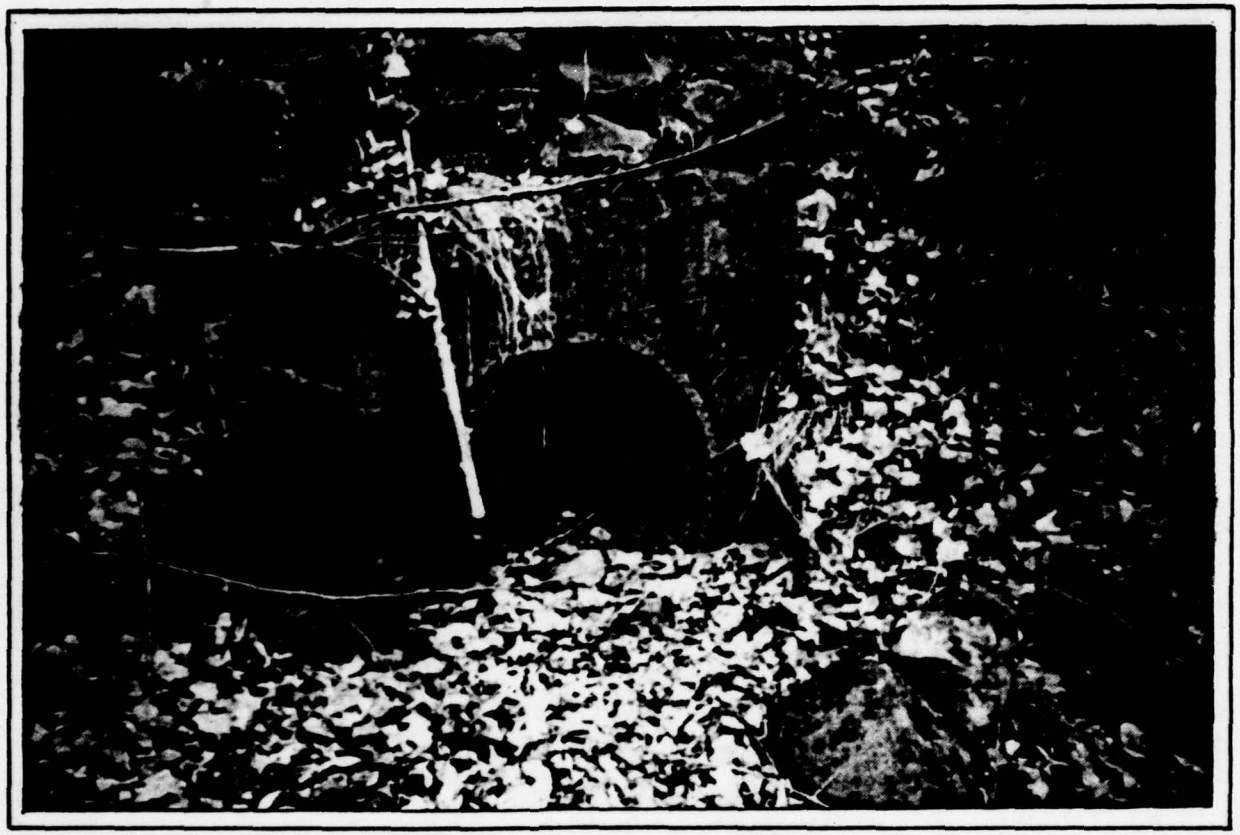
RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.30	3903.	795.3	43.67
.40	5210.	795.8	43.50
.50	6537.	796.3	43.50
.80	10469.	797.5	43.33
1.00	13090.	798.2	43.33

APPENDIX

D

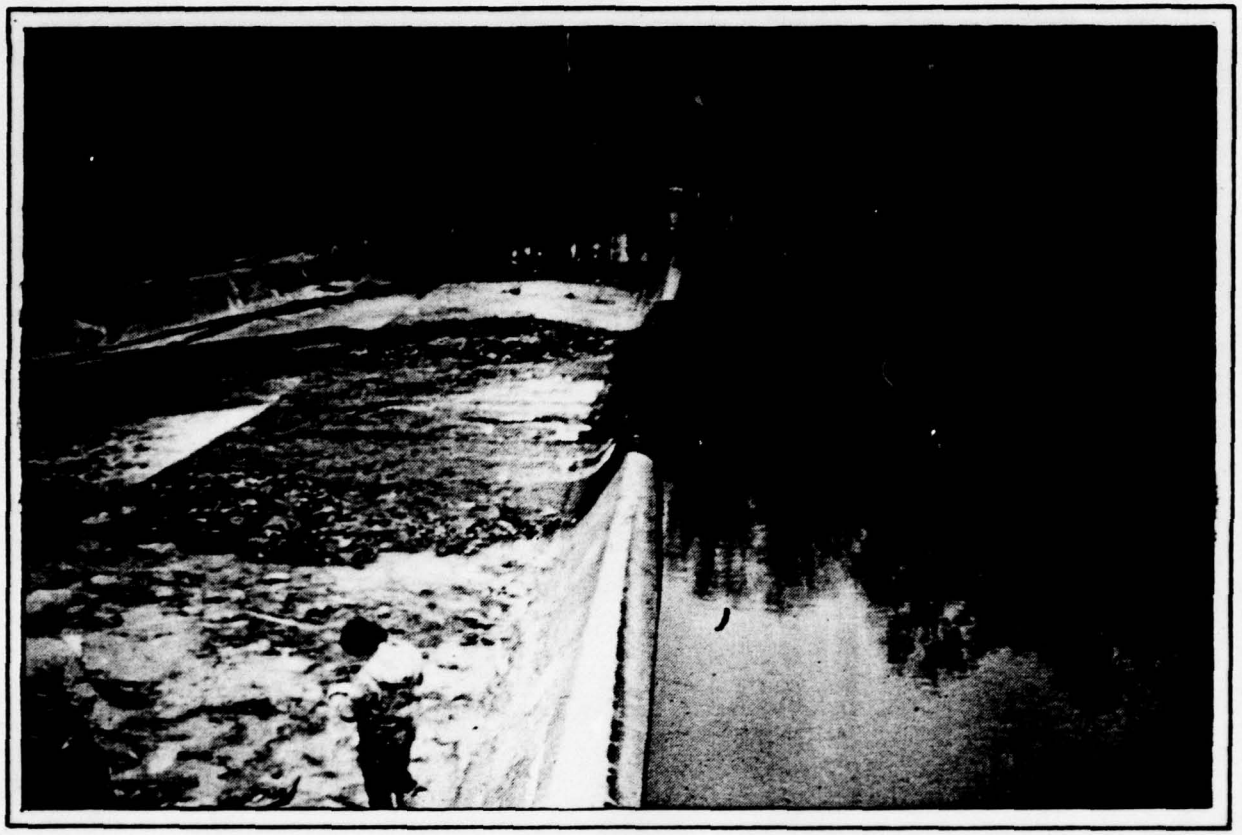
POND DRAIN VALVE LOCATED UPSTREAM
OF CREST.

PHOTOGRAPH NO. 1



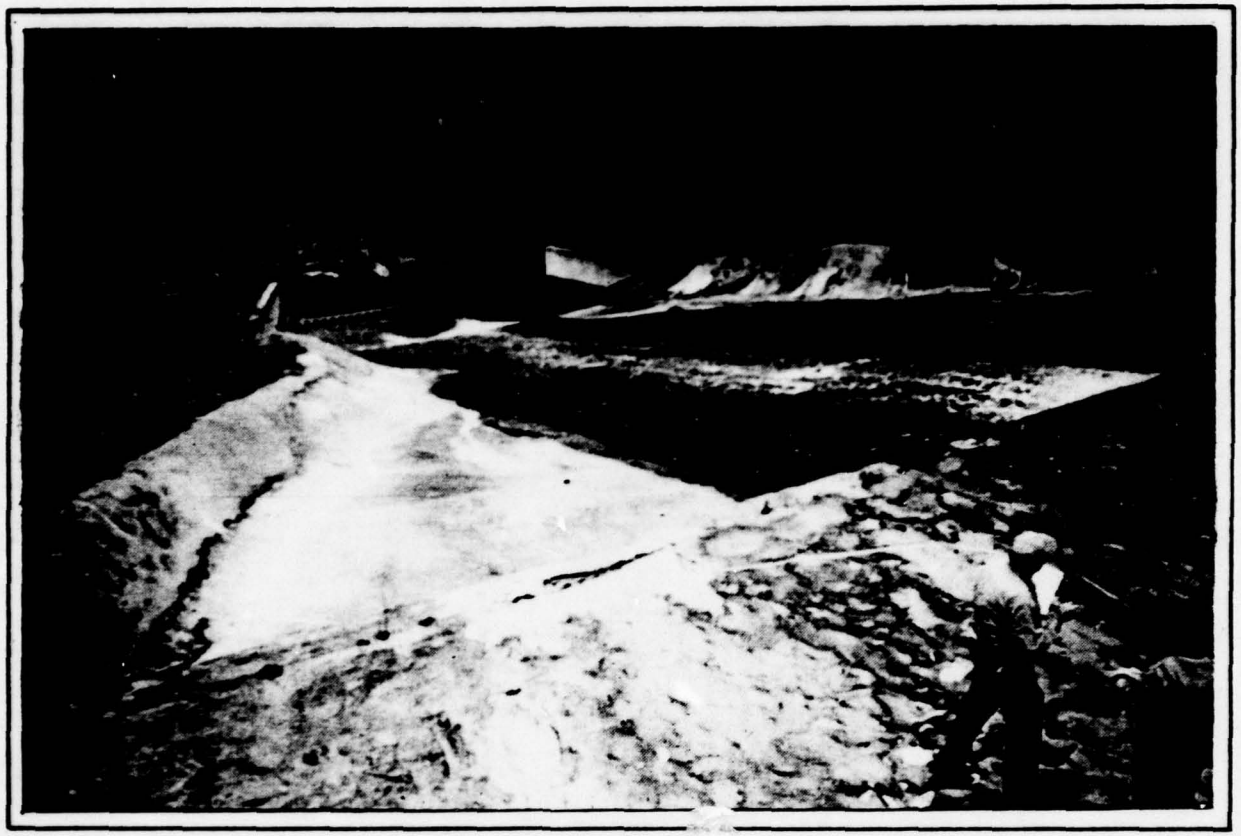
POND DRAIN OUTLET PIPE AT EMBANKMENT TOE.

