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NATIONAL DAM INSPECTION PROGRAM. THORN RUN DAM, NDI NUMBER PA-2--ETC(U)
SEP 78 DACW31-78-C-0052

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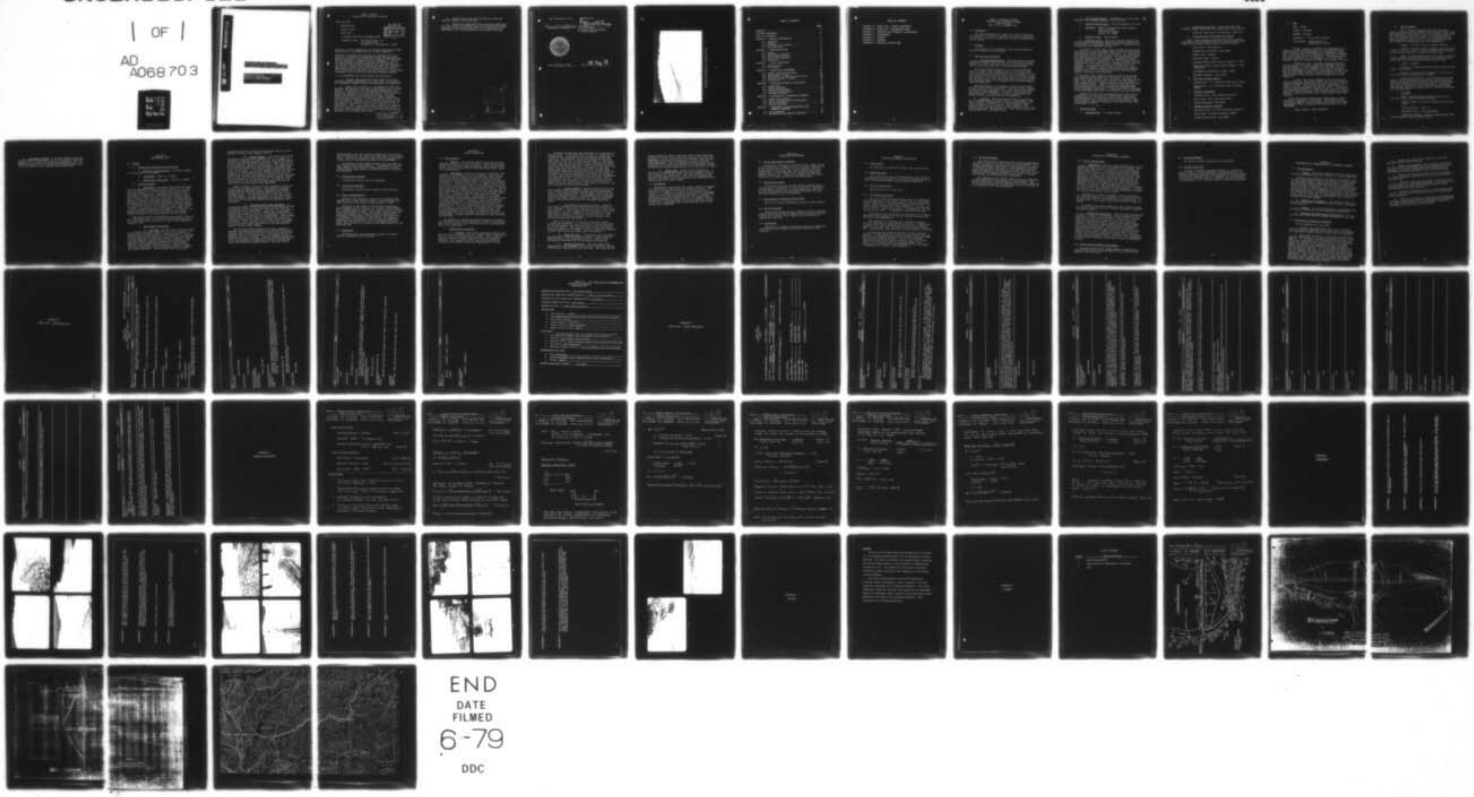

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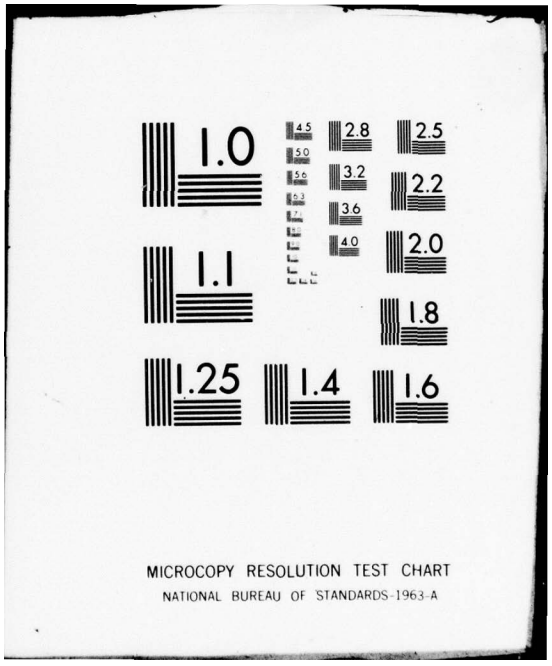
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Thorn Run Dam, NDI Number PA-271.
Ohio River Basin, Thorn Creek, Butler County,
Pennsylvania. Phase I Inspection Report.

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PHASE I REPORT
National Dam Inspection Program

Thorn Run Dam

Pennsylvania

Butler County

Thorn Run

31 August 1978 and 5 September 1978

Inspection Team - GAI Consultants, Inc.
570 Beatty Road
Monroeville, Pennsylvania 15146

Based on a visual inspection and available engineering data, the facility is considered to be in poor condition.

Hydraulic and hydrologic calculations indicate that the facility is capable of discharging and/or storing approximately 23 percent of the flow from a storm of PMF magnitude and the spillway is deemed seriously inadequate. Due to the questionable structural integrity of the spillway in its current deteriorated condition, the spillway inadequacy, and the poor access to the impoundment site, the overall deficiencies of the facility are of such a nature that, if left uncorrected, could result in the failure of the dam with subsequent loss of lives or substantial property damage.

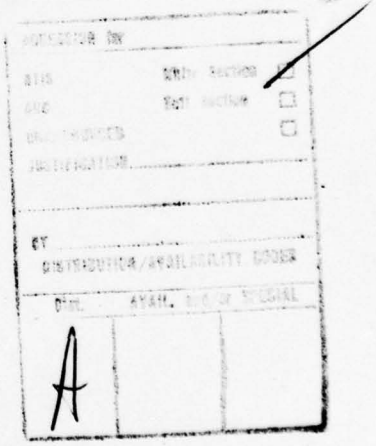
It is recommended that owner perform the following:

a. Maintain the operational pool level at 15 feet below the present embankment crest until the investigations and subsequent remedial repairs listed below are completed.

b. Retain the services of a registered professional engineer experienced in the design and construction of earth dams to: 1) perform a detailed hydraulic/hydrologic and structural investigation of the facility to more accurately assess the adequacy of the spillway system. The owner should then initiate any modifications and/or remedial measures deemed necessary to make the system hydraulically and structurally adequate; 2) investigate the source of the gas expulsion and seepage found at the area beyond the toe and evaluate its effect on the overall stability of the embankment. (Note: this investigation should be conducted with the reservoir temporarily at the normal pool level to determine other seepage areas which may exist downstream of the dam or on the downstream slope.)

c. Upgrade the access road to allow for safe and expedient access to the facility.

d. Regrade the embankment crest providing additional fill and riprap with bedding along the upstream slope where necessary to bring the dimensions of the embankment into conformance with the drawings for the original facility.



GAI Consultants, Inc.

Bernard M. Mihalcin, P.E.

Date 26 Sept 78

Approved by:

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

Date 28 Sep 78

OVERVIEW PHOTOGRAPH OF THORN RUN DAM

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
THORN RUN DAM
NDI# PA-271, PENNDER# 10-2

1.0 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.

1.1 Purpose.

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

1.2 Description of Project.

a. Dam and Appurtenances. Thorn Run Dam is an earth embankment approximately 660 feet in length with a maximum height of 39 feet. The facility has an uncontrolled concrete service spillway with a broad-crested entrance.

The outlet works consists of (1) a 24-inch diameter cast-iron supply pipe (formerly used as a blow-off line) with its inlet located upstream of the gate chamber and (2) a 20-inch diameter cast-iron supply line originating at the gate chamber. Both lines are valved within the gate chamber. The 24-inch line is also valved near the downstream toe of the embankment where it is equipped with a 12-inch diameter cast-iron blow-off.

The gate house is a rectangular concrete and masonry structure with inside dimensions 8 feet by 10 feet. Access to the gate house is provided by a foot bridge connected to the crest of the embankment. Located at the base of the downstream toe is a masonry structure formerly used as a pumping booster station which is now abandoned.

b. Location. Thorn Run Dam is located along Thorn Run in Oakland Township, Butler County, Pennsylvania. The City of Butler, Pennsylvania, is located approximately 3 miles southwest of the facility. Dam, reservoir, and watershed are contained within the East Butler U.S.G.S. 7.5 minute quadrangle (see Appendix G). The coordinates of the dam are N40° 53.7' and W79° 53.0'.

c. Size Classification. Intermediate (39 feet high, 1080 acre-feet storage capacity at top of dam).

d. Hazard Classification. High (see Section 3.1.c.5).

e. Ownership. Western Pennsylvania Water Company
Butler District
105 Lincoln Avenue
Butler, PA 16001

f. Purpose of Dam. Water supply.

g. Historical Data. Thorn Run Dam was designed and constructed by the American Waterworks Company (parent firm of the Western Pennsylvania Water Company). Construction of the facility was completed in 1903.

On August 29, 1903, heavy rains resulted in the breach and failure of nearby Boydstown Reservoir Dam located in the watershed adjoining Thorn Run to the north. As a result of this accident the spillway at Thorn Run Dam was reevaluated and found to be less than adequate. Correspondence available from PennDER files indicates the problem was one of constant concern over the years. In 1946, drawings for the modification of the spillway were submitted to the state for approval. At this point records are sketchy and it is difficult to ascertain what transpired relative to this proposal. It appears, however, that the original spillway remains intact at the project site and has not been subjected to any major modifications.

