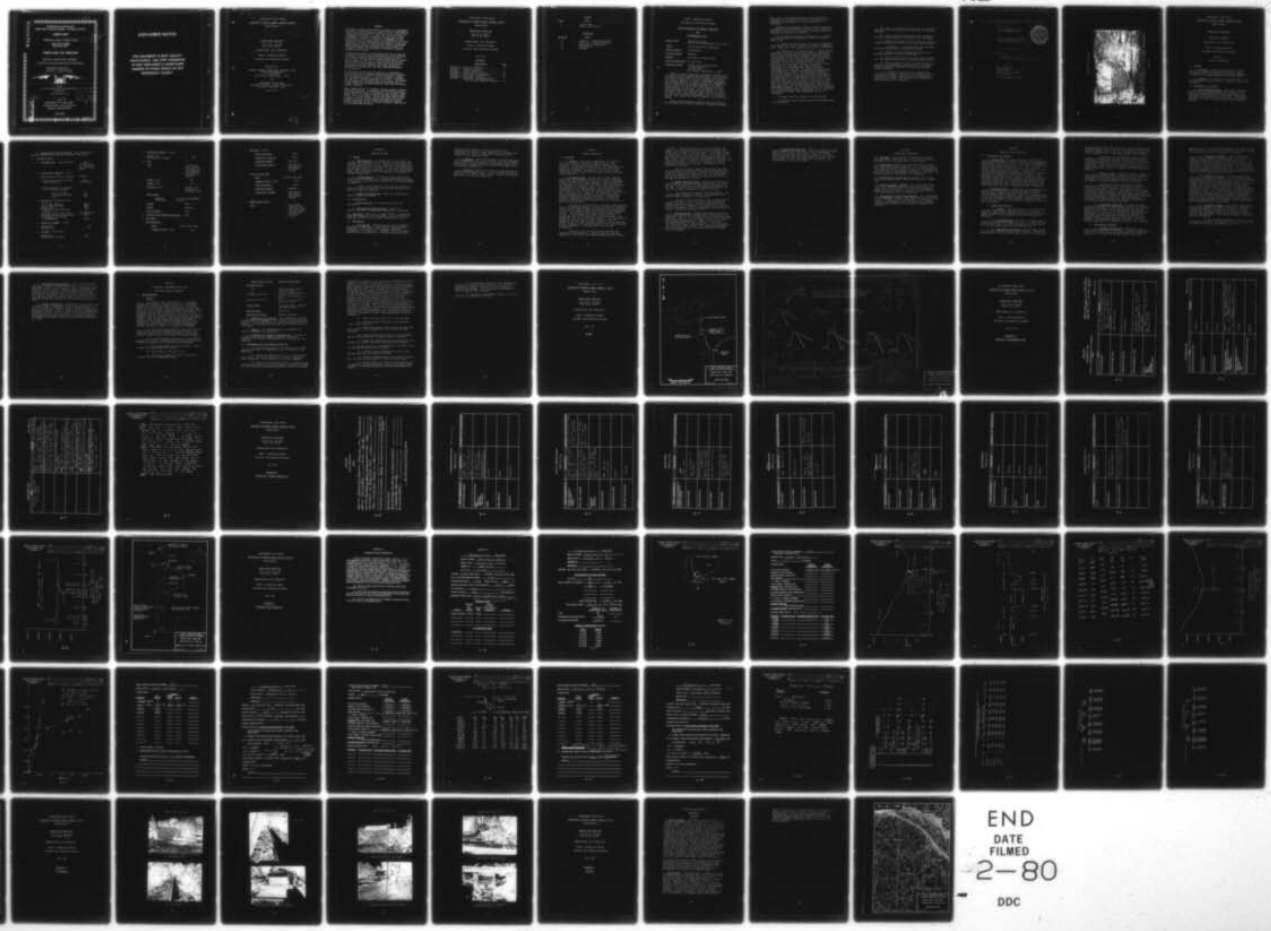
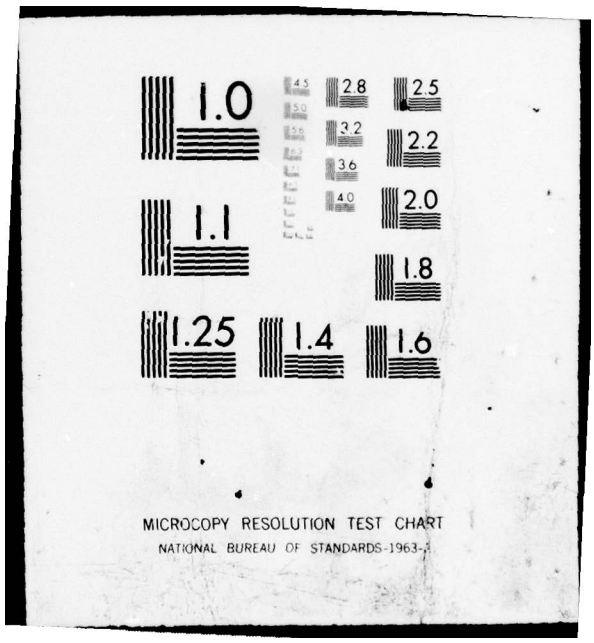
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TRIBUTARY TO BEAVER CREEK, WYOMING COUNTY