PHOTOGRAPH NO. 2



SPILLWAY LOOKING TOWARDS RIGHT ABUTMENT.

PHOTOGRAPH NO. 3

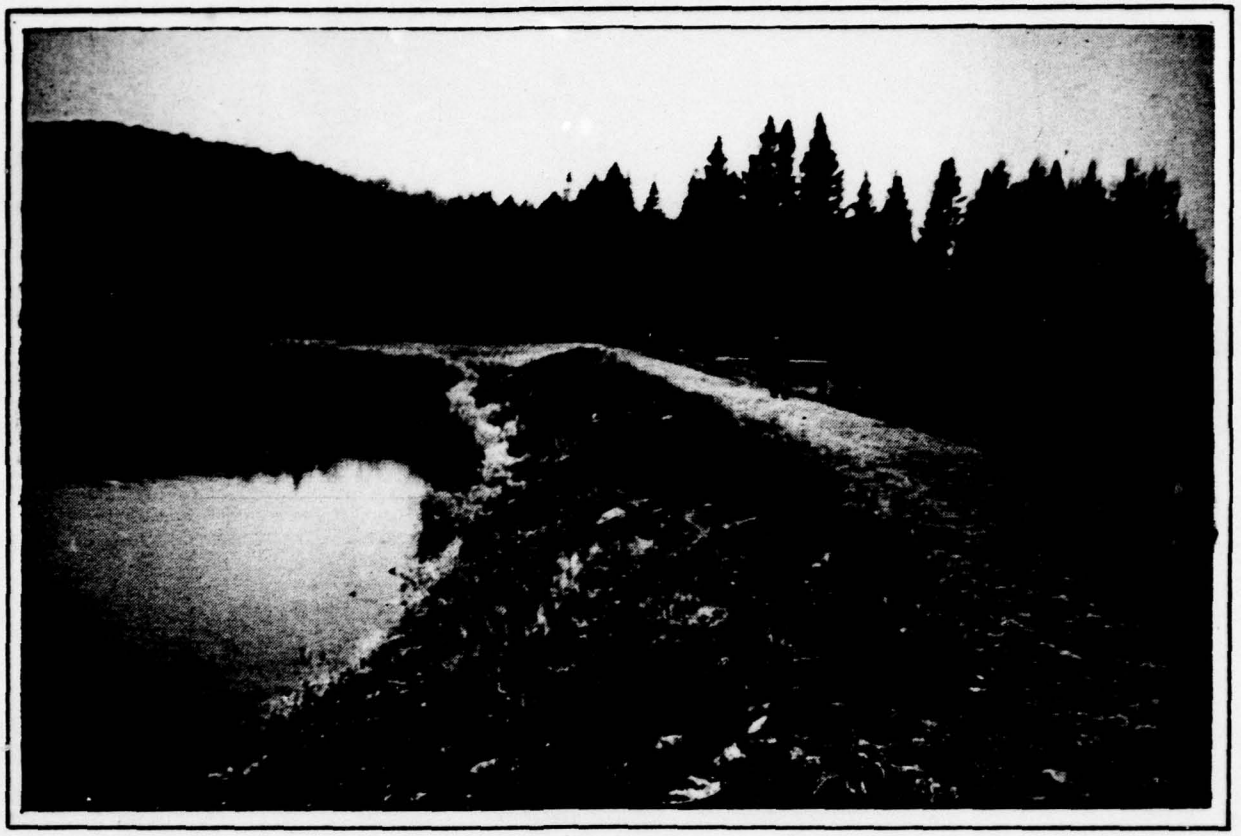


SPILLWAY DISCHARGE CHANNEL AND
FLIP BUCKET.

PHOTOGRAPH NO. 4

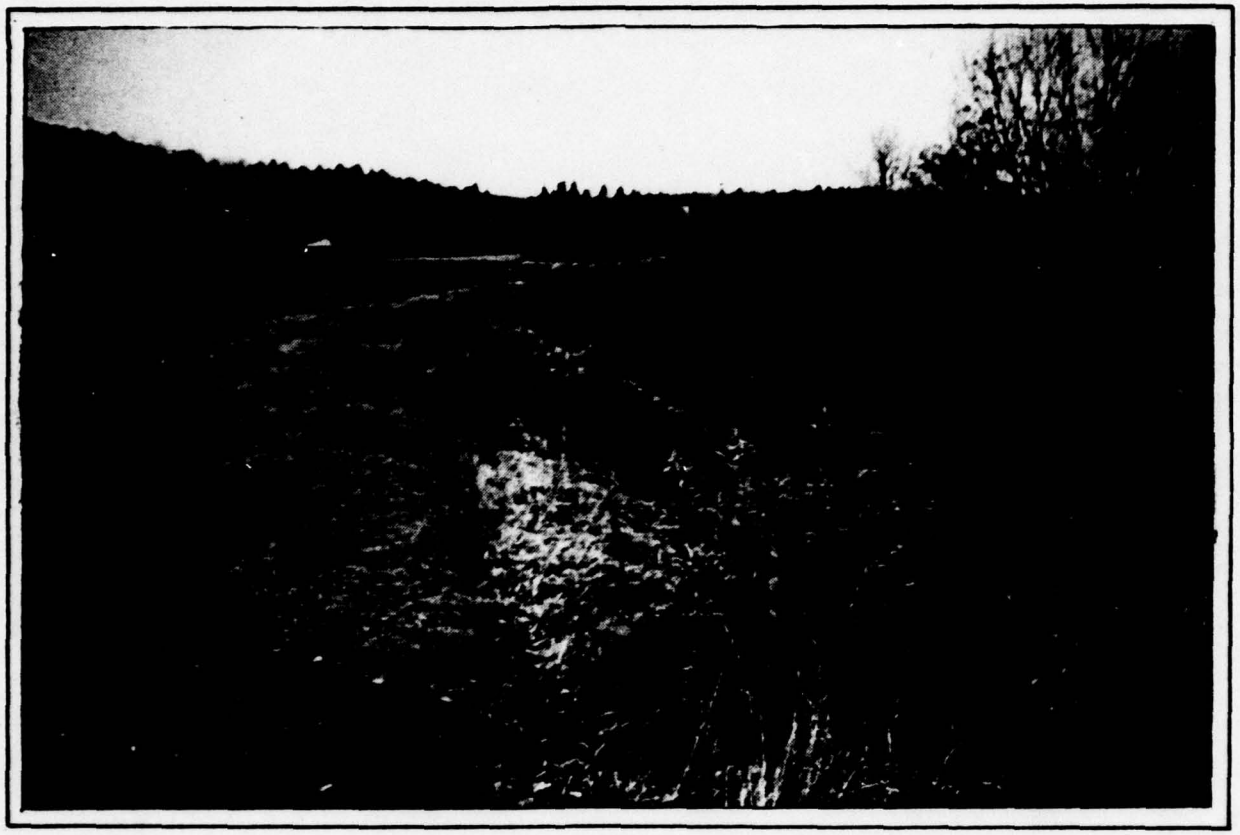
DISCHARGE CHANNEL DOWNSTREAM OF DAM.