Periodic state inspection reports reveal the dam has been adequately maintained over the years. In fact, the majority of these reports state its general appearance to be good. The inspection reports, however, clearly document what appeared to be a steadily deteriorating condition relative to the concrete. Leaks at various locations along the spillway have also been observed but apparently were never considered significant. In addition, minor settlement of the embankment crest near the spillway was also mentioned.

Records indicate that consideration was given to the construction of a new facility around 1960. Subsurface investigations of the dam site and proposed borrow areas were performed, but construction was not undertaken. Thus, the facility in existence today is virtually the same one constructed in 1903.

1.3 Pertinent Data.

a. Drainage Area. 6.3 square miles.

b. Discharge at Dam Site. Daily discharge and reservoir level records are not available at this facility.

Discharge capacity of the spillway ≈ 1935 cfs.

c. Elevation (feet above mean sea level).

Note: The following elevations are based on field measurements and information obtained from the owner indicating the spillway crest to be at elevation 1054.5.

Top of Dam ≈ 1060 (Design).

Maximum Pool of Record - Not known.

Normal Pool ≈ 1054.5.

Spillway Crest ≈ 1054.5.

Upstream Portal Invert Outlet Conduits ≈ 1026.5.

Downstream Portal Invert Outlet Conduit ≈ 1020 (blow-off).

Streambed at Centerline of Dam ≈ 1022.

Maximum Tailwater - Not known.

d. Reservoir Length (miles).

Maximum Pool ≈ 1.5 (elevation 1060 Top of Dam).

Normal Pool ≈ 1.0 (elevation 1054.5 spillway crest).

e. Storage (acre-feet).

Spillway Crest ≈ 630 (elevation 1054.5).

Top of Dam ≈ 1018 (elevation 1060).

Design Surcharge - Not known.

f. Reservoir Surface (acres).

Spillway crest ≈ 49 acres (elevation 1054.5).

Top of Dam ≈ 92 acres (elevation 1060).

Maximum Design Pool - Not known.

g. Dam.

Type - Earth.

Length - 660 feet.

Height - 39 feet.

Top Width - 7 to 10 feet (varies).

Side Slopes - Upstream 2H:1V
Downstream 1-1/2H:1V

Zoning - Figure 3 indicates the embankment to be comprised of two zones separated by a concrete core wall located several feet downstream of the embankment centerline. The upstream zone is apparently composed of selected fill of not less than 30 percent clay. The drawings indicate the downstream zone is composed of a more pervious material; that is, a mixture of sods, sand, gravel and clay.

Impervious Core - Available drawings indicate a concrete core wall extends across the embankment and into both abutments. It was designed to be 24 inches thick at the top increasing to a thickness of 5 feet at its base. The maximum height of the wall is approximately 38 feet with the top reportedly located 5 feet below the crest and the base located 5 feet into the natural ground surface (see Figure 3).

Cutoff - The center section of the corewall was placed atop tongue and groove timber sheet piling, driven to refusual through 14 feet of gravel into "soapstone", "fireclay", and coal. The drawings indicate this sheetpile cutoff to be approximately 250 feet in length. The pilings are reportedly formed of 3 layers of heavy plank, 15 feet in length and spiked together. The ends were sharpened diagonally to a point and fitted with a steel shoe to facilitate driving.

Three clay puddle trenches were excavated to assist cutting off seepage along the base. These trenches were constructed parallel to the corewall and beneath the original ground surface covered by the upstream portion of the embankment.

Grout curtain - None indicated.

h. Outlet Conduit.

Type - 24-inch diameter cast-iron, low level supply line with intake located on the reservoir floor a few feet upstream of the tower. The line is valved at the tower and controlled from the gate house. A 12-inch diameter cast-iron blowoff pipe is valved at its connection to the 24-inch diameter supply line at a point approximately 40 feet beyond the downstream toe of the embankment.

Length ≈ 175 feet (inlet to blowoff outlet).

Closure - 24-inch diameter manually operated valve located at the gate house. 16-inch diameter "T" connection to the 24-inch line also valved at the gate house.

Type - 20-inch diameter cast-iron supply line with intake located within the gate tower. The line is valved within the tower and controlled from the gate house.

Length - Unknown.

Closure - 20-inch diameter manually operated valve within intake tower.

Access - Gate controls located on first floor of gate house and accessible by foot bridge.

Regulating Facilities - Flow through the 24-inch supply line is regulated by 24-inch and 16-inch diameter manually operated valves located at the base of the intake and controlled from within the gate house. In addition, flow can be regulated at the treatment plant downstream. Flow through the 20-inch supply line is similarly regulated by a 20-inch valve.

i. Spillway.

Type - Broad-crested concrete spillway with a multiple tiered concrete spillway channel.

Channel Length ≈ 270 feet (includes control section).

Crest Elevation ≈ 1054.5.

Upstream channel - Not applicable.

Downstream channel - Natural stream channel that winds through a heavily wooded valley.

j. Regulating Outlets. A 12-inch diameter cast-iron blowoff pipe is connected to the 24-inch diameter cast-iron supply line at a point just beyond the embankment toe. In addition, flow in the 20- and 24-inch diameter supply lines can be regulated at the treatment plant downstream.

SECTION 2
ENGINEERING DATA

2.1 Design.

a. Design Data Availability and Sources.

1. Hydrology and Hydraulics. No design reports or calculations are available.

2. Embankment. Same as 1 (above).

3. Appurtenant Structures. Same as 1 (above).

b. Design Features.

1. Embankment. Available design drawings indicate the embankment is constructed of earthfill. It consists primarily of two zones separated by a concrete core wall (see Section 1.3.g). The upstream portion of the embankment is indicated as selected fill composed of not less than 30 percent clay and containing no stones larger than 3 inches. The fill was to be placed in layers not in excess of 6 inches, wetted and compacted. The face of the upstream slope was to be paved with "tamped broken stone". The downstream portion of the embankment, as shown on Figure 3, consists of a mixed fill composed of sods, sand, gravel and clay. The material was to be adequately tamped and rolled to prevent significant settlement. In addition, the downstream face was to be covered with sod that would promote vegetation and protect against surface erosion.

The drawings show the embankment was designed with a 2H on 1V upstream slope, a 1.5H on 1V downstream slope, and a 12.5 foot wide crest (see Figures 2 and 3, note comments in Section 3.1.b).

2. Appurtenant Structures.

a) Spillway. The spillway at Thorn Run Dam is a concrete structure located at the right abutment. It was designed as a multi-tiered rectangular channel with a broad-crested control section at its entrance. The spillway entrance measures 50 feet wide, while the wingwalls extend 5.5 feet above the spillway crest (field measured). The drawings indicate concrete keys have been constructed at both ends of the approximately 270-foot long spillway channel. Also shown on the drawings is a small drainage canal that discharges into the spillway channel at a point just beyond the crest. This drainage canal reportedly

collects runoff from a dairy farm located along the right abutment hillside (see Figures 2 and 3).

b) Outlet Conduit. The outlet works shown on Figure 3 has since been modified and is no longer an accurate representation of the system. The original design called for a 24-inch diameter cast-iron blowoff pipe and a 20-inch diameter cast-iron service main. The lines were to be laid near the center of the embankment, surrounded with clay and constructed with concrete piers surrounding each joint (see Figure 3). When the system was modified (date of which is not known) the 24-inch diameter blowoff pipe was extended to the treatment plant and now also serves as a supply line. Blowoff and drawdown capabilities are provided by a 12-inch pipe connected to the 24-inch diameter supply line and valved at the downstream toe. In addition, the flow in the 20- and 24-inch diameter supply line can be regulated at the treatment plant downstream.

Figure 2 shows a booster station structure located at the base of the downstream toe. This masonry structure housed pumping equipment used to supplement the pumping capabilities of the water supply system located at the treatment plant. The booster station was not part of the original design. It was constructed in 1940, many years after the project had been completed and remained in operation until the system was modified and is presently non-functional.

c) Gate House and Intake Structure. A rectangular masonry intake structure and gate house has been constructed within the reservior near the toe of the upstream slope of the embankment. Access to the structure is provided by a steel truss foot bridge with a wood plank walkway connecting the tower to the embankment crest. The intake tower is divided into two compartments. The drawings indicate three 16-inch diameter intakes with inverts at elevations 5 feet, 16.3 feet, and 27 feet below the normal pool level. These intakes, each controlled by a separate 16-inch diameter valve, admit water to the upstream compartment of the intake chamber.

The original design called for a copper screen to separate the upstream compartment from the downstream compartment which contained the control valve for the 20-inch diameter inlet to the supply main. The downstream compartment was also to contain a 16-inch diameter intake and valve for draining the tower through a branch connection to the 24-inch diameter blowoff pipe. The 24-inch diameter valve controlling the blowoff conduit, the inlet end of

which projects into the reservoir beyond the intake tower, was also located in the downstream compartment of the intake tower. The 20-inch diameter supply main was equipped with a gate valve on the downstream side of the embankment.

The present outlet system utilizes only the lowest of the original three inlet portals. A representative of the water company stated that the upper two portals are kept closed and the lower portal is always open and in fact may be inoperable.

2.2 Construction Records.

Construction records are not available.

2.3 Operational Records.

Operational records are not kept for this facility.

2.4 Other Investigations.

Several state inspection reports are available from PennDER files. The earliest report is dated February 10, 1915, while the most recent is dated August 7, 1967.

Contained in the files of the Western Pennsylvania Water Company, Butler District, is a report titled "Report on an Investigation of Borrow Sites and Utilization of Soils for Proposed Thorn Run Dam." This report, dated August 22, 1960, was prepared by Pittsburgh Testing Laboratory of Pittsburgh, Pennsylvania, for the American Waterworks Service Company, Philadelphia, Pennsylvania. The apparent purpose of the investigation was to determine subsurface conditions, suitability of soils for prospective borrow areas, and utilization of soils in the construction of a new Thorn Run Dam.

2.5 Evaluation.

Sufficient data were available to make an accurate general assessment of the structure.