PENNSYLVANIA

WINOLA MILL POND DAM

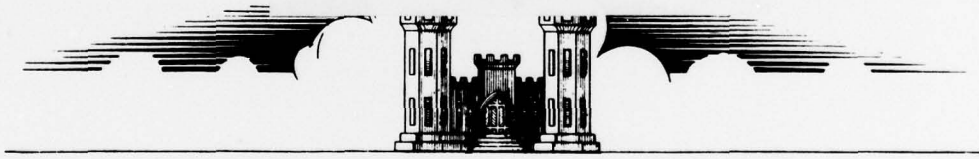
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NDI ID NO. PA-00893
DER ID NO. 66-35

PENNSYLVANIA FISH COMMISSION

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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Prepared by
GANNETT FLEMING CORDDRY AND CARPENTER, INC.
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WINOLA MILL POND DAM

NDI ID No. PA-00893
DER ID No. 66-35

PENNSYLVANIA FISH COMMISSION

(10) Frederick / Futchko

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

Prepared By

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Consulting Engineers
P.O. Box 1963
Harrisburg, Pennsylvania 17105

For

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 20203

July 1979

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PREFACE

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

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

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

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway 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.

SUSQUEHANNA RIVER BASIN

TRIBUTARY TO BEAVER CREEK, WYOMING COUNTY

PENNSYLVANIA

WINOLA MILL POND DAM

NDI NO. PA-00893
DER ID No. 66-35

PENNSYLVANIA FISH COMMISSION

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

JULY 1979

CONTENTS

Description	Page
SECTION 1 - Project Information	1
SECTION 2 - Engineering Data.	7
SECTION 3 - Visual Inspection	9
SECTION 4 - Operational Procedures.	12
SECTION 5 - Hydrology and Hydraulics.	13
SECTION 6 - Structural Stability.	16
SECTION 7 - Assessment, Recommendations, and Proposed Remedial Measures.	19

PLATES

Plate	Title
1	Location Map
2	Profile and Sections

APPENDICES

Appendix	Title
A	Checklist - Engineering Data.
B	Checklist - Visual Inspection.
C	Hydrology and Hydraulics.
D	Photographs.
E	Geology.

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT OF GENERAL CONDITION

AND

RECOMMENDED ACTION

Name of Dam:	Winola Mill Pond NDI ID No. PA-00893/DER ID No. 66-35
Owner:	Pennsylvania Fish Commission
State Located:	Pennsylvania
County Located:	Wyoming
Stream:	Tributary to Beaver Creek
Date of Inspection:	13 June 1979
Inspection Team:	Gannett Fleming Corddry and Carpenter, Inc. P.O. Box 1963 Harrisburg, Pennsylvania 17105

Based on visual inspection, available records, calculations and past operational performance, and according to criteria established for these studies, Winola Mill Pond Dam is judged to be unsafe, nonemergency, because the spillway capacity is rated as seriously inadequate. The existing walls of the main spillway will overtop at about 6 percent of the Probable Maximum Flood (PMF). Overtopping of the walls will cause erosion of the dry masonry section of the dam. It is estimated that the 15 percent PMF would cause sufficient erosion to cause the dam to fail. The initial surge from the failure of the dam would increase the hazard to loss of life downstream. As a whole, the dam is judged to be in fair condition.

Cracks have developed in the concrete liner wall on the upstream face of the dry masonry. Excessive leakage → over

and a hole in the upstream earthfill had previously developed and the repairs made to the structure do not eliminate the possibility of these conditions re-occurring.

Although a preliminary stability analysis indicates no apparent need for immediate concern, the theoretical stability of Winola Mill Pond Dam is unknown because the foundation conditions are unknown.

The following measures are recommended to be undertaken by the Owner, in approximate order of priority, immediately:

(1) Remove the debris from the toe of the dam and then inspect the dam for evidence of seepage, bulging and other conditions. Take appropriate action as necessary.

(2) Perform the following studies: A study to more accurately ascertain the spillway capacity required at Winola Mill Pond Dam and the measures required to make the spillway hydraulically adequate, with particular consideration of the elevation difference between Winola Mill Pond Dam and Lake Winola Dam as well as the hydraulic control for Lake Winola Dam; a study to determine the structural stability of Winola Mill Pond Dam, which, as a minimum, will require further investigation to determine the actual structural dimensions of the dam and the engineering properties of the foundation; a study to determine the potential of developing further holes in the upstream earthfill, which, as a minimum, will require further investigation to determine both the engineering properties of the upstream earthfill and the extent of the cracks in the concrete liner wall; and a study to determine the best means of providing an operational outlet works at the dam. Any active outlet works should have provision for upstream closure and any abandoned outlet works should be permanently plugged. All the studies should be performed by a professional engineer experienced in the design and construction of dams. Take appropriate action as necessary.