PHOTOGRAPH NO. 5



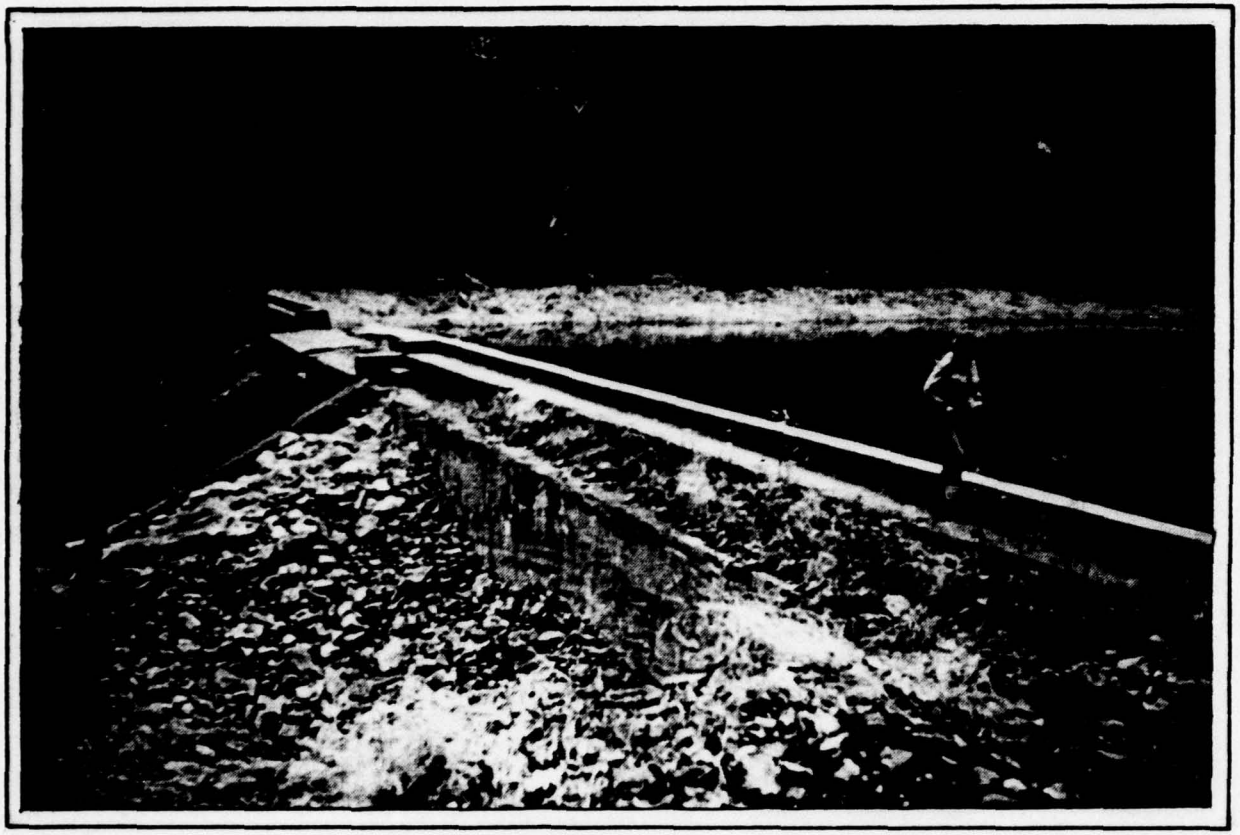
USPSTREAM SLOPE LOOKING FROM SPILLWAY
TOWARDS LEFT ABUTMENT OF DAM.

PHOTOGRAPH NO. 6



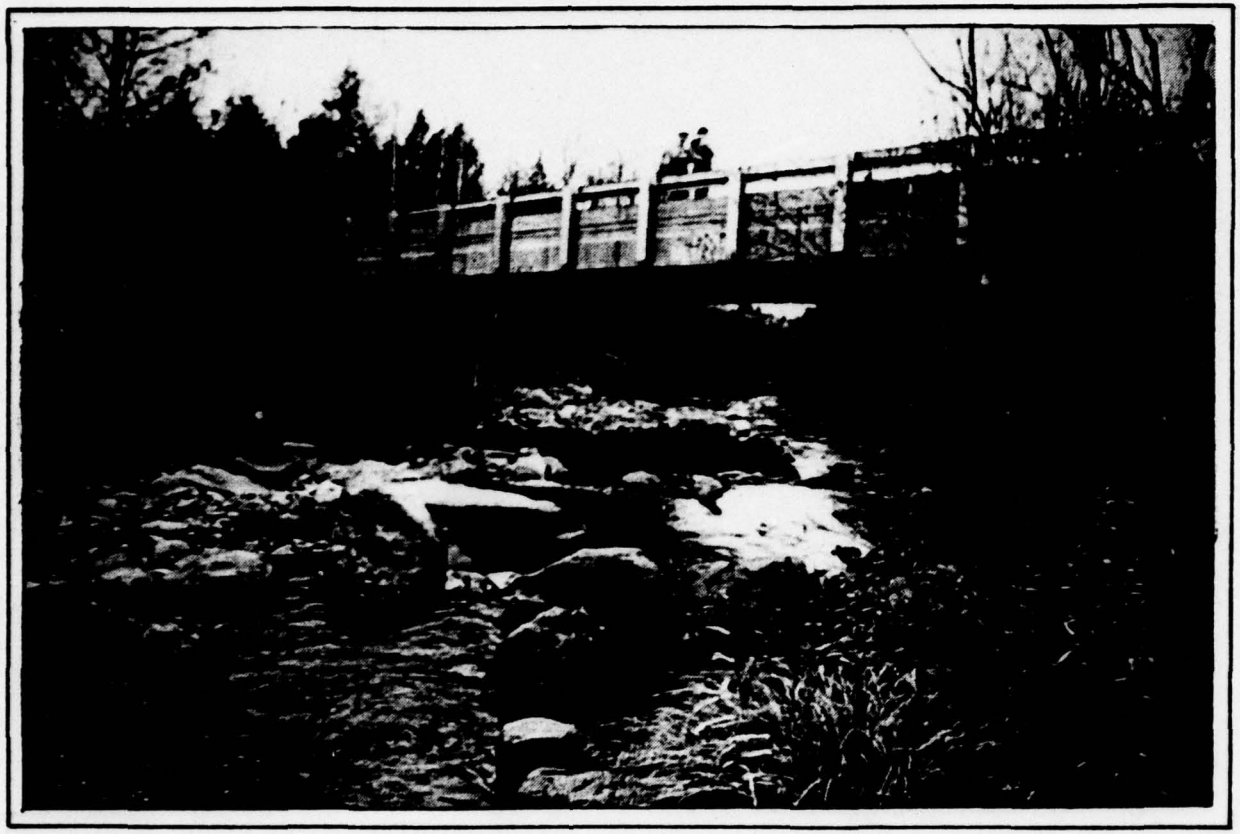
DOWNSTREAM SLOPE LOOKING FROM SPILLWAY
TOWARDS LEFT ABUTMENT OF DAM.

PHOTOGRAPH NO. 7



LAKE MINAUSIN DAM LOCATED UPSTREAM
OF LAKE SWIFTWATER. NOTE FAILURE
OF SPILLWAY.