SECTION 3
VISUAL INSPECTION

3.1 Observations.

a. General. The general appearance of the facility suggests that it is in poor condition. Observations noted during the inspection indicate numerous deficiencies exist at the facility which require immediate maintenance, repair and investigation.

b. Embankment. Based on the visual inspection, the embankment is considered in fair condition. Deficiencies include evidence of erosion of the upstream slope; areas which lack adequate riprap protection; and differential settlement of the embankment crest. The riprap is composed primarily of sandstone referred to as "tamped broken stone" on Figure 3. Several bare areas are visible near the spillway at the right abutment and at the foot bridge to the gate house near the dam center (see Photographs 2 and 7). During the inspection the reservoir pool level was approximately 7 feet below normal pool exposing much of the upstream embankment face. It appears that in some areas the riprap is being washed down the slope. The possibility of slope erosion becomes increasingly evident when the upstream slope is viewed near the crest. The top 5 feet of the slope is virtually unprotected. Furthermore, measurements of the crest width indicate it varies between 7 to 10 feet as opposed to the 12.5 feet indicated by the contract drawings (see Figure 2). The variation is possibly due to erosion of the unprotected portions of the upstream slope. The vertical alignment of the crest, as indicated by field measurements, is quite irregular and exhibits several areas of settlement (maximum observed variation in crest elevation was one foot).

No evidence of seepage was observed emanating through the downstream face of the embankment; however, observations may not be conclusive due to the low level of the reservoir during the inspection.

c. Appurtenant Structures.

1. Spillway. The visual inspection revealed the spillway to be in poor condition. Severe concrete deterioration is visible throughout the structure. Large areas of spalling and scaling were observed along with extensive cracking. The alignment of the lower left wingwall was visibly off by several inches (see Photographs 9 and 10).

Although the spillway has reportedly not discharged in recent weeks, a significant pool of water is visible at its discharge end. According to the available drawings (see Figure 2), the discharge end of the spillway is designed such that a small pool is normally impounded in this area, apparently to act as a stilling basin. However, the amount of water observed at the time of inspection appeared to be excessive (see Photograph 10). Less than 20 feet beyond the pool a definite flow was observed indicating that some seepage was emanating from the pool area. A small seep (less than 5 GPM) was located directly behind and below the old booster station approximately level with the stream surface. Upon further examination of this seep, gas bubbles were observed issuing from below the water level. Upon re-examining the pool area at the end of the spillway, gas bubbles were also observed from several different areas within this pool (see Figure 1). The nature or origin of the gas could not be readily ascertained.

2. Outlet Conduit. The only portion of the low level conduit that could be inspected was the exposed section of the 12-inch diameter blowoff pipe located approximately 40 feet downstream of the embankment and to the left of the old booster station. Conversations with representatives of the owner present during the inspection indicate that the system and its valves are in proper operating order.

3. Gate House and Intake Structure. Based on the visual inspection, this appurtenance is considered in fair condition. No signs of masonry cracking or joint decay were evident. A foot bridge provides the only access to the gate house. The steel members of the bridge are in good condition and appear to have been painted recently. The wood deck of the bridge, however, is old, decayed, and a definite hazard (see Photograph 7).

Within the interior of the gate house, six manual controls were observed. As indicated previously only three of the controls are currently utilized in the operation of the outlet system. The condition of the valves associated with the controls is not known. They are reportedly operated several times a year as needed (see Photograph 8).

4. Reservoir Area. The general area surrounding the reservoir is characterized by moderate slopes that are heavily wooded (see Photographs 3 and 4). Much of the surrounding watershed area is developed agriculturally.

5. Downstream Channel. The area immediately downstream of the embankment is a thickly vegetated, heavily wooded valley approximately 500 feet wide. The slope of the

stream channel is gentle, while the valley side slopes are moderate to steep. At a point less than one mile from the embankment, an auto salvage yard is situated along the left embankment while several residences are found along the right embankment. All are considered sufficiently near the floodplain to be within the effects of an embankment breach. Therefore the hazard classification of the facility is "high".

6. Access Road. Access to the facility is gained via an unimproved narrow road that extends along the left side of the stream valley from the embankment to the auto salvage yard downstream. The route is approximately one mile in length, and is generally in poor condition being poorly graded and deeply rutted.

3.2 Evaluation.

Observations made during the visual inspection suggests that the overall condition of the facility is poor. This conclusion is based on a variety of deficiencies that include: 1) evidence of erosion of the upstream embankment slope; 2) a severely deteriorated spillway; 3) seepage and gas expulsion at the discharge end of the spillway and behind the abandoned booster station; 4) evidence of minor differential crest settlement; 5) lack of adequate riprap protection; 6) hazardous foot bridge decking; and 7) poor access road conditions.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Normal Operational Procedure.

According to the owner's representatives, there are no formal operational procedures for the facility. Normal pool is controlled by the spillway which discharges into the stream below. The manual gate valves which control flow through the low level conduits are reportedly operated several times a year. Water can be pumped into the watershed near its north end from the Allegheny River.

4.2 Maintenance of Dam.

The present condition of the facility suggests that little regular maintenance is being performed. Maintenance is apparently carried out on an infrequent basis and primarily includes mowing the embankment crest and toe area, and clearing debris from the spillway.

4.3 Maintenance of Operating Facilities.

There is no formal maintenance program at the facility.

4.4 Warning Systems.

There are no formal warning systems in effect; however, Western Pennsylvania Water Company has an emergency plan for maintaining a potable water supply that can readily be adapted for this use.

4.5 Evaluation.

The lack of a formal maintenance program has apparently contributed to the steadily declining condition of the facility.

SECTION 5
HYDROLOGIC/HYDRAULIC EVALUATION

5.1 Design Data.

No hydrologic or hydraulic design data are available.

5.2 Experience Data.

Data relative to the past performance of the facility is minimal and inconclusive. All observed appurtenances are intact indicating probable adequate past performance.

5.3 Visual Observations.

See Section 3.1.c.1 and 6.1.b.

5.4 Overtopping Potential.

The ratio "PMF Peak Flow/Drainage Area" was determined from an empirical curve supplied by the Corps of Engineers, Baltimore District. The curve used was the Ohio River Basin Curve. Based on this curve and a drainage area of 6.3 square miles, Peak PMF Q/A = 1670 cfs/sq. mi., and Peak PMF Q = 10,521 cfs. The size category is "intermediate" and the hazard rating "high". Consequently, the SDF is the PMF.

Calculations were performed to evaluate the overtopping potential using spillway and storage capacities during the PMF event (see Appendix C).

The spillway (as designed) has a maximum discharge capacity equivalent to approximately 1930 cfs. A comparison of peak inflow with maximum discharge shows the discharge capacity to be less than the peak inflow resulting from the PMF. Consequently, some additional storage volume is required.

Calculating the volume of storage available and comparing it to the volume of storage required reveals that the facility is incapable of discharging and/or storing the flow from a storm of PMF magnitude. In fact, the analysis indicates the dam will discharge and/or store only 23 percent of the flow from a storm of PMF magnitude. As a result, it is likely that the embankment will be overtopped if subjected to a storm of PMF intensity.

5.5 Spillway Adequacy.

The facility will discharge and/or store approximately 23 percent of the flow from a storm of PMF magnitude. As a result, overtopping and subsequent embankment failure would be expected during a PMF event. Since embankment failure would significantly increase the tailwater level and the potential hazard to life downstream of the facility, as compared to the anticipated condition just prior to failure, the spillway is deemed seriously inadequate.

The capacity of the outlet conduits was not considered in the evaluation of the adequacy of the spillway. The maximum additional discharge capacity that could be supplied by the outlets would not significantly affect the results of the analysis or the final conclusion.

SECTION 6
EVALUATION OF STRUCTURAL INTEGRITY

6.1 Visual Observations.

a. Embankment. Based on visual observations, the embankment appears to be in fair structural condition. The downstream slope has been constructed at an excessively steep slope 1.5H on 1V. In addition, available drawings show no indication of any drainage system within the embankment or at the toe to facilitate the relief of excess hydrostatic pressures and to protect against piping. The embankment also possesses several deficiencies that are detrimental to its overall stability. The width of the embankment crest, for example, is irregular and measures between 7 and 10 feet wide as opposed to 12.5 feet as originally designed. The upstream slope exhibited evidence of slope erosion and inadequate riprap protection. Seepage and gas emitting beyond the toe of the embankment are cause for concern and require further study.

Although no evidence of seepage could be detected on the downstream face of the embankment, it should be pointed out that the reservoir level during the inspection was approximately 7 feet below normal pool (12.5 feet below the crest).

In summary, the above conditions could possibly effect the overall stability of the structure and require immediate corrective action.

b. Appurtenant Structures. The only major appurtenant structure of which its structural integrity appears to be presently in doubt is the spillway. This opinion is based primarily on the conditions detailed in Section 3.1.C.1 which include severe cracking and spalling of concrete surfaces, clearly noticeable wingwall displacement and/or rotation, and possible seepage beneath the spillway under the current low pool level. The spillway has steadily deteriorated through the years and there is concern as to whether or not it would remain intact if subjected to the flows resulting from a significant flood event. Consequently, its condition presents a potential serious hazard to the overall stability of the facility in that instability of the spillway structure could lead to eventual embankment failure.

6.2 Design and Construction Techniques.

No actual design data, design reports, computations, construction reports or photographs were available for any aspect of this facility.

6.3 Past Performance.

No records of past performance are available.

6.4 Seismic Stability.

The dam is located in Seismic Zone No. 1. Since the static stability of the embankment is questionable, it is possible that the additional minor earthquake induced dynamic forces associated with Zone 1 earthquakes may be sufficient to lead to a stability failure. However, no calculations or investigations, etc., were performed to confirm this opinion.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS FOR REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The visual inspection and available engineering data suggest that the facility is in poor condition.

Hydraulic and hydrologic calculations performed as part of this investigation indicate the facility is only capable of discharging and/or storing approximately 23 percent of the flow from a storm of PMF magnitude and the spillway is deemed seriously inadequate. Due to the questionable structural integrity of the spillway in its current deteriorated condition, the spillway inadequacy, and the poor access to the impoundment site, the overall deficiencies of the facility are of such a nature that, if left uncorrected, could result in the failure of the dam with subsequent loss of lives or substantial property damage.

b. Adequacy of Information. The available data are considered sufficient to make an accurate Phase I assessment of the facility.

c. Urgency. It is suggested that the recommendations and studies indicated below be implemented immediately.

d. Necessity for Additional Investigations. The investigations listed below are deemed necessary at this time.