(3) Remove brush and trees on or near the dam.

(4) Provide erosion protection on the upstream slope of the earthfill.

(5) Remove the shelter near the main spillway and make repairs to the eroded area to the left of the main spillway.

(6) Replace the missing stones on the dry masonry dam and provide measures to prevent further vandalism.

(7) Repair the cracked concrete liner wall and the cracked and spalled concrete in the auxiliary spillway.

In addition, it is recommended that the Owner modify his operational procedures as follows:

(1) Develop a detailed emergency operation and warning system for Winola Mill Pond Dam.

(2) Provide round-the-clock surveillance of Winola Mill Pond Dam during periods of unusually heavy rains.

(3) When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency operation and warning system procedures.

(4) As presently required by the Commonwealth, institute a program of detailed annual inspections by a professional engineer experienced in the design and construction of dams. Use the results to determine if remedial measures are necessary.

(5) Institute a maintenance program to properly maintain all features of the dam.

Submitted by:

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.



FREDERICK FUTCHKO
Project Manager, Dam Section

Date: 7 August 1979

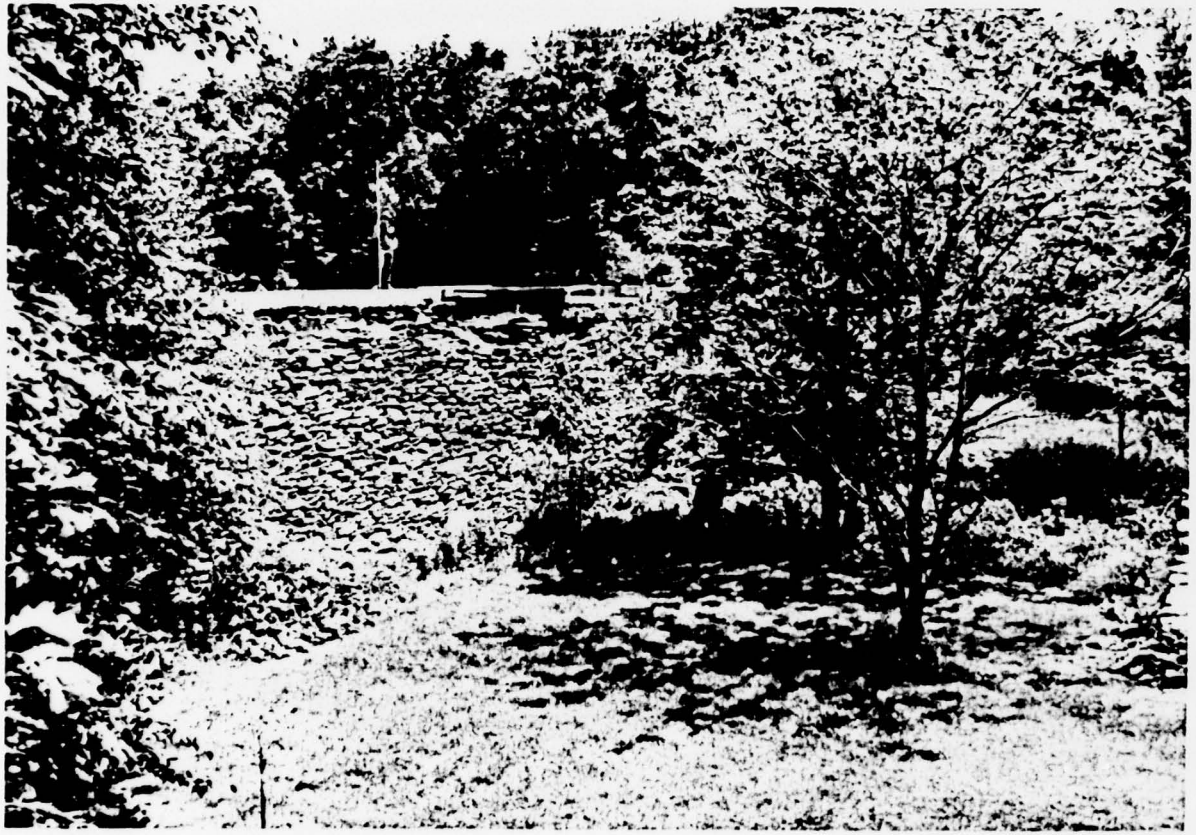
Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

DATE: 23 August 1979

WINOLA MILL POND DAM



Overview

SUSQUEHANNA RIVER BASIN

TRIBUTARY TO BEAVER CREEK, WYOMING COUNTY

PENNSYLVANIA

WINOLA MILL POND DAM

NDI ID No. PA-00893
DER ID No. 66-35

PENNSYLVANIA FISH COMMISSION

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

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. Winola Mill Pond Dam consists of a dry masonry section, a concrete liner wall along the upstream face of the dry masonry, and earthfill extending along the liner wall. The top of the earthfill is about 4 feet below the top of the dam. The dam is 275 feet long and 20 feet high at maximum section.