PHOTOGRAPH NO. 8

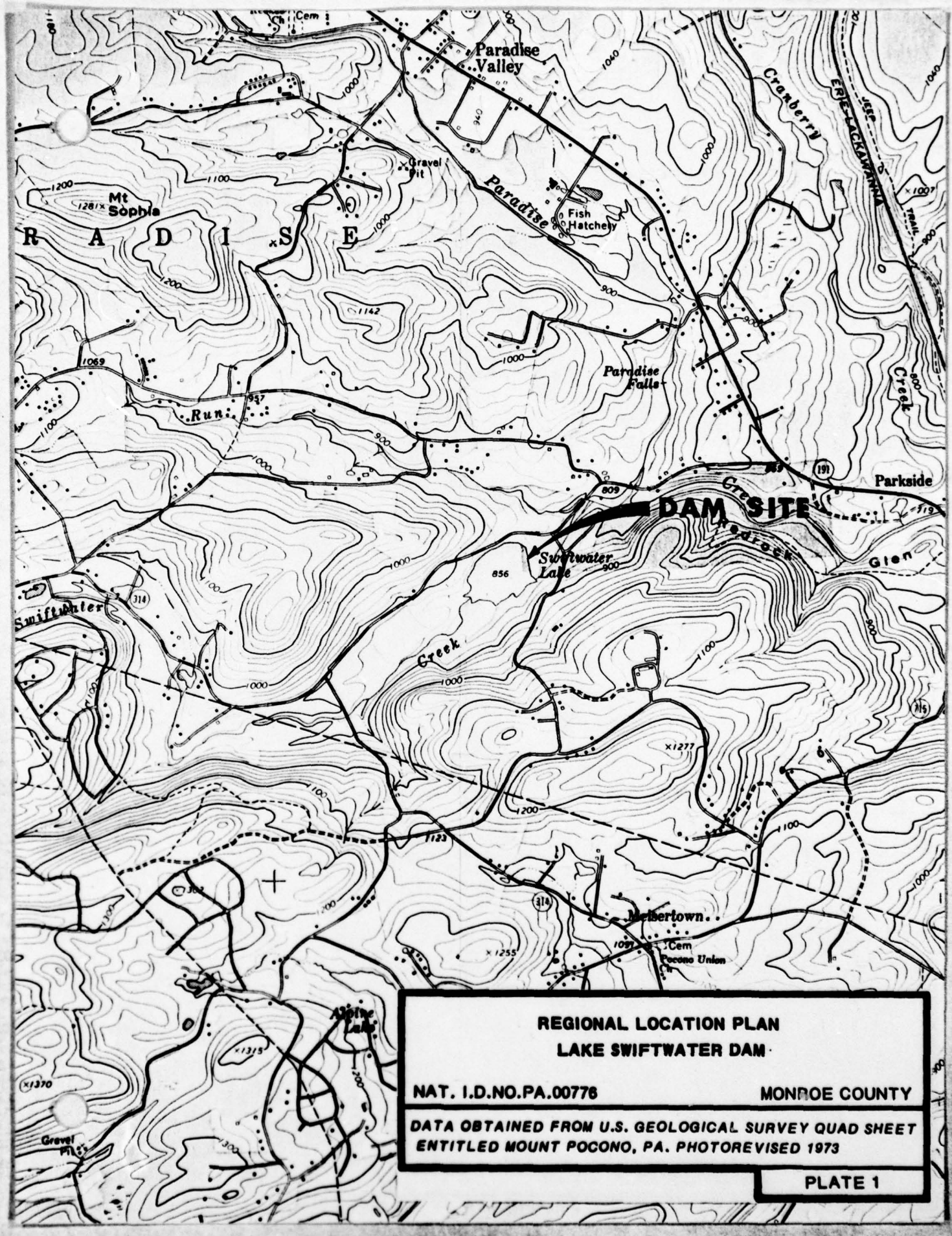


FIRST BRIDGE DOWNSTREAM OF LAKE
SWIFTWATER.