7.2 Recommendations/Remedial Measures.

It is recommended that the owner:

a. Maintain the operational pool level at 15 feet below the present embankment crest until the investigations and subsequent remedial repairs listed below are completed.

b. Retain the services of a registered professional engineer experienced in the design and construction of earth dams to: 1) perform a detailed hydraulic/hydrologic and structural investigation of the facility to more accurately assess the adequacy of the spillway system. The owner should then initiate any modifications and/or remedial measures deemed necessary to make the system hydraulically and structurally adequate. 2) Investigate the source of the gas expulsion and seepage found at the area beyond the toe and evaluate its effect on the overall stability of the embankment. (Note: this investigation should be conducted with the reservoir temporarily at the normal pool level to determine other seepage areas which may exist downstream of the dam or on the downstream slope.)

c. Upgrade the access road to allow for safe and expedient access to the facility.

d. Regrade the embankment crest providing additional fill and riprap with bedding along the upstream slope where necessary to bring the dimensions of the embankment into conformance with the drawings for the original facility.

e. Replace the foot bridge deck so as to eliminate its present hazardous condition and allow for safe access to the gate house.

f. Develop a formal warning system to allow for the safe evacuation of downstream inhabitants in the event of an unusually heavy rainfall and including round-the-clock surveillance during such periods.

g. Develop an operations manual clearly defining the function and functional controls of the outlet system and their locations.

h. Retain the services of a qualified registered professional engineer experienced in dam design and inspection to inspect the facility on an annual basis and report on hazardous conditions which might develop.

APPENDIX A

CHECK LIST - ENGINEERING DATA

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Thorn Run Dam

ID # NDI# PA-271, PennDER# 10-2

ITEM	REMARKS	SHEET 1
AS-BUILT DRAWINGS	Several drawings are contained in PennDER files. Duplicates are available from owner. Owner also has a recent contour map dated 1960.	
REGIONAL VICINITY MAP	U.S.G.S. 7.5 minute quadrangles East Butler and Mount Chestnut, PA.	
CONSTRUCTION HISTORY	Historical data available on microfiche contained in PennDER files.	
TYPICAL SECTIONS OF DAM	Figure 2, Appendix F	
OUTLETS - PLAN	Figures 1 and 2, Appendix F	
- DETAILS		
- DISCHARGE RATINGS		
RAINFALL/RESERVOIR RECORDS	Daily rainfall records are available at the treatment plant downstream. Reservoir records are not available.	

DESIGN REPORTS

None available.

GEOLOGY REPORTS

None available.

DESIGN COMPUTATIONS
HYDROLOGY & HYDRAULICS
DAM STABILITY
SEEPAGE STUDIES

None available.

MATERIALS INVESTIGATIONS
BORING RECORDS
LABORATORY
FIELD

A detailed subsurface investigation and analysis was performed by Pittsburgh Testing Laboratory of Pittsburgh, Pennsylvania the results of which are presented in a report titled "An Investigation of Borrow Sites and Utilization of Soils for Proposed Thorn Run Dam". The report is dated August 22, 1960.

POST-CONSTRUCTION SURVEYS OF DAM

Area contour map dated 1960 was put together as part of the above report and is available from the owner.

BORROW SOURCES

Not known.

ITEM	REMARKS	ID # PA-271	SHEET 3

MONITORING SYSTEMS

None

MODIFICATIONS

See Section 2.1.b.2.a.

HIGH POOL RECORDS

"Hurricane Hazel" (October 1954) resulted in the highest pool to date according to conversations with the owner's representatives. However, no data is available to substantiate the claim.

POST CONSTRUCTION ENGINEERING
STUDIES AND REPORTS

1960 study by PTL.

PRIOR ACCIDENTS OR FAILURE OF DAM
DESCRIPTION
REPORTS

Spillway was reportedly damaged during "Hazel" and subsequently repaired.

MAINTENANCE
OPERATION
RECORDS Work order records available from owner (major items only).

ITEM	REMARKS	ID # PA-271	SHEET 4

SPILLWAY PLAN

SECTIONS — Figures 1 and 2, Appendix F

DETAILS

OPERATING EQUIPMENT
PLANS & DETAILS

Figure 2, Appendix F

CHECK LIST ID # NDI# PA-271, PENNDER# 10-2
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 6.3 square miles.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): ≃ 1054.5 (630 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): Not known

ELEVATION MAXIMUM DESIGN POOL: Not known

ELEVATION TOP DAM: ≃ 1060 (1080 acre-feet)

SPILLWAY DATA:

a. Crest Elevation 1054.5
b. Type Rectangular concrete channel with broad-crested entrance
c. Weir Length 50 feet
d. Channel Length ≃ 275 feet
e. Location Spillover Right abutment
f. Number and Type of Gates None

OUTLET WORKS:

a. Type 20-inch diameter cast iron supply line; 24-inch diameter cast iron supply line equipped w/12-inch blow-off
b. Location Approximate center of dam
c. Entrance Inverts 1026.5 (24-inch supply line) (20-inch supply line
d. Exit Inverts 1020 (blow-off)
e. Emergency Draindown Facilities 12-inch diameter cast iron blow-off

HYDROMETEOROLOGICAL GAGES:

a. Type Rain gage
b. Location Treatment plant approximately 1 miles downstream
c. Records Daily

MAXIMUM NON-DAMAGING DISCHARGE: Not known

APPENDIX B

CHECK LIST - VISUAL INSPECTION

CHECK LIST
VISUAL INSPECTION
PHASE 1

DAM NAME Thorn Run Dam COUNTY Butler STATE Penna. ID # PA-271, PennDER# 10-2

TYPE OF DAM Earth HAZARD CATEGORY High

DATE(S) INSPECTION August 31, 1978 September 5, 1978 WEATHER Overcast, Rain Sunny, Clear TEMPERATURE 70° 80°

POOL ELEVATION AT TIME OF INSPECTION 1047.25 M.S.L. TAILWATER AT TIME OF INSPECTION 1022 ~ M.S.L.

INSPECTION PERSONNEL:

S.R. Machalski (GAI)
D.L. Bonk (GAI)
E.J. Mannella (GAI)
B.M. Mihalcin (GAI)
J.P. Nairn (GAI)

Bill McAdams (WPW)
Ray Black (WPW)
Al Reeder (WPW)
E.J. Manella RECORDER

EMBANKMENT ID# PA-271 Sheet 1

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	Apparent erosion of upstream face of the dam has caused a decrease in the width of the dam crest.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Surface of crest deviates from the vertical by as much as a foot. Horizontal alignment of the upstream face appears off because of erosion.	
RIPRAP FAILURES	The riprap layer is very thin in two (2) areas: 1) near the gate house 2) on the right abutment near the spillway. In addition, the top 5 feet of the upstream slope is unprotected without riprap. Consequently, this area appears to have the subject of some erosion which has decreased the once uniform crest width of 12.5 feet. Field measurements indicate the crest width to vary between 7 and 10 feet.	

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Good condition	
ANY NOTICEABLE SEEPAGE	No seepage through the downstream face of the embankment was observed. Although the spillway was not discharging during the inspection (reservoir level was approximately 7 feet below the spillway crest) a large pool of water is located at the stilling basin. Slight seepage was believed to be emanating from the stilling basin and beneath the rock below the pump house and at a point approximately 400 feet downstream. Gas was observed bubbling in the stilling basin pool and also behind the pump house.	
STAFF GAGE AND RECORDER	None observed	
DRAINS	None observed	

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None observed	
INTAKE STRUCTURE	Submerged	
OUTLET STRUCTURE	The discharge end of a 12-inch diameter cast-iron blow-off pipe was observed located approximately 20 feet to the left of the pump house situated just beyond the downstream embankment toe. The visible portion of the conduit is unobstructed and apparently in good condition. Also observed was the abandoned 20-inch diameter cast-iron supply line located adjacent to the pump house and to the right of the present blow-off.	
OUTLET CHANNEL	Natural stream channel characterized by loosely defined channel banks and areas of high grass and thick vegetation.	
EMERGENCY GATE	Not observed. Six manual gate controls are located in the gate house which is situated in the reservoir valley near the center of the embankment. The condition of gates could not be observed.	

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS

CONCRETE WEIR Rubble masonry broad-crested weir. Gunnite had apparently been applied to the surface of the weir years ago and has deteriorated steadily since then. Severe spalling, cracking and general concrete deterioration is evident over the entire spillway. Evidence of joint separation and wingwall misalignment were also observed.

APPROACH CHANNEL An unprotected, sloping earth approach was visible during the inspection due to the low pool level.

DISCHARGE CHANNEL (see "concrete weir" above)

Poor condition - spalling and cracking concrete
Some effervesence evident.
Horizontal alignment of the wingwalls deviates several inches and is particularly visible at the lower left side of the spillway channel.

BRIDGE AND PIERS

None

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	N/A	
APPROACH CHANNEL	N/A	
DISCHARGE CHANNEL	N/A	
BRIDGE AND PIERS	N/A	
GATES AND OPERATION EQUIPMENT	N/A	

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS		
None observed		
OBSERVATION WELLS		
None observed		
WEIRS		
None observed		
PIEZOMETERS		
None observed		
OTHERS		
None observed		

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	The area surrounding the reservoirs contains moderate slopes that are heavily wooded.	
SEDIMENTATION	Minimal, some evidence of minor sedimentation was observed along the exposed portion of the shoreline that was visible during the inspection due to the low pool level.	

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	The downstream channel is best described as a vegetated stream and consequently is somewhat obstructed. No manmade obstructions or debris were observed immediately beyond the embankment.	
SLOPES	The valley containing the stream bed is approximately 500 feet wide near the base and extends approximately 1 mile whereby Thorn Run converges with Connoquenessing Creek. The channel slope appears to be gentle as the stream winds between the thick woods and moderate to steep side slopes that characterize the valley.	
APPROXIMATE NO. OF HOMES AND POPULATION	Auto salvage yard and 3 or 4 residences located within 1 mile of the dam. Population - 8-12 persons	
Access Road	Situated along the left side of the downstream valley (looking downstream from the embankment) is a narrow dirt road which provides the only vehicular access to the embankment. The road is in generally poor condition. It is poorly graded, deeply rutted, and lined on both sides with thick overgrowth.	