The dam contains a main spillway and an auxiliary spillway. The main spillway is a concrete ski-jump chute located near the middle of the dam. Its crest is 11 feet long and is 5 feet below the design top of the dam. The auxiliary spillway is also a concrete ski-jump chute. It is located to the right of the main spillway. Its crest is 17.5 feet long and is about 1 foot below the design top of the dam.

Two outlet works are provided at the dam. The first is located just to the right of the auxiliary spillway, and it consists of a 24-inch cast-iron pipe, whose downstream invert is about 8 feet above the toe of the dam. Its operating mechanism is not known. The second outlet works is located beneath the main spillway. It consists of two 10-inch diameter pipes with valves at the downstream toe. The various features of the dam are shown on the Plates at the end of the report and on the Photographs in Appendix D.

b. Location. The dam is located on a tributary to Beaver Creek approximately 7 miles southeast of Tunkhannock, Pennsylvania. Winola Mill Pond Dam is shown on USGS Quadrangle, Factoryville, Pennsylvania, with coordinates N41°30'20" -W75°50'30" in Wyoming County, Pennsylvania. Lake Winola, which is dammed by a separate structure, is 0.3 mile upstream of Winola Mill Pond Dam. The location map is shown on Plate 1.

c. Size Classification. Small (20 feet high, 61 acre-feet).

d. Hazard Classification. High hazard. Downstream conditions indicate that a high hazard classification is warranted for Winola Mill Pond Dam (Paragraph 5.1c(5)).

e. Ownership. Pennsylvania Fish Commission, Harrisburg, Pennsylvania.

f. Purpose of Dam. Contingency water supply for firefighting.

g. Design and Construction History. The early history of Winola Mill Pond Dam is unknown. The earliest record of the dam is in 1910, when plans were

prepared to provide a concrete liner wall on the upstream face of the dry masonry. Modifications to the upstream earthfill were also proposed at that time. These modifications were apparently made at that time. The dam was then owned by the Lake Winola Park Company. As the dam is termed "Mill Pond," it may have been a mill dam at one time. Other information suggests it was previously owned by the Northern Electric Railway Company, for an unknown purpose.

In 1919, the dam was briefly studied by the Pennsylvania Water Supply Commission. No recommendations were forthcoming from their study.

Sometime between 1930 and 1933, the dam was acquired by the Lake Winola Association. In 1933, the outlet of Lake Winola was excavated 3 feet deeper, which dropped the Lake level. This resulted in the level of Lake Winola being controlled by Winola Mill Pond Dam. Many arguments ensued concerning the proper level of Lake Winola, but they are not pertinent to this report.

In 1940, deterioration of Winola Mill Pond Dam became evident. At that time, the dam was leaking severely and the dry masonry had settled substantially. One inspector suspected undermining as the cause.

A "large" hole was noted in the upstream earthfill during a 1948 inspection. Winola Mill Pond Dam reservoir could not be maintained at spillway crest at that time because of leakage through the dam. Also, the outlet works gate had almost completely deteriorated.

By 1962, Winola Mill Pond Dam reservoir could not be maintained much above the level of the outlet works intake. In 1964, a new spillway, which is the existing main spillway, was constructed. Thus, the old spillway became the existing auxiliary spillway. Earthfill, upstream of the existing earthfill, was added at that time.

Winola Mill Pond Dam, as well as Lake Winola, was acquired by the Pennsylvania Fish Commission in 1969. Winola Mill Pond is not utilized by the Fish Commission for recreational purposes. It is utilized locally as an emergency water supply for firefighting.

h. Normal Operational Procedure. The reservoir is normally maintained at the main spillway crest level.

1.3 Pertinent Data.

a. Drainage Area. (square miles.) 1.9 of which 1.7 is controlled by Lake Winola Dam.

b. Discharge at Damsite. (cfs.)

Maximum known flood at damsite	Unknown
Outlet works at main spillway crest elevation	Not Operational
Spillway capacity at maximum pool elevation (design)	
Main spillway	330
Auxiliary spillway	55
Total	385

c. Elevation. (feet above msl.)

Top of dam (design)	998.1
Top of dam (existing)	997.4
Maximum pool	998.1
Normal pool (main spillway crest)	993.1
Upstream invert outlet works	Not Available
Downstream invert outlet works	985.3
Streambed at toe of dam (approximate)	978.0

d. Reservoir Length. (miles.)

Normal pool	.19
Maximum pool	.21

e. Storage. (acre-feet.)

Normal pool	32
Maximum pool (design)	61

f. Reservoir Surface. (acres.)

Normal pool	4.2
Maximum pool (design)	7.7

g. Dam.

Type	Dry Masonry with concrete liner wall on upstream face and earthfill upstream of liner.
Length (feet)	275
Height (feet)	20
Topwidth (feet)	Varies, about 18 feet at spillway crest
Side Slopes	
Upstream	1V on 2H (approximate)
Downstream	vertical
Zoning	None
Cutoff	Unknown
Grout Curtain	None

h. Diversion and Regulating Tunnel. None

i. Spillway.