PHOTOGRAPH NO. 9

APPENDIX

E

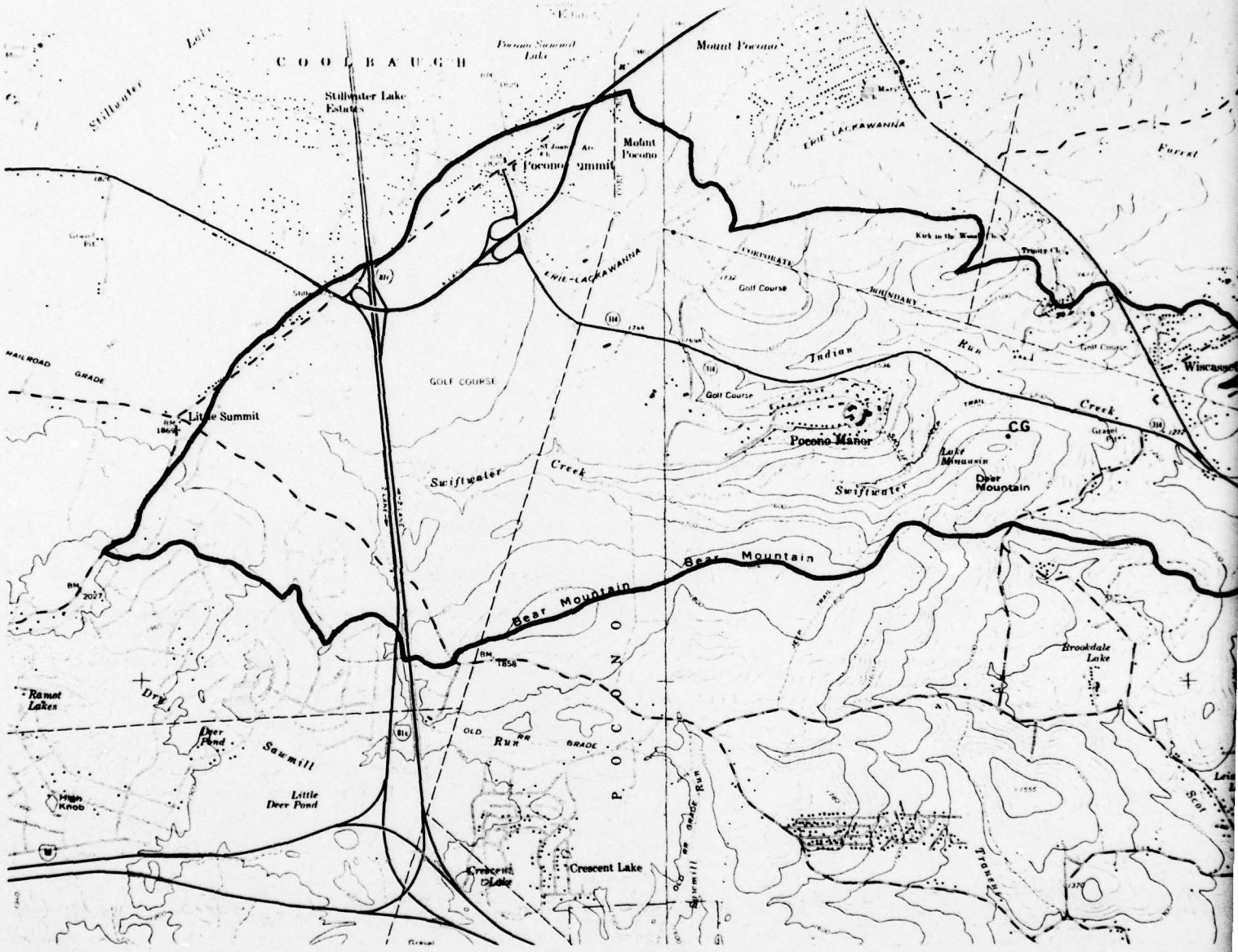


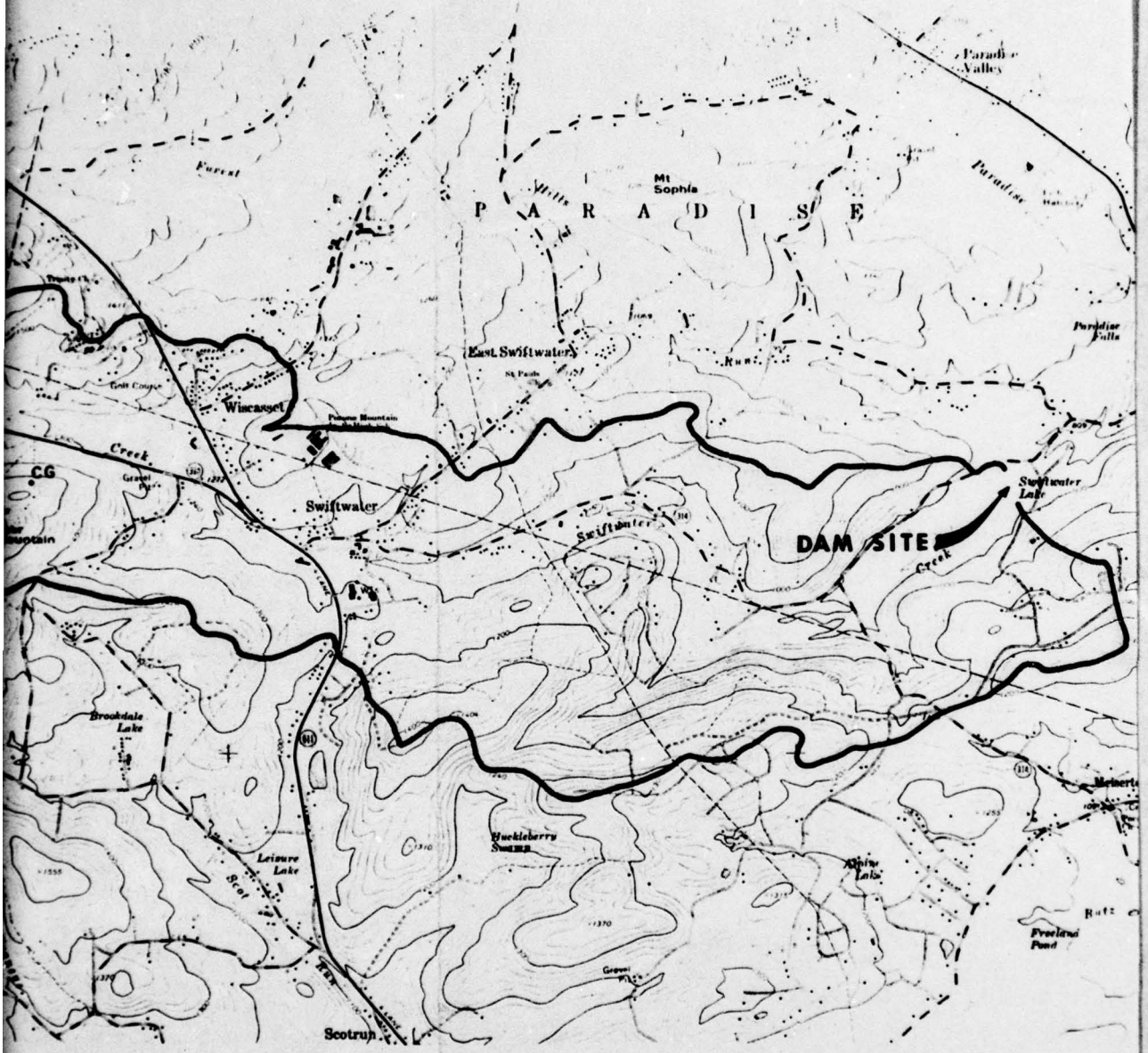
REGIONAL LOCATION PLAN
LAKE SWIFTWATER DAM

NAT. I.D.NO.PA.00776 **MONROE COUNTY**

DATA OBTAINED FROM U.S. GEOLOGICAL SURVEY QUAD SHEET ENTITLED MOUNT POCONO, PA. PHOTOREVISED 1973

PLATE 1


COOLBAUGH
Stillwater Lake Estates
Mount Pocono
Pocono Summit
Mount Pocono
ERIE-LACKAWANNA
Golf Course
Indian Run
Creek
Pocono Manor
CG
Lake Minsinin
Deer Mountain
Swiftwater Creek
Swiftwater
Bear Mountain
Bear Mountain
Little Summit
GOLF COURSE
RAILROAD GRADE
Brookdale Lake
Ramat Lakes
Deer Pond
Sawmill
Little Deer Pond
High Knob
OLD RR GRADE
Crescent Lake
Crescent Lake
POCONO

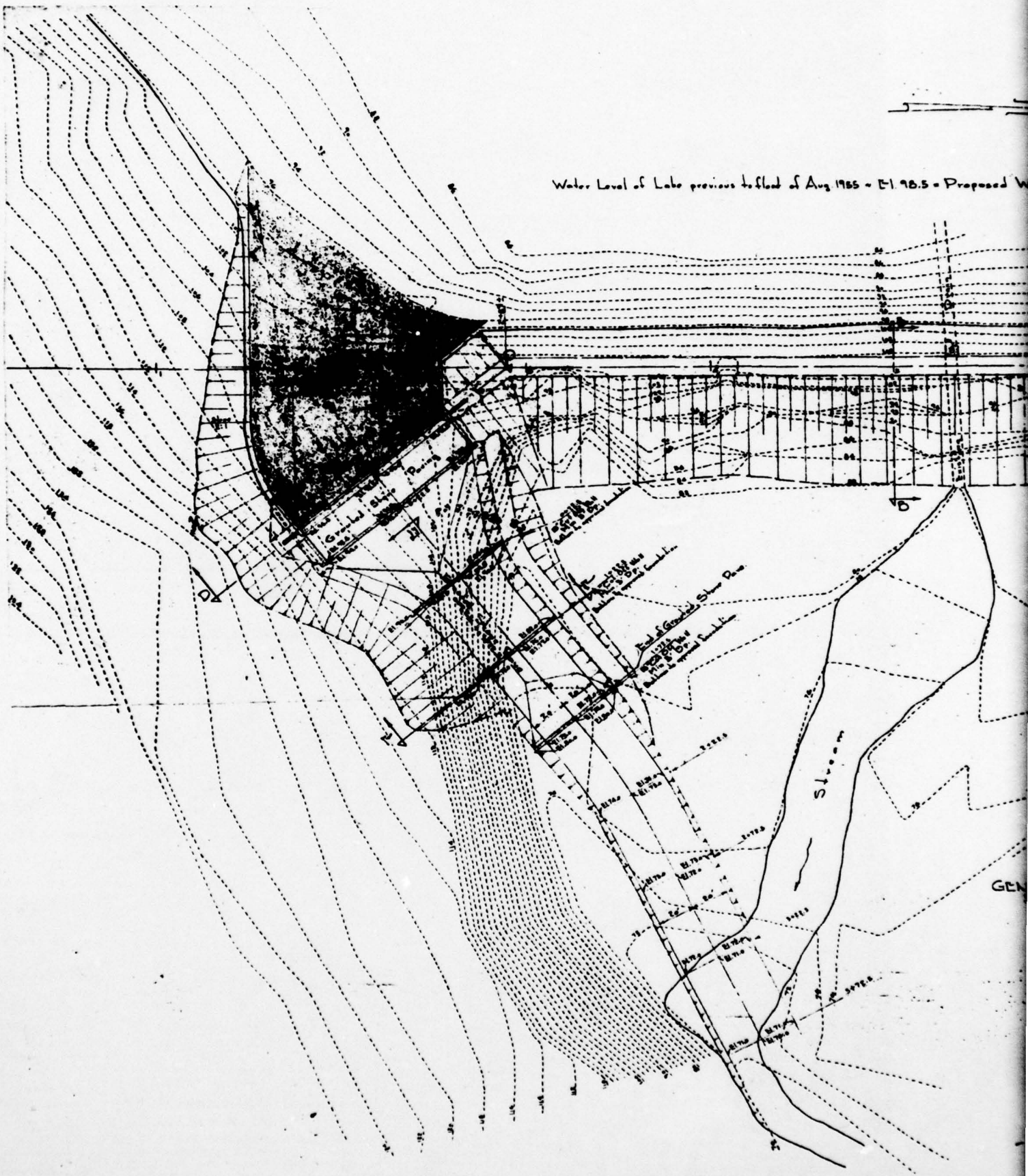


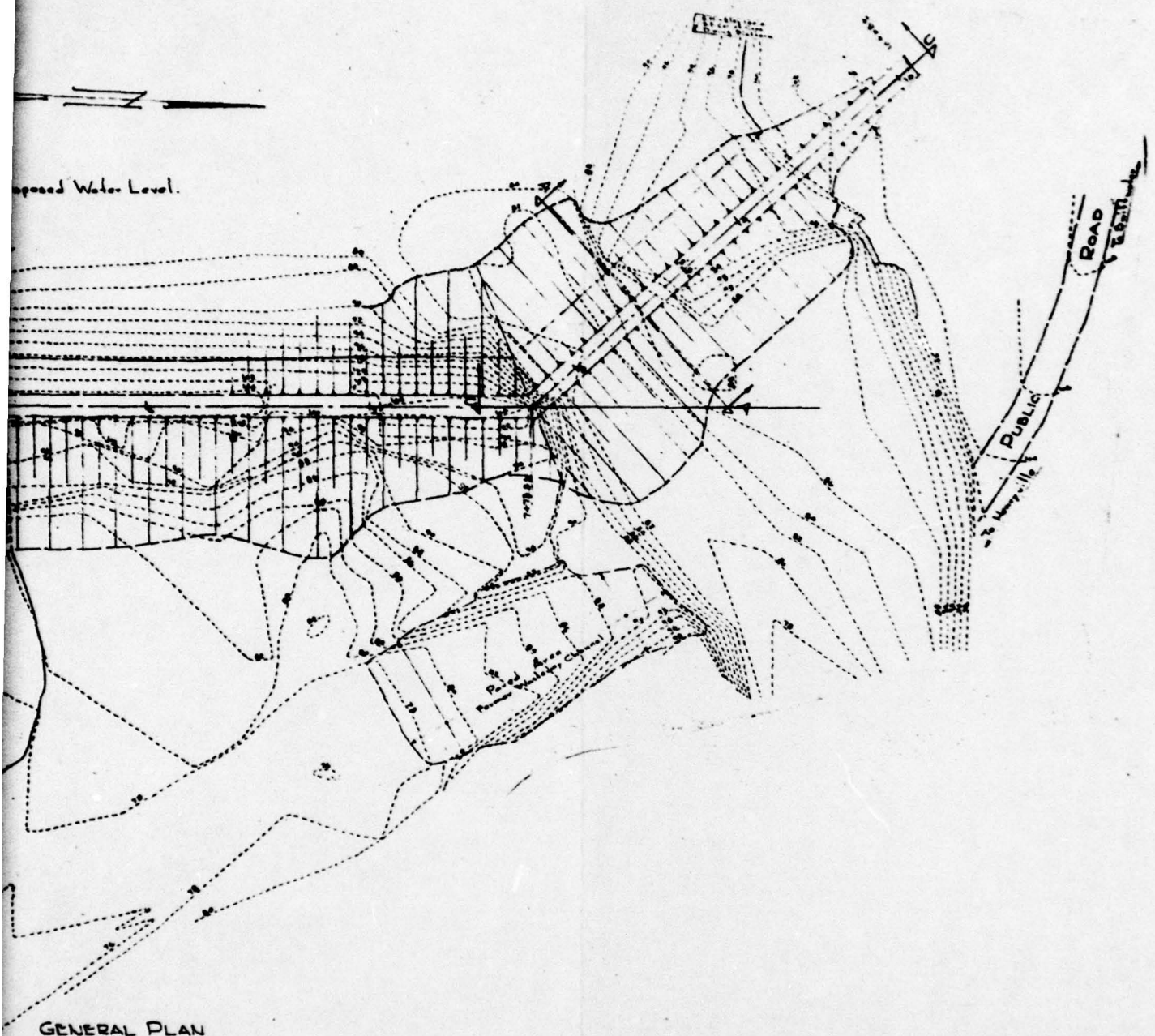
HYDROLOGIC MAP
LAKE SWIFTWATER DAM

NAT. I.D.NO.PA.00776 MONROE COUNTY

PLATE 1A

2


Water Level of Lake previous to flood of Aug 1955 = El. 98.5 = Proposed W
Ground Sluice Dam
Stream