APPENDIX C

HYDRAULICS/HYDROLOGY

SUBJECT DAM SAFETY INSPECTION
THORN RUN DAM

BY DLB DATE 9-7-78 PROJ. NO. 78-501-271

CHKD. BY EJM DATE 9-15-78 SHEET NO. 1 OF 9

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DAM STATISTICS

MAXIMUM HEIGHT ≅ 39 FEET (REF 1: pg 99)

DRAINAGE AREA ≅ 6.3 SQUARE MILES " "

STORAGE CAPACITY ≅ 630 AC-FT @ NORMAL POOL " "
1018 AC-FT @ TOP OF DAM (SHEET 5)

SIZE CLASSIFICATION

DAM SIZE - INTERMEDIATE (REF 2: TABLE 1)

HAZARD RATING - HIGH (FIELD OBSERVATION)

REQUIRED SDF - PMF (REF 2: TABLE 3)

REFERENCES

1 "DAMS, RESERVOIRS, AND NATURAL LAKES," WATER RESOURCES BULLETIN, BUREAU OF ENGINEERING, HARRISBURG (1970)

2 "RECOMMENDED GUIDELINES FOR SAFETY INSPECTION OF DAMS" DEPT. OF THE ARMY - OFFICE OF CHEIF ENGINEER, APPENDIX D

3 STANDARD HANDBOOK FOR CIVIL ENGINEERS, F. S. MERRITT, MCGRAW-HILL, INC., NEW YORK (1976)

4 "SIMULATION OF FLOW THROUGH BROAD CREST NAVIGATION DAMS WITH RADIAL GATES," R.W. SCHMITT, U.S. ARMY CORPS OF ENGINEERS, PITTSBURGH DISTRICT

SUBJECT DAM SAFETY INSPECTION
THORN RUN DAM

BY DLB DATE 9-7-78 PROJ. NO. 78-501-271

CHKD. BY EJM DATE 9-15-78 SHEET NO. 2 OF 9

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PMF (PEAK FLOW)/AREA = 1670 CFS/SQ. MI. (REF: C OF E CURVE, OHIO RIVER BASIN)

PMF = (1670 CFS/SQ. MI.)(6.3 SQ. MI.) = 10,521 CFS

PEAK PMF Q = 10,521 CFS = Q_{IMAX}

VOLUME OF INFLOW HYDROGRAPH

$V = \frac{1}{2}(Q_{IMAX})(TIME)$

DURATION TIME = 41.5 HRS (REF: C OF E CURVE, OHIO RIVER BASIN)

V = ½ (10,521 CFS)(41.5 HRS)(3600 SEC/HR)(1 ACRE/43,560 SQ. FT.)

= 18,042 AC-FT

DETERMINE THE AVERAGE RUNOFF REQUIRED TO PRODUCE THE ABOVE VOLUME OF INFLOW.

(18,042 AC-FT)(1 SQ. MI/640 ACRES)(12 IN/FT)/(6.3 SQ. MI.) = 53.7 INCHES

VOLUMES PRODUCED BY RUNOFF IN EXCESS OF 26 INCHES ARE TO BE RECALCULATED USING 26 INCHES AS AN UPPER BOUND

(26 INCHES)(6.3 SQ. MI.)(640 ACRES/SQ. MI.)(1 FT/12 IN) = 8736 AC-FT

VOLUME OF INFLOW (RECALCULATED) = 8736 AC-FT

SUBJECT DAM SAFETY INSPECTION
THORN RUN DAM

BY DLB DATE 9-7-78 PROJ. NO. 78-501-271

CHKD. BY EJM DATE 9-15-78 SHEET NO. 3 OF 9

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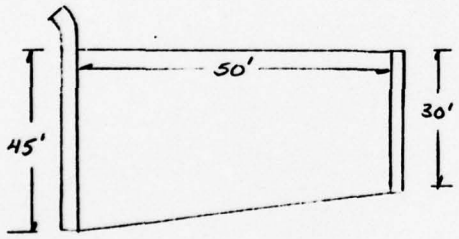
NOTE: $Q_{I_{MAX}}$ REMAINS CONSTANT.
DURATION TIME DECREASES IN ACCORDANCE WITH THE DECREASE IN INFLOW VOLUME.

$$\text{EQUIVALENT DURATION TIME} = \frac{(8736 \text{ AC-FT})(2)(43{,}560 \text{ SQ. FT/ACRE})}{(10{,}521 \text{ CFS})(3600 \text{ SEC/HR})}$$

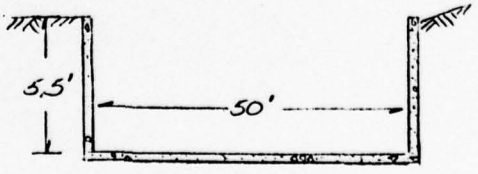
$$= 20.1 \text{ HRS}$$

SPILLWAY CAPACITY

BROAD-CRESTED WEIR



PLAN VIEW



VIEW AT SPILLWAY ENTRANCE

ASSUME ANY MINOR EMBANKMENT SETTLEMENTS TO BE RESTORED TO PROPER GRADE (MAXIMUM MEASURED SETTLEMENT EQUALS APPROXIMATELY ONE FOOT)

SUBJECT DAM SAFETY INSPECTION
THORN RUN DAM

BY DLB DATE 9-8-78 PROJ. NO. 78-501-271

CHKD. BY EJM DATE 9-15-78 SHEET NO. 4 OF 9

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$Q = C L H^{3/2}$ (REF 3, EQ 21-121)

L = LENGTH OF WEIR = 50 FT (SHEET 3)
H = MAXIMUM HEAD OVER SPILLWAY CREST = 5.5 FT "

BREADTH OF SPILLWAY = (30 TO 45) FT VARIES "
AVG. ≈ 37.5 FT "

C = COEFFICIENT OF DISCHARGE

(FROM REF 4; FIGURE 3)

$\frac{H \text{ GROSS HEAD}}{L \text{ BREADTH}} = \frac{5.5 \text{ FT}}{37.5 \text{ FT}} = 0.15$

$\therefore C = 3.0$

$Q = (3.0)(50)(5.5)^{3/2} = 1935 \text{ CFS}$

MAXIMUM DISCHARGE (1935 CFS) < PEAK PMF Q (10,521 CFS)

SUBJECT DAM SAFETY INSPECTION
THORN RUN DAM

BY DLB DATE 9-8-78 PROJ. NO. 78-501-271

CHKD. BY EJM DATE 9-15-78 SHEET NO. 5 OF 9

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CONSIDER INFLOW RELATIVE TO BOTH OUTFLOW AND STORAGE USING THE SHORT CUT METHOD AS RECOMMENDED BY NAD.

$P = \frac{\text{MAXIMUM DISCHARGE}}{\text{PEAK PMF Q}} = \frac{1935 \text{ CFS}}{10,521 \text{ CFS}}$ (SHEET 4) (SHEET 2)

$P = 0.18$

$(1-P) = \frac{\text{REQUIRED RESERVOIR STORAGE}}{\text{INFLOW VOLUME}} = 0.82$

INFLOW VOLUME = 8736 AC-FT (SHEET 2)

REQUIRED STORAGE = (0.82)(8736 AC-FT)

= 7164 AC-FT

CALCULATE AVAILABLE STORAGE

RESERVOIR SURFACE (@ NORMAL POOL EL 1054.5) ≈ 49 ACRES (REF 1, PG 99)

RESERVOIR SURFACE (@ TOP OF DAM EL 1060) ≈ 92 ACRES (SEE NOTE BELOW)

STORAGE AVAILABLE ≈ (5.5 FT)[(92 + 49) ACRES/2] ≈ 388 ACRE-FEET

REQUIRED STORAGE (7164 AC-FT) > AVAILABLE STORAGE (388 AC-FT)

NOTE: PLANIMETERED FROM EAST BUTLER, PA., 7.5 MINUTE U.S.G.S. MAP (1972)

SUBJECT DAM SAFETY INSPECTION
THORN RUN DAM

BY DLB DATE 9-8-78 PROJ. NO. 78-501-271

CHKD. BY EJM DATE 9-15-78 SHEET NO. 6 OF 9

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ESTABLISH WHAT PERCENT PMF IS PASSED AND/OR CONTAINED BASED ON THE ASSUMPTIONS AND CRITERIA OF THE PREVIOUS FIVE PAGES

$$(1-P) = \frac{\text{AVAILABLE STORAGE}}{\text{INFLOW VOLUME}} = \frac{388 \text{ AC-FT}}{(\frac{1}{2})(Q_{IMAX})(20.1 \text{ HRS})(3600 \text{ SEC/HR})(1 \text{ AC}/43{,}560 \text{ FT}^2)}$$

$$P = \frac{\text{MAXIMUM DISCHARGE}}{\text{PEAK PMF Q}} = \frac{1935 \text{ CFS}}{Q_{IMAX}} \quad \text{(SHEET 4)}$$

$$\therefore 1 - \frac{1935}{Q_{IMAX}} = \frac{388}{0.83 Q_{IMAX}}$$

$$0.83 Q_{IMAX} - 1606 = 388$$

$$Q_{IMAX} = 2402 \text{ CFS}$$

PEAK PMF Q = 10,521 CFS

Q_{IMAX} = 22.8 % PEAK PMF Q

SUBJECT DAM SAFETY INSPECTION
THORN RUN DAM

BY DLB DATE 9-22-78 PROJ. NO. 78-501-271

CHKD. BY RMM DATE 9/27/78 SHEET NO. 7 OF 9

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CONSIDER THE OVERALL LOSS IN SPILLWAY EFFICIENCY DUE TO THE MEASURED CREST SETTLEMENT OF APPROXIMATELY 1 FOOT (SEE SHEET 3)

SPILLWAY CAPACITY (SEE SHEET 4)

$Q = CLH^{3/2}$

$L = 50\,FT$

$H = (5.5\,FT - 1FT) = 4.5\,FT$

BREADTH OF SPILLWAY = (30 TO 45) FT VARIES
AVG. $\simeq 37.5\,FT$

(FROM REF 4; FIGURE 3)

$$\frac{H_{GROSS\ HEAD}}{L_{BREADTH}} = \frac{4.5\,FT}{37.5\,FT} = 0.12$$

$\therefore \quad C = 3.0$

$Q = (3.0)(50)(4.5)^{3/2} = 1432\,CFS$

MAXIMUM DISCHARGE (1432 CFS) < PEAK PMF Q (10,521 CFS)

SUBJECT DAM SAFETY INSPECTION
THORN RUN DAM

BY DLB DATE 9-22-78 PROJ. NO. 78-501-771

CHKD. BY BMM DATE 9/27/78 SHEET NO. 8 OF 9

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CONSIDER INFLOW RELATIVE TO BOTH OUTFLOW AND STORAGE USING THE SHORT CUT METHOD AS RECOMMENDED BY NAD

$$P = \frac{\text{MAXIMUM DISCHARGE}}{\text{PEAK PMF Q}} = \frac{1432 \text{ CFS}}{10,521 \text{ CFS}}$$ (SHEET 7) (SHEET 2)

$P = 0.14$

$$(1-P) = \frac{\text{REQUIRED RESERVOIR STORAGE}}{\text{INFLOW VOLUME}} = 0.86$$