Main Spillway

Type	Concrete Ski-Jump
Length of Weir (feet).	11.0

i. Spillway. (cont'd)

Crest Elevation	993.1
Side Wall Elevation	994.1
Upstream Channel	Reservoir
Downstream Channel	Overfall beyond dam to the natural stream.

Auxiliary Spillway

Type	Concrete Ski-Jump
Length of Weir (feet)	17.5
Crest Elevation	997.0
Upstream Channel	Reservoir
Downstream Channel	Overfall beyond dam to the natural stream.

j. Regulating Outlets.

Type	One 20-inch diameter cast-iron pipe (CIP) and two 10-inch diameter CIP. Not Operational.

SECTION 2

ENGINEERING DATA

2.1 Design.

a. Data Available. No design data are available for review. The earliest record of the dam is from 1910, when modifications were made to it. Except for one drawing for the 1910 modification, no design data are available for any of the modifications to the dam. In 1919, the Pennsylvania Water Supply Commission prepared a brief report on the dam. Other than a description of the features, it contains no further design data.

b. Design Features. The dam and appurtenances are described in Paragraph 1.2a. The design features are shown on the Plate at the end of the report and on the Photographs in Appendix D.

A profile and sections of the dam are on Plate 2. This plate does not show the existing main spillway, for which no plans are available.

c. Design Considerations. There are insufficient data to assess the design.

2.2. Construction.

a. Data Available. No construction data are available.

b. Construction Considerations. There are insufficient data to assess the construction of the dam.

2.3 Operation. There are no formal records of operation. Based on information in the records, all structures have performed satisfactorily, except as previously noted.

2.4 Evaluation.

a. Availability. Engineering data was provided by the Bureau of Dam Safety, Obstructions, and Storm Water Management, Department of Environmental Resources, Commonwealth of Pennsylvania (PennDER), and by the Owner, Pennsylvania Fish Commission. The Owner made available a

senior project engineer and the area manager for information during the visual inspection. The Owner also researched his files for additional information upon request of the inspection team.

b. Adequacy. The type and amount of design data and other engineering data is very limited, and the assessment must be based on the combination of available data, visual inspection, performance history, hydrologic assumptions, and hydraulic assumptions.

c. Validity. There is no reason to question the validity of the available data. It is not known from where the sections on Plate 2 were derived. They do not entirely agree with the existing conditions.

SECTION 3

VISUAL INSPECTION

3.1 Findings.

a. General. The overall appearance of the dam is fair, with some deficiencies as noted herein. The locations of deficiencies are shown in Appendix B on Plate B1. Survey data acquired during this inspection are presented in Appendix B. Difficulties with the survey datum are explained in Appendix B. On the day of the inspection, the pool was 0.1 foot above the main spillway crest elevation.

b. Dry Masonry Dam. The dry masonry dam, concrete liner wall, and upstream earthfill are in fair condition. Brush is growing along the earthfill at the left abutment. A small tree is at the right abutment. Small trees are also growing near the toe to the left of the main spillway. The earthfill is somewhat uneven at its top, and it is unprotected on the upstream side. The dry masonry is in good condition, but vandals have removed stones from the top of the structure. Stones of the structure, from 4 to 7 feet, vertically, are missing to the right of the main spillway downstream from the liner wall. Although some stones are apparently missing to the left of the main spillway, the area has been covered with soil, and tall grass is growing there.

The portion of the concrete liner wall that projects above the upstream earthfill is in fair condition. Numerous cracks, which extend through the concrete, also extend from the top of the concrete down to the earthfill and presumably beyond. The spacing of the cracks varies between 8 and 35 feet. The dry masonry has been removed from the downstream side of the liner wall in certain areas. This leaves the liner wall with little support. The liner wall is bulged and spalled over a 10-foot length at the left abutment. At the right abutment, the wall deflects upstream about 5 degrees; it is not known whether this deflection was planned or whether it occurred after the wall was constructed.

The area to the left of the main spillway has apparently been washed out. There is a 3-foot wide gap between the left side of the main spillway and the concrete

liner wall. Immediately downstream the dry masonry has eroded. At the downstream face of the dry masonry, the eroded area is about 10 feet wide and it is eroded to about 1 foot below the main spillway crest. To the right of the main spillway, a concrete block shelter was constructed against the concrete liner wall and dry masonry section. A hole, about 1 foot in diameter, was created in the liner wall side of the shelter. Access to the shelter is from an opening facing the main spillway. The purpose of this structure is unknown.

The toe of the dry masonry dam beneath the main and auxiliary spillways is covered with an extensive pile of debris, mostly old timber. The pile is 4 feet high in places and extends for a maximum of 50 feet downstream. The debris obscures the toe of the dam in this area. No seepage was observed at the dam.

c. Appurtenant Structures. The main spillway is in good condition. However, the walls are only 1 foot high. The tops of the walls are 4 feet below the design top of the dam. If these walls are overtopped, water would flow over the adjacent dry masonry section of the dam.