GENERAL PLAN
Scale of 1"=30'

NOTE: THE SPILLWAY SHOWN HERE WAS REBUILT IN 1970 AND CAN BE SEEN ON PLATE 5

PLAN OF DAM AND APPURTENANT STRUCTURES
LAKE SWIFTWATER DAM

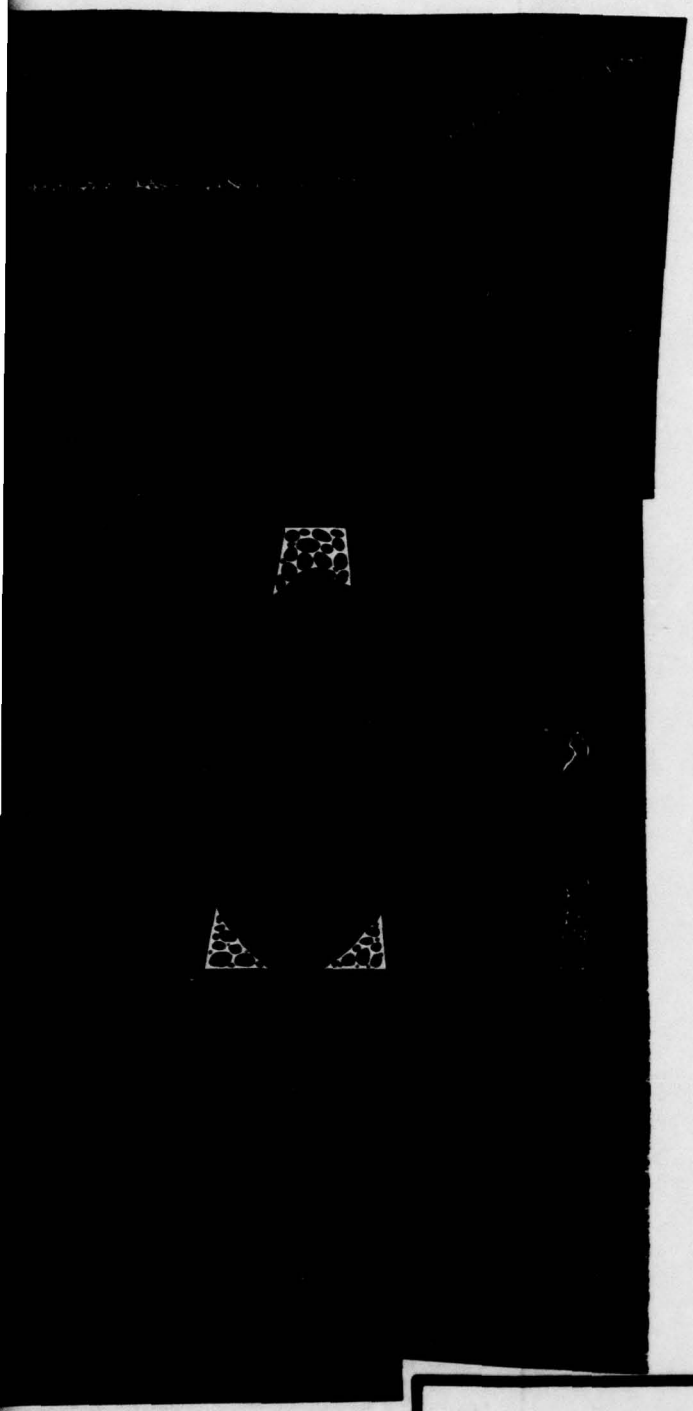
NAT. I.D.NO. PA.00776 **MONROE COUNTY**

DATA OBTAINED FROM EDWARD C. HESS, CIVIL ENGINEER STROUDSBURG, PA., DATED JAN 3, 1956

PLATE 2

-10

2



TYPICAL EMBANKMENT SECTION

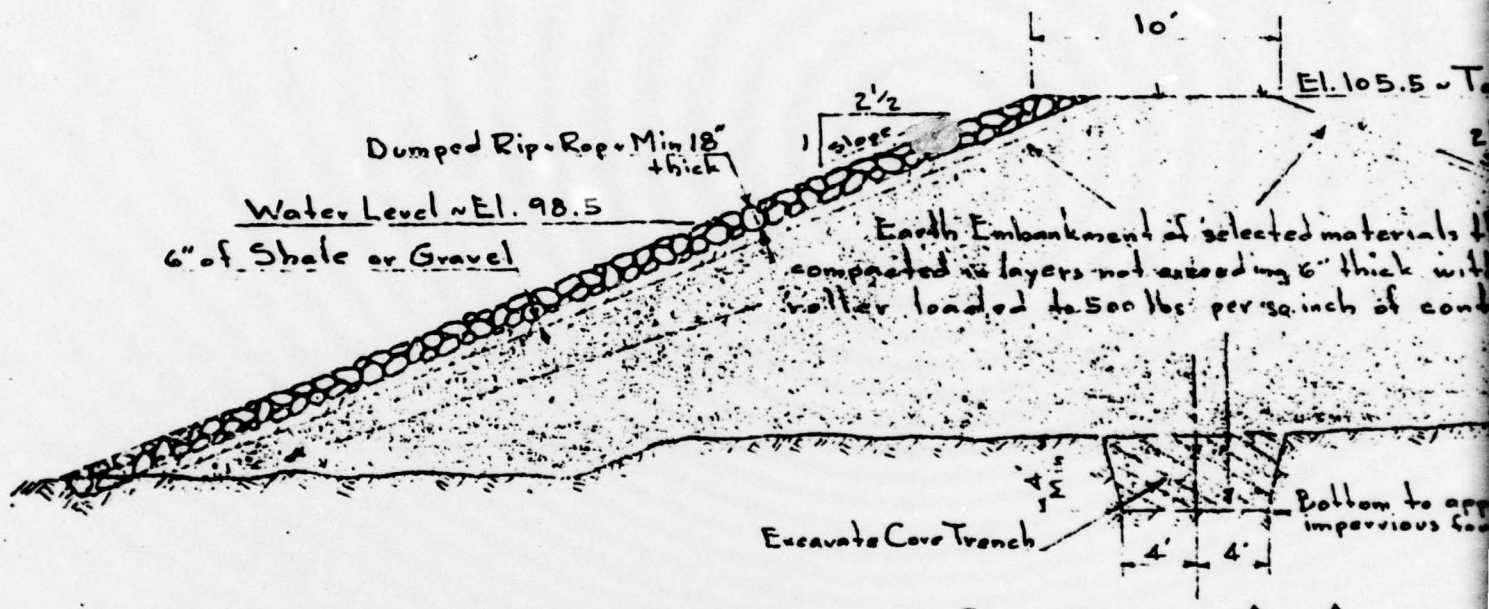
LAKE SWIFTWATER DAM

NAT. I.D.NO.PA.00776 **MONROE COUNTY**

DATA OBTAINED FROM GEORGE P. STOWITTS, CONSULTING ENGINEER,1020 TEMPLE BAR BUILDING, CINCINNATI, OHIO DATED APRIL 14,1928