INFLOW VOLUME = 8736 AC-FT (SHEET 2)

REQUIRED STORAGE = (0.86)(8736 AC-FT)

= 7513 AC-FT

BASED ON COMPUTED STORAGE (SHEET 5) OF 388 AC-FT AT TOP OF DAM ELEVATION 1060, THE STORAGE AVAILABLE AT ELEVATION 1059 IS ESTIMATED TO APPROXIMATELY EQUAL 300 AC-FT

REQUIRED STORAGE (7513 AC-FT) > AVAILABLE STORAGE (300 AC-FT)

SUBJECT DAM SAFETY INSPECTION
THORN RUN DAM

BY DLB DATE 9-22-78 PROJ. NO. 78-501-271

CHKD. BY [illegible] DATE 9/27/78 SHEET NO. 9 OF 9

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ESTABLISH WHAT PERCENT PMF IS PASSED AND/OR CONTAINED BASED ON THE ASSUMPTIONS AND CRITERIA FROM PAGES 7 & 8

$$(1-P) = \frac{\text{AVAILABLE STORAGE}}{\text{INFLOW VOLUME}} = \frac{300 \text{ AC-FT}}{(\frac{1}{2})(Q_{IMAX})(20.1 \text{ HRS})(3600 \text{ SEC/HR})(1 \text{ AC}/43,560 \text{ FT}^2)}$$

$$P = \frac{\text{MAXIMUM DISCHARGE}}{\text{PEAK PMF Q}} = \frac{1432}{Q_{IMAX}} \quad \text{(SHEET 7)}$$

$$\therefore 1 - \frac{1432}{Q_{IMAX}} = \frac{300}{0.83 Q_{IMAX}}$$

$$0.83 Q_{IMAX} - 1189 = 300$$

$$Q_{IMAX} = 1794 \text{ CFS}$$

PEAK PMF Q = 10,521 CFS (SHEET 2)

Q_{IMAX} = 17 % PEAK PMF Q (CONSIDERING CREST SETTLEMENT)

Q_{IMAX} = 22.8% PEAK PMF Q (NEGLECTING CREST SETTLEMENT)
← (SHEET 6)

TOTAL LOSS OF EFFICIENCY = 5.8%

APPENDIX D

PHOTOGRAPHS

PHOTOGRAPH 1 This view is looking southeast along the crest and downstream slope of the embankment.

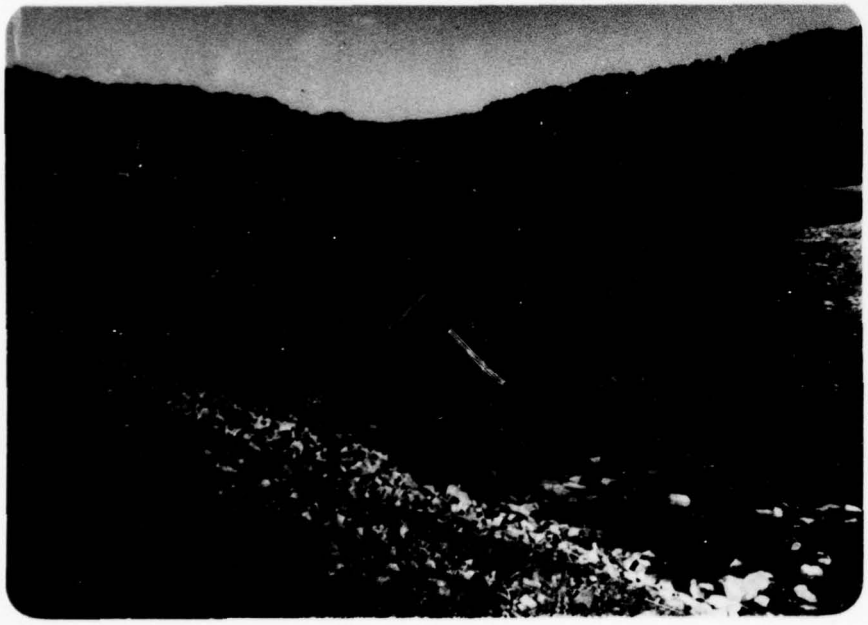
PHOTOGRAPH 2 View along the upstream slope of the embankment. The slope is undercut by wave action along the line of vegetation.

PHOTOGRAPH 3 This view is looking north across Thorn Reservoir.

PHOTOGRAPH 4 View of the embankment crest from the left abutment. Note gate house on the right and the abandoned pump house at the toe of the embankment.

1

2



3

4

PHOTOGRAPH 5 View of the downstream slope and toe area of the embankment from the left abutment. Note the spillway in the background on the right abutment. Note, also, the abandoned pump house just above center.

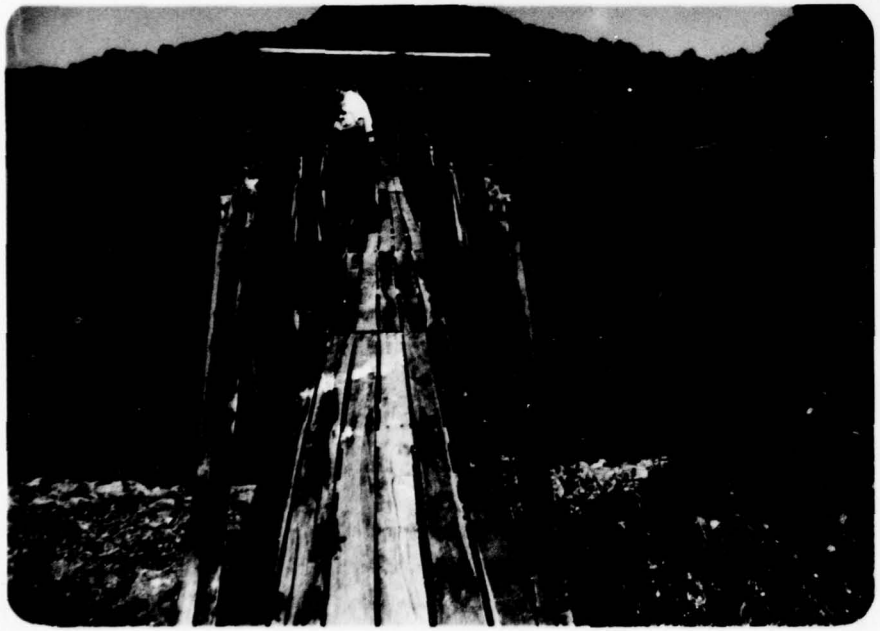
PHOTOGRAPH 6 Downstream toe area of the embankment. The vertical piping in the right middleground and center and left background are related to the operation of an underground gasoline storage tank used to fuel a pump in the now abandoned pump house (See Photograph 5).

PHOTOGRAPH 7 Plank bridge leading to the gate house.

PHOTOGRAPH 8 View of the interior of the gate house. The three floor stand valves in the background operate the intake gates. The three near valves operate supply and blowoff lines.

5

6



7

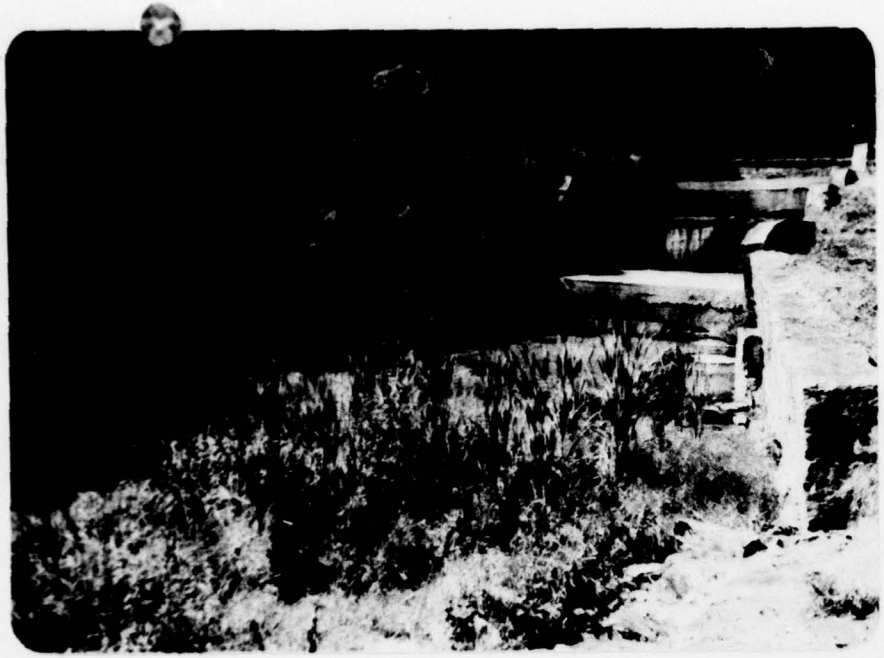
8

PHOTOGRAPH 9 Detailed view of the stilling basin and spillway in the right abutment. Note the wingwalls and spillway sidewalls are out of plumb at several locations.

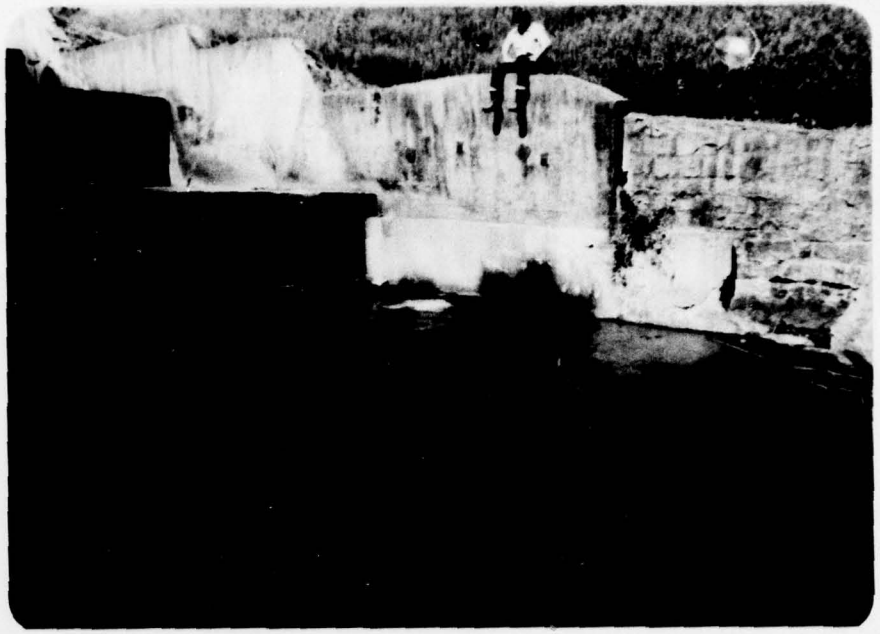
PHOTOGRAPH 10 Detail of the stilling basin. Water currently in the stilling basin is apparently derived from seepage beneath or around the spillway.