The auxiliary spillway is in fair condition. The upstream edge is spalled in areas. The right wall has cracks entirely through it at two places.

The outlet works with the 24-inch diameter CIP is in poor condition. A seep of about 1 gpm was observed flowing from the outfall. There is no evidence of an intake structure or operator. The outlet works with the two 10-inch diameter pipes is presumably buried beneath the debris. There is no evidence of it.

d. Reservoir Area. Access to the dam is via public roads, which extend both upstream and downstream from the reservoir. Most of the drainage area is controlled by Lake Winola Dam, which is a 3-foot high, 25-foot wide structure. The Lake Winola watershed is wooded, rolling hills with development around the lake. There is a road about 150 feet downstream of Lake Winola Dam. The road crosses the stream on a small bridge. The uncontrolled drainage area at Winola Mill Pond is wooded, rolling hills with minor development.

e. Downstream Conditions. There is a dwelling at the right abutment of the dam about 100 feet downstream. Its first floor is about 5 feet below the top of the dam. There is another dwelling, which is located at the bank of the stream, about 300 feet downstream of the dam. There are at least 13 other dwellings built adjacent to the stream within 1 mile of the dam.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedure. The reservoir is maintained at main spillway crest, Elevation 993.1, with excess inflow discharging over the spillway and into the stream.

4.2 Maintenance of Dam. The dam is visited at least twice monthly by the area manager, who is responsible for observing the general condition of the dam and appurtenant structures and for assessing any changes or deficiencies. The Owner does not make formal inspections of the dam. The brush and grass on the dam are cut infrequently.

4.3 Maintenance of Operating Facilities. The outlet works is not operational. There is no operator to maintain.

4.4 Warning Systems in Effect. The Owner stated that there is no emergency operation and warning plan. He stated that he was aware of the need for an emergency operation and warning plan, as he has prepared them for other dams owned by the Fish Commission.

4.5 Evaluation of Operational Adequacy. The maintenance of the embankment is poor. The outlet works is not operational. A formal annual inspection by a professional engineer is necessary so that the dam can be assessed by a professional engineer for potentially hazardous conditions.

SECTION 5

HYDROLOGY AND HYDRAULICS

5.1 Evaluation of Features

a. Design Data. The data available consist of an analysis of the original spillway design by the Pennsylvania Water Supply Commission in 1919. The Commission estimated the spillway design capacity at 45 cfs. For this study, the design capacity was estimated at 55 cfs and it is the capacity used for this report for the above spillway, which is the existing auxiliary spillway. In 1964, the Pennsylvania Department of Environmental Resources (PennDER) analyzed the recently constructed main spillway. They estimated the spillway design capacity at 406 cfs using a discharge coefficient of 3.3. Using a discharge coefficient of 2.7 for this report, the estimated main spillway design capacity is 330 cfs. Also included in this report is the discharge capacity of the 3-foot wide washout area to the left of the main spillway. Computations are in Appendix C.

b. Experience Data. A memorandum in the PennDER files, dated 1960, indicates that the dam had been overtopped several times. However, the dates and depths of the overtoppings were not indicated. There is no evidence that the top of the dam has been overtopped since the construction of the main spillway in 1964. However, judging by the erosion to the left of the spillway, the spillway walls have been overtopped.

c. Visual Observations.

(1) General. The visual inspection of Winola Mill Pond Dam, which is described in Section 3, resulted in a number of observations relevant to hydrology and hydraulics. These observations are evaluated herein for the various features.

(2) Dry Masonry Dam. As noted previously, the erosion to the left of the main spillway indicates that the main spillway walls have been overtopped. The low areas at the top of the dam reduce the spillway capacity.

(3) Appurtenant Structures. The low walls of the main spillway create a serious erosion hazard. Substantial overtopping of the walls would cause erosion of the dry ma-

sonry and probable failure of the dam. In the analysis described hereafter, the top of dam is assumed to be the top of the main spillway walls. The auxiliary spillway capacity is almost negligible, but it has been included in the analysis.

Conditions at the outlet works are of concern. Judging by the observed flow, the 24-inch diameter outlet works was not adequately plugged. No details are available for the upstream closure for this outlet works, which is not operational. There is no known upstream closure for the other outlet works, the valves of which are apparently buried beneath the debris. There is no means of drawing down the reservoir.

(4) Reservoir Area. Access to the dam is good. No conditions were observed in the reservoir area or watershed that might present significant hazard to the dam. The assessment of the dam is based on existing conditions, and the effects of future development are not considered.

Lake Winola Dam and the road and bridge immediately downstream will have a significant effect on the inflow to Winola Mill Pond Dam. The analysis that is included in Appendix C uses the two cross-sections surveyed on the day of the inspection. As high pools in Winola Mill Pond Dam may cause a backwater effect at Lake Winola Dam, and because the elevation difference between Winola Mill Pond Dam and Lake Winola Dam is uncertain, much more detailed topographic information and a more sophisticated analysis would be required in any further studies.