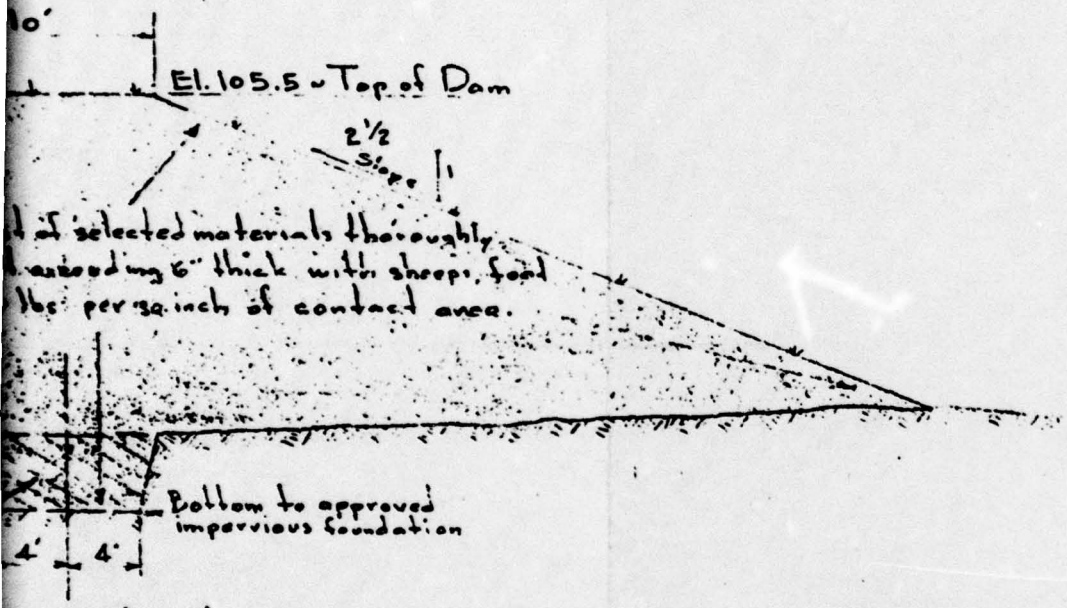
PLATE 3

2



SECTION A ~ A
Scale: ~ 1" = 10'

1



ON A & A
: ~ 1" = 10'

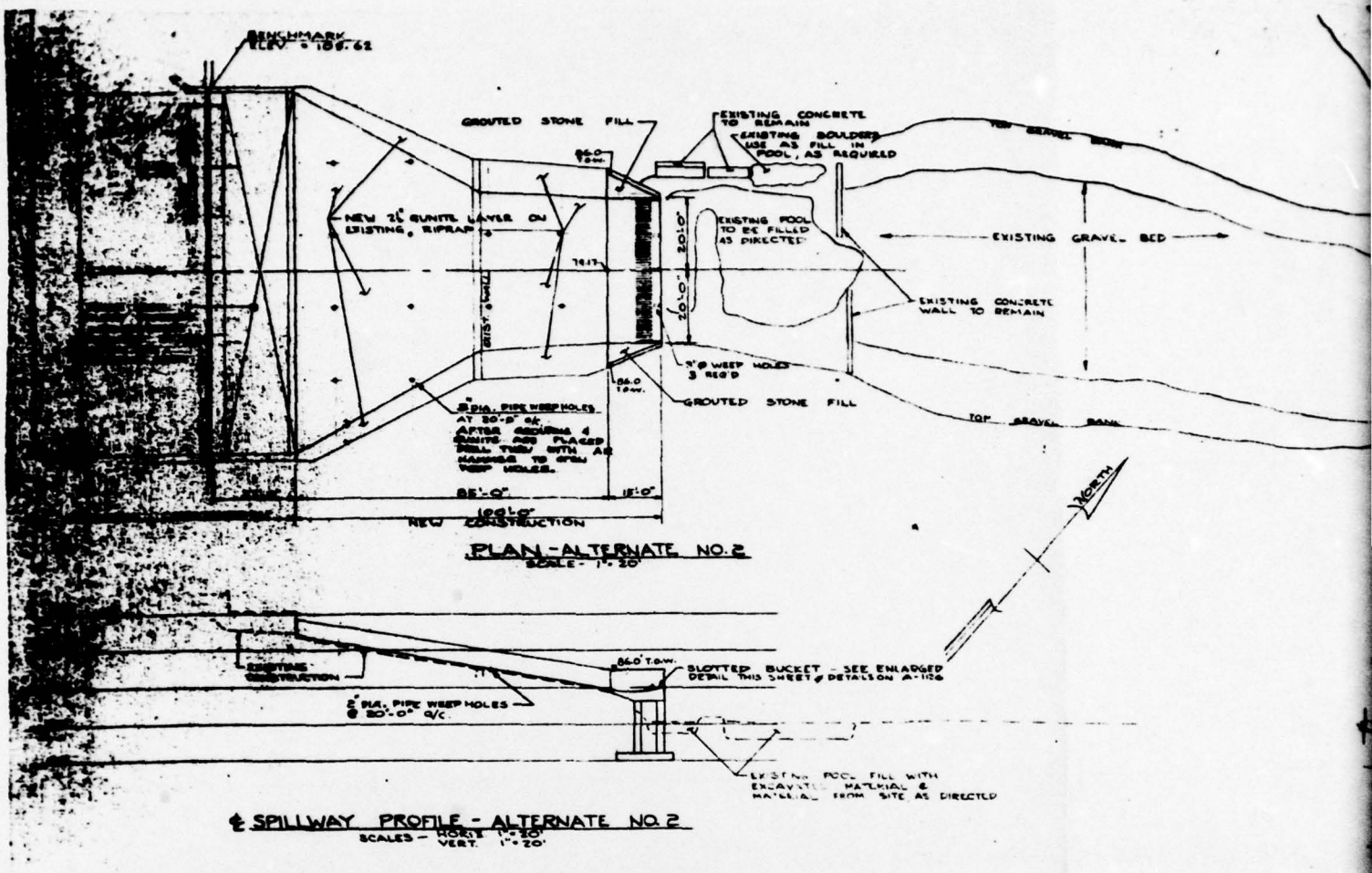
TYPICAL EMBANKMENT SECTION THROUGH OLD SPILLWAY LOCATION

LAKE SWIFTWATER DAM

NAT. I.D.NO.PA.00776 **MONROE COUNTY**

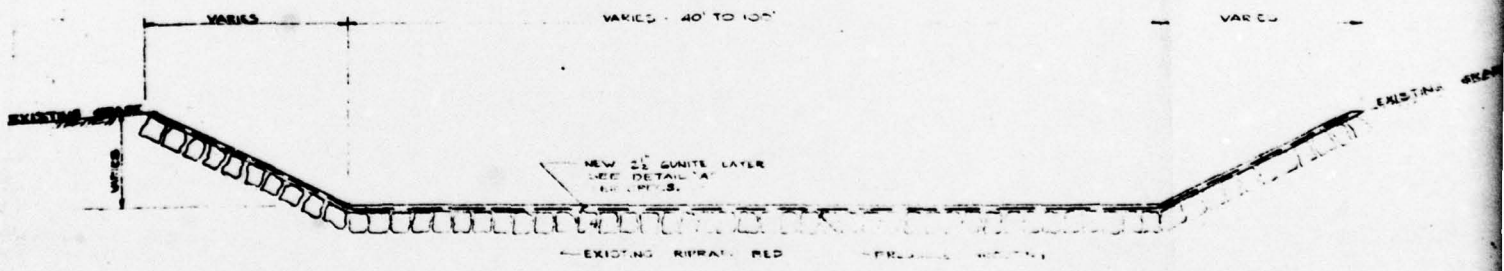
DATA OBTAINED FROM EDWARD C. HESS, CIVIL ENGINEER STROUDSBURG, PA., DATED JAN. 3, 1956

PLATE 4

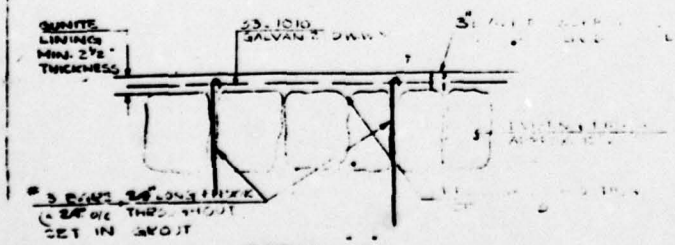


PLAN - ALTERNATE NO. 2
SCALE - 1" = 20'