PHOTOGRAPH 11 This view shows the Thorn Run Channel immediately below the stilling basin. Note the moderate flow in the channel.

PHOTOGRAPH 12 View of the outlet end of the recently installed 12-inch blow-off line.



9



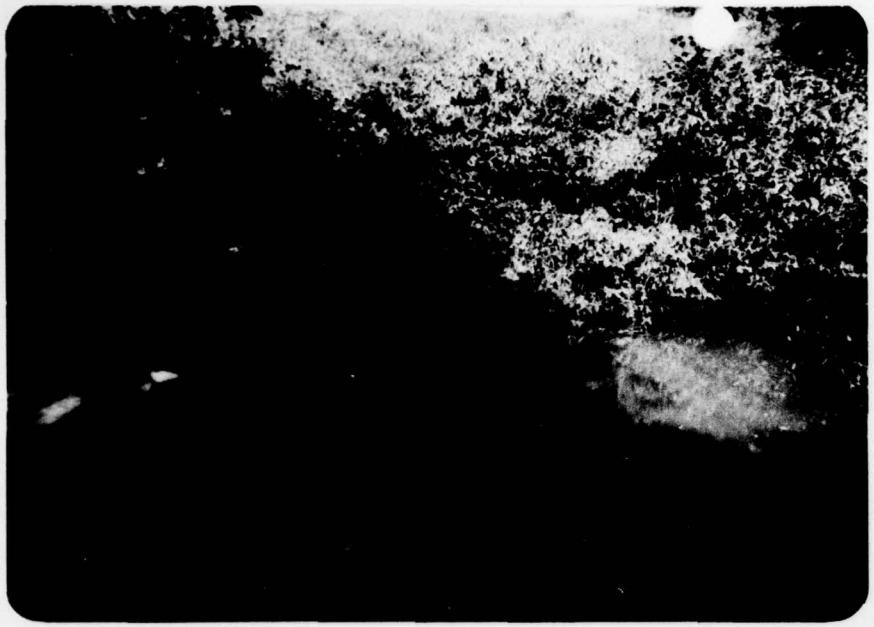
10

11

12

PHOTOGRAPH 13 This view shows the abandoned 20-inch blow-off, left of center, and the 12-inch blow-off just right of center near water level.

PHOTOGRAPH 14 This view is looking up the valley of Thorn Run from a point approximately 4,500 feet downstream of the embankment. In addition to the business on the right, several houses lie on the floodplain on the far side of the creek behind the trees just left of center. The bridge passing over Thorn Run on State Route 38 can be seen to the left of center.



13

14

APPENDIX E

GEOLOGY

GEOLOGY

The site of the Thorn River Dam and Reservoir is located in the Pittsburgh Plateau Section of the Appalachian Plateau Province. The dam and reservoir are located along a synclinal axis which plunges gently to the southwest at approximately 25 feet per mile. The bedrock at the dam site, therefore, consists of nearly horizontal beds dipping at a few degrees to the southwest.

The strata above reservoir pool and occupying the hilltops consist of sandstone, shale, limestone, thin coal seams and claystones of the Conemaugh Formation. The strata immediately below the reservoir and underlying the embankment consist of sandstone, shale, limestone and several potentially commercial coal beds of the Allegheny Formation. Both formations are of Pennsylvanian Age.

APPENDIX F

FIGURES

LIST OF FIGURES

SUBJECT THORN RUN DAM

BY SRM DATE 9/12/78 PROJ. NO. 78-501-271

CHKD. BY _____ DATE _____ SHEET NO. 1 OF 1

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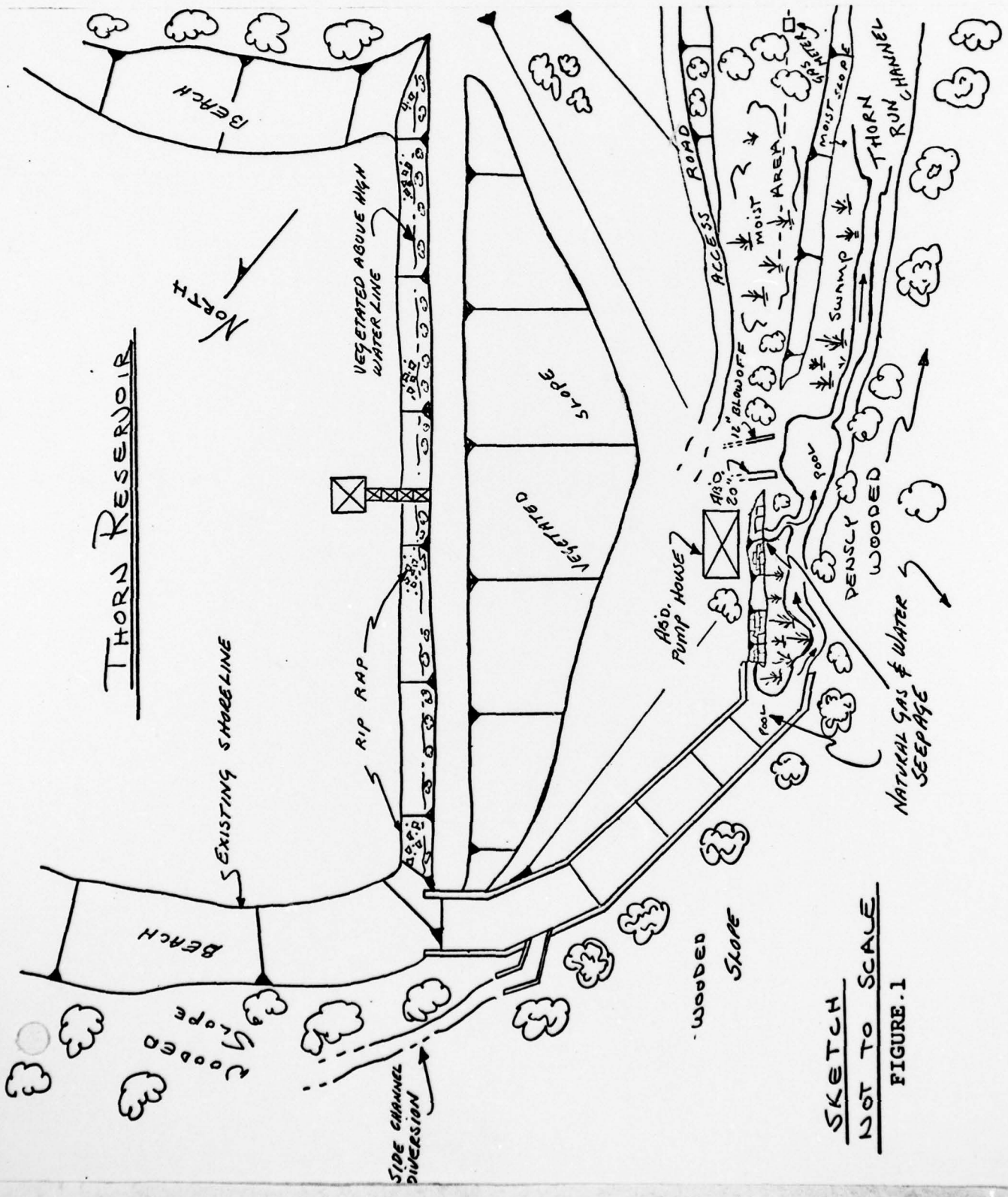
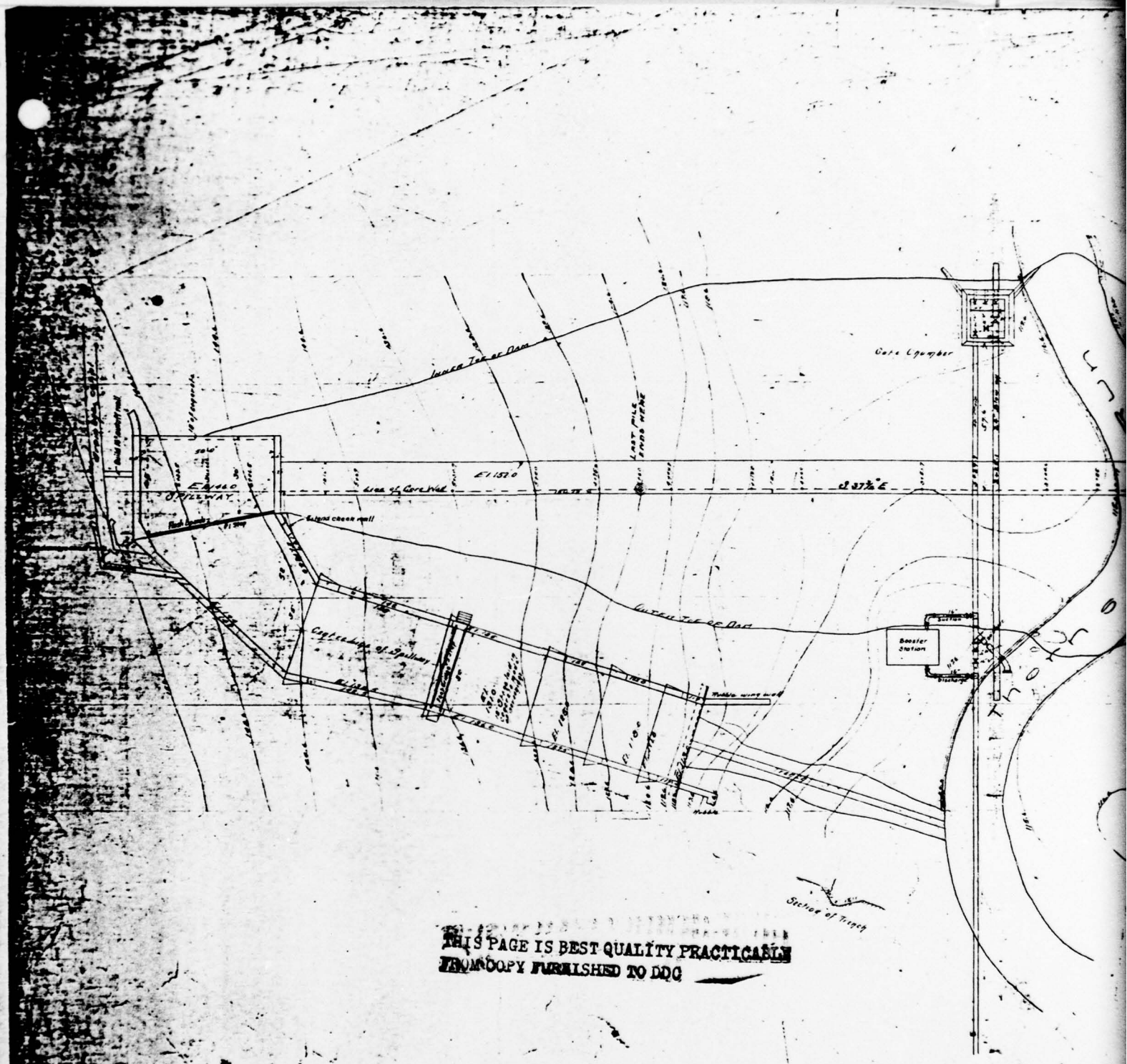


SKETCH
NOT TO SCALE

FIGURE. 1



Revised April 1, 1947 - Added Flash Boards, I.B.
Sept 19, 1949 - Repairs to Spillway, I.B.
Oct 6, 1960 - Added Booster Station and Footbridge, W.K.Y.