(5) Downstream Conditions. No conditions were observed downstream that might present significant hazard to Winola Mill Pond Dam. If the dam were to fail, the initial surge from the failure would significantly increase the hazard to loss of life at one or more dwellings immediately downstream. Floodflows would increase the hazards at dwellings further downstream, although the effects would dissipate fairly rapidly because of the small reservoir storage. The downstream conditions indicate that a high hazard classification is warranted for Winola Mill Pond Dam.

d. Overtopping Potential.

(1) Spillway Design Flood. According to the criteria established by the Office of the Chief of Engineers (OCE) for the size (Small) and hazard potential (High) of Winola Mill Pond Dam, the Spillway Design Flood (SDF) is

between one-half of the Probable Maximum Flood (PMF) and the PMF. Because of the sizeable downstream population, the PMF is selected as the SDF for Winola Mill Pond Dam.

(2) Description of Model. The watershed was modeled with the HEC-1DB computer program. The HEC-1DB computer program computes a PMF runoff hydrograph and routes the flows through both reservoirs and stream sections. In addition, it has the capability to simulate an overtopping dam failure. The PMF inflow to Lake Winola was determined and routed through Lake Winola Dam. The outflow was combined with the uncontrolled inflow to Winola Mill Pond and was then routed through Winola Mill Pond Dam. Identical methods were used for various percentages of the PMF.

(3) Summary of Results. Pertinent results are tabularized at the end of Appendix C. The analysis reveals that Winola Mill Pond Dam can pass about 6 percent of the PMF without overtopping of the main spillway walls. It is estimated that 1 foot of overtopping, or about 15 percent of the PMF, would cause failure of the dam. If the main spillway walls were raised to the top of the dam, the dam could pass 43 percent of the PMF without overtopping of the existing low area. If, in addition, the top of the dam were raised to its design elevation, the dam could pass about 56 percent of the PMF without overtopping. Raising of the main spillway walls would require a complete structural analysis of the U-frame main spillway. The above results are only approximate because of the effect of Lake Winola Dam, which was modelled with limited data.

(4) Spillway Adequacy. The criteria used to rate the spillway adequacy of a dam are described in Appendix C. Although the dam will not pass the 1/2 PMF, no further analysis was performed because it is estimated that the initial surge from dam failure will increase the hazard to loss of life downstream. The spillway capacity is rated as seriously inadequate.

If both the main spillway walls and the top of the dam were raised to the design top of dam elevation, the spillway capacity would be rated as inadequate.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations.

(1) General. The visual inspection of Winola Mill Pond Dam, which is described in Section 3, resulted in a number of observations relevant to structural stability. These observations are evaluated herein for various features.

(2) Dry Masonry Dam. Brush and trees on the upstream earthfill are undesirable. The lack of erosion protection on the earthfill is an erosion hazard. The removal of the stones on top of the dry masonry not only increases the probability that the dam will fail if it were overtopped, but their removal also adversely affects the structural stability. Where the stones have been removed beneath the concrete liner wall, the ability of this section to withstand a maximum reservoir load is questionable.

The cracks in the liner wall are of concern. If they extend beneath the earthfill, fines from the earthfill have the potential to pipe through the cracks into the coarse dry masonry. In view of both the hole that developed in the earthfill and the reported leakage before the 1964 modification, the situation has potential hazards. As there are no contraction or expansion joints, the cracks probably developed because of shrinkage and temperature fluctuations. As the dam has reportedly settled over 2 feet since 1919, this could also be a contributing cause for the cracks. The cause of the conditions at the liner wall adjacent to the abutments is unknown; the conditions could be an indication of movement of the dam. The shelter and associated hole in the liner wall allow water to flow through the dry masonry when the pool is substantially above main spillway crest. This is undesirable.

Although no seepage was observed at the dam, the debris at the toe of the dam made inspection of this area impossible. If there were seepage at the dam, it would normally be expected to outlet at the lowest area. Since there is debris at the lowest area, no conclusions about

seepage can be reached until the debris is removed. A bulge had previously been reported in the dry masonry. No evidence of it was observed. It may have been obscured by the debris.

(3) Appurtenant Structures. The cause of the cracks in the auxiliary spillway is similiar to the cause of cracking on the concrete liner wall. The outlet works is assessed in Section 5.

b. Design and Construction Data. As noted previously, there are no design or construction data. In 1919, the Pennsylvania Water Supply Commission analyzed the stability of the structure. Only the results are on file; the assumed loading conditions are not known, but is is surmised that the pool was assumed to be at spillway crest, which was one foot below the top of the dam. The analysis indicates that the resultant was at the middle third point with an acceptable factor of safety against sliding. The toe pressure was reported as being about 2.4 tons per square foot.