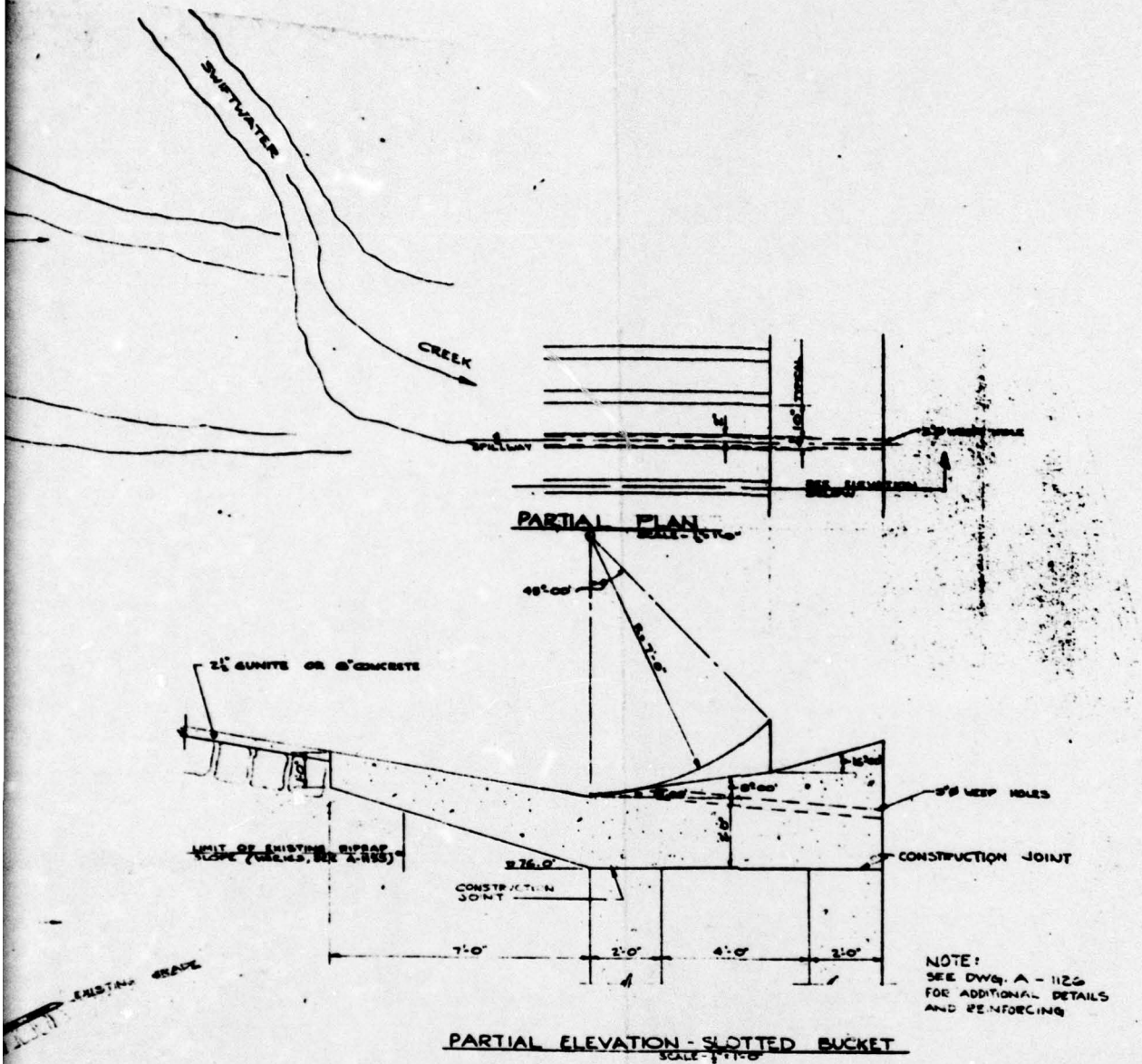
℄ SPILLWAY PROFILE - ALTERNATE NO. 2
SCALES - HORIZ. 1" = 20'
VERT. 1" = 20'



TYPICAL SPILLWAY CROSS-SECTION
ALTERNATE NO. 2



DETAIL A
ALTERNATE NO. 2



PARTIAL ELEVATION - SLOTTED BUCKET

ASTM A 615, GRADE 40.

TYPICAL PLAN AND PROFILE OF RECONSTRUCTED SPILLWAY

LAKE SWIFTWATER DAM

NAT. I.D.NO.PA.00776 **MONROE COUNTY**

DATA OBTAINED FROM HEIKKI K. ELO, CONSULTING ENGINEER, EASTON, PA., DATED JUNE 2, 1970

PLATE 5

2

APPENDIX

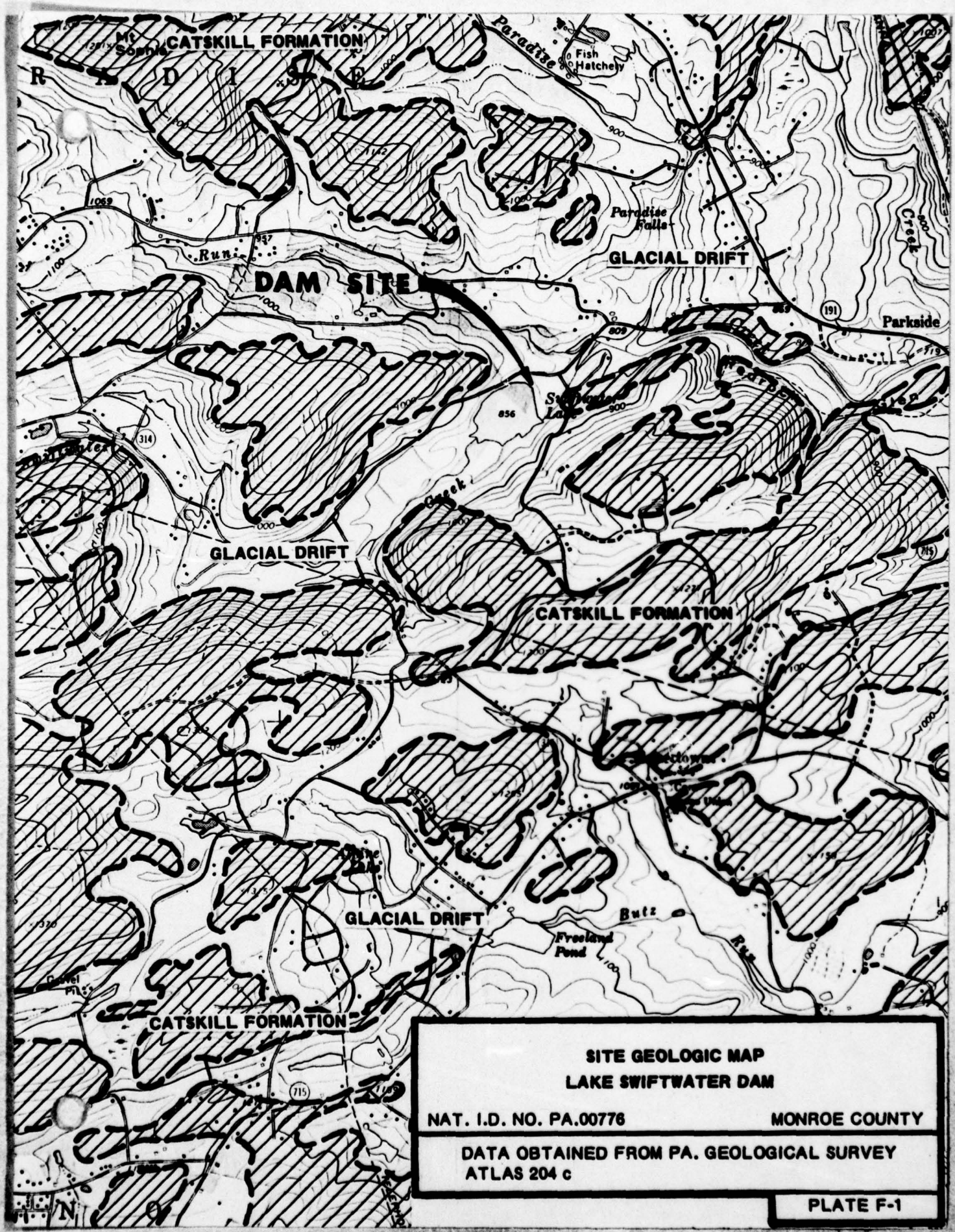
F

SITE GEOLOGY
LAKE SWIFTWATER DAM

Lake Swiftwater Dam is located in the Glaciated Low Plateaus Section (adjacent to the Pocono Plateau Section) of the Appalachian Plateaus Physiographic Province. As shown on Plate F-1, the dam site and surrounding region, as is much of northeastern Pennsylvania, is underlain by the Upper Devonian age Catskill Formation which is overlain by a mantle of Wisconsin age glacial drift.

No bedrock exposures were encountered during the field inspection. Information contained in the State of Pennsylvania, Department of Environmental Resources files indicates that the dam is founded upon "hardpan" consisting of glacial drift. As is typical for glacial deposits, seepage potential would be an inherent characteristic, particularly within the Swiftwater Creek channel area.

Seepage observed during the field inspection was located in the vicinity of the original spillway (left portion of dam) where a general marshy soil condition was encountered. Also, a pool of stagnant water was observed adjacent to the outlet conduit, but no indication of flow was observed.



SITE GEOLOGIC MAP

LAKE SWIFTWATER DAM

NAT. I.D. NO. PA.00776 MONROE COUNTY

DATA OBTAINED FROM PA. GEOLOGICAL SURVEY
ATLAS 204 c

PLATE F-1