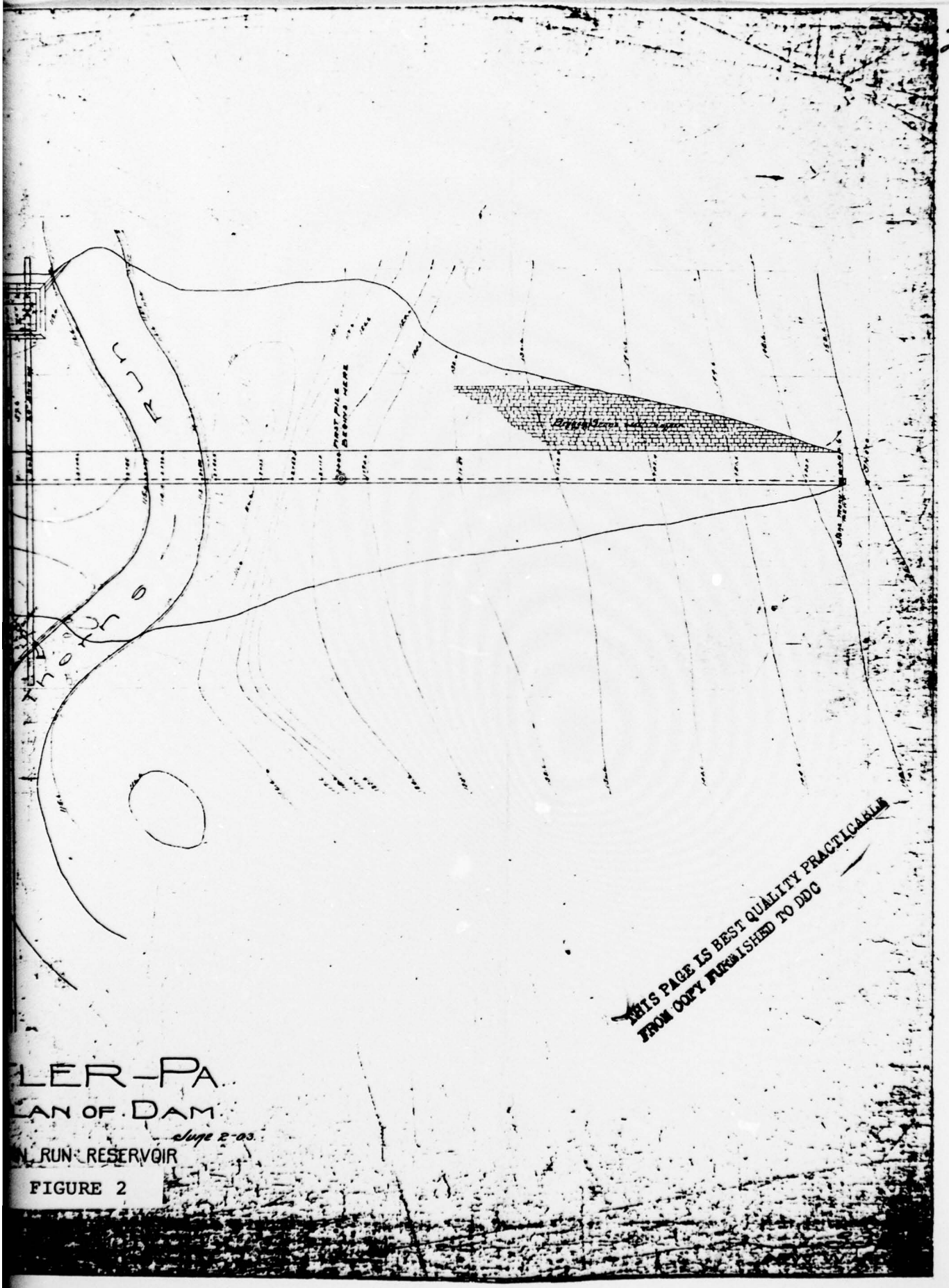
BUTLER

GEN. PLAN OF D

Scale 1" = 20'

THORN RUN RESERVE

FIGURE 2



LER-PA.

LAN OF DAM

Judge E-03.

N RUN RESERVOIR

FIGURE 2

FIGURE 3

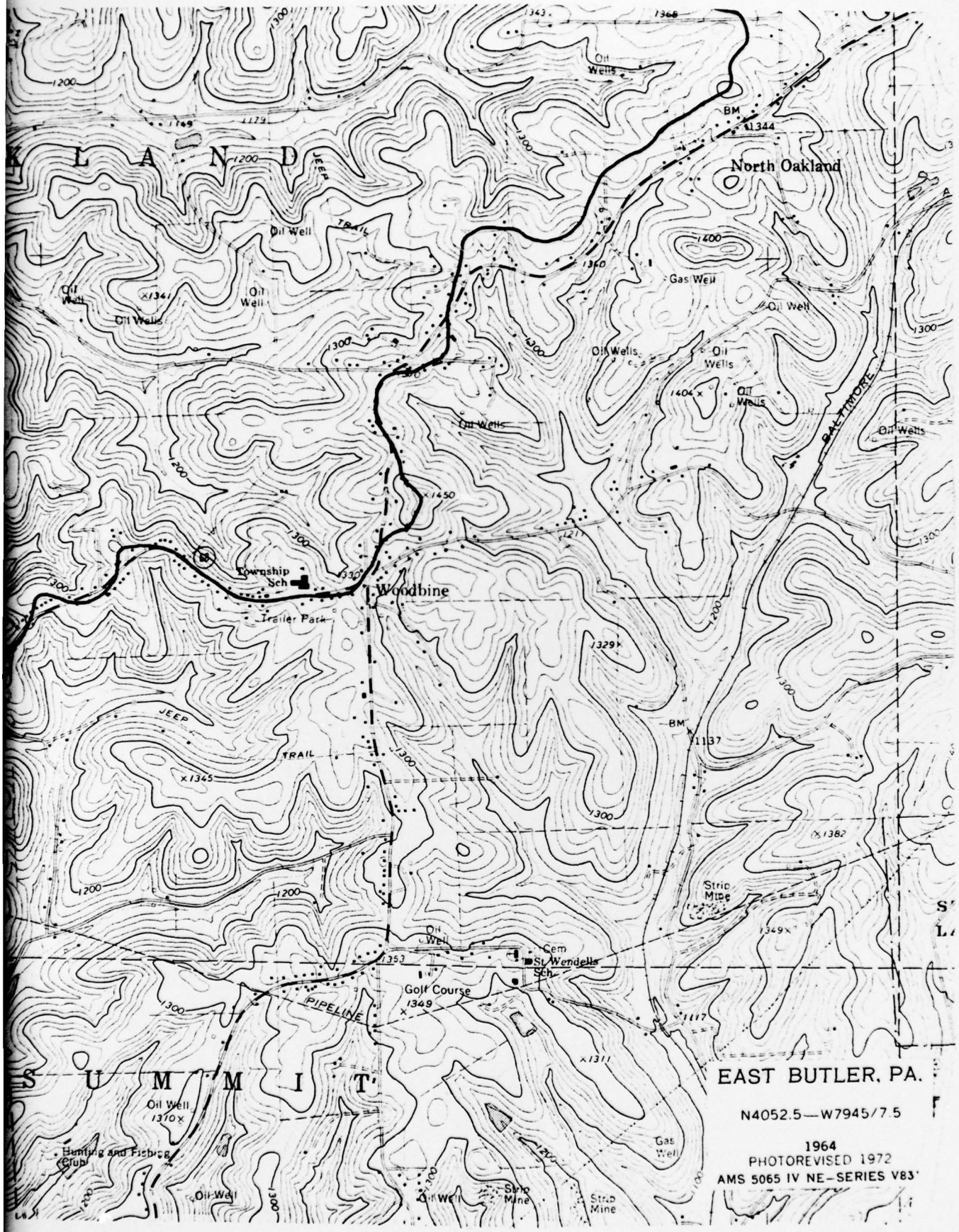
BUTLER PA.

DETAIL OF SPILLWAY AND DAM

Scale 1/4"=1'

Jul 22-03.


MOUNT CHESTNUT, PA.
N4052.5—W7952.5/7.5
1964
PHOTOREVISED 1972
AMS 5065 IV NW—SERIES V831
THORN RUN DAM
Oneida
Thorn Reservoir
Thorn Creek
East Butler
North Butler Ch. & Cem
Oil Wells
Strip Mine
Radio Tower
Drive-in Theater
BESSEMER AND LAKE ERIE
PIPE LINE
CORP
BOUNDARY
LAKE ERIE
Connoquenessing
SUMMIT
OAK


North Oakland
Woodbine
Township Sch
Trailer Park
Oil Wells
Gas Well
Oil Well
JEEP TRAIL
BALTIMORE
BM 1344
BM 1137
Strip Mine
Cem
St Wendelins Sch
Golf Course
1349
PIPELINE
Hunting and Fishing Club
S U M M I T
EAST BUTLER, PA.
N4052.5—W7945/7.5
1964
PHOTOREVISED 1972
AMS 5065 IV NE-SERIES V83