For this report another analysis was performed. The analysis used the following assumptions: Pool at the top of the dam, full hydrostatic head and at-rest earth pressures on the upstream face, tailwater at the toe of the dam, and uplift varying between full tailwater at the toe and full tailwater plus two thirds the difference between headwater and tailwater at the heel. For these loading conditions, the resultant is just outside the middle third, about 6.0 feet from the toe, and the factor of safety against sliding appears to be adequate. The toe pressure is about 2.0 tons per square foot. Assuming adequate foundation conditions, these are essentially within the OCE guideline for stability. However, the foundation conditions are unknown. Also, the sections shown on Plate 2 did not correlate exactly with the observed field conditions. In addition, no allowance was made in the analysis for the missing dry masonry stones. Although there is no apparent reason for immediate concern, the theoretical stability of the section must remain as unknown without further information.

c. Operating Records. The Owner has no formal records of operation. According to PennDER records, no stability problems, other than the previously noted hole in the earthfill and a possible bulge, have occurred over the operational history of the dam.

d. Post-Construction Changes. The post-construction addition of earthfill in 1964, upstream of the earthfill that was added in 1910, has been noted. A hole developed in the earthfill placed in 1910. There is reason to believe that there still is a potential for developing further holes. Although the hole was filled in, the reason for its development was not eliminated. Without further information concerning the earthfill placed in 1964, it can only be assumed that its properties are similar to the earthfill placed in 1910.

e. Seismic Stabilility. Winola Mill Pond Dam is located in Seismic Zone 1. Normally it can be considered that, if a dam in this zone had adequate factors of safety under static loading conditions, it can be assumed safe for any expected earthquake loading. However, since there are no formal static stability analyses, and since there is the possibility of earthquake forces further cracking the concrete liner wall, the theoretical seismic stability of Winola Mill Pond Dam is not known.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety.

(1) Based on the visual inspection, available records, calculations, and past operational performance, Winola Mill Pond Dam is judged to be in fair condition. However, the existing main spillway walls will overtop at about the 6 percent PMF. Water overtopping the walls will flow over the dry masonry downstream face of the dam. It is estimated that at about 15 percent of the PMF, the dry masonry will erode, causing failure of the dam. It is also estimated that the initial surge from failure of the dam will cause at least one dwelling, immediately downstream, to be flooded. The spillway capacity is rated as seriously inadequate. According to criteria established for these studies, the dam is judged to be unsafe, nonemergency, because the spillway capacity is seriously inadequate.

(2) The foundation conditions at the dam are unknown and the structural dimensions are uncertain. Its structural stability is unknown, although a preliminary analysis indicates there is no need for immediate concern.

(3) A hole developed previously in the earthfill upstream of the dam. Subsequent modifications have not eliminated the possibility of further holes developing.

(4) The outlet works is not operational. There is no means of drawing down the reservoir.

(5) Maintenance of the dam is poor.

(6) The visual inspection revealed some deficiencies, which are summarized below.

Feature and Location	Observed Deficiency
Dry Masonry Dam	
Toe	Trees adjacent, debris below spillways.
Top	Stones missing, washout.
Concrete Liner Wall	Cracked, shelter constructed near main spillway.
Upstream Earthfill	No erosion protection, trees and brush
Outlet Works	Not operational, uncertain upstream closure.
Main Spillway	Low walls.
Auxiliary Spillway	Cracks, spalling

b. Adequacy of Information. The information available is such that an assessment of the conditon of the dam can be inferred from the combination of visual inspection, past performance, and computations performed prior to and as part of this study.

c. Urgency. The recommendations in Paragraph 7.2 should be implemented immediately.

d. Necessity for Further Investigations. In order to accomplish some of the remedial measures outlined in Paragraph 7.2, further investigations by the Owner will be required.

7.2 Recommendations and Remedial Measures.

a. The following measures are recommended to be undertaken by the Owner, in approximate order of priority, immediately:

(1) Remove the debris from the toe of the dam and then inspect the dam for evidence of seepage, bulging and other conditions. Take appropriate action as necessary.

(2) Perform the following studies: A study to more accurately ascertain the spillway capacity required at Winola Mill Pond Dam and the measures required to make the spillway

hydraulically adequate, with particular consideration of the elevation difference between Winola Mill Pond Dam and Lake Winola Dam as well as the hydraulic control for Lake Winola Dam; a study to determine the structural stability of Winola Mill Pond Dam which, as a minimum, will require further investigation to determine the actual structural dimensions of the dam and the engineering properties of the foundation; a study to determine the potential of developing further holes in the upstream earthfill, which, as a minimum, will require further investigation to determine both the engineering properties of the upstream earthfill and the extent of the cracks in the concrete liner wall; and a study to determine the best means of providing an operational outlet works at the dam. Any active outlet works should have provision for upstream closure and any abandoned outlet works should be permanently plugged. All the studies should be performed by a professional engineer experienced in the design and construction of dam. Take appropriate action as necessary.

(3) Remove brush and tress on or near the dam.

(4) Provide erosion protection on the upstream slope of the earthfill.

(5) Remove the shelter near the main spillway and make repairs to the eroded area to the left of the main spillway.

(6) Replace the missing stones on the dry masonry dam and provide measures to prevent further vandalism.

(7) Repair the cracked concrete liner wall and the cracked and spalled concrete in the auxiliary spillway.

b. In addition, it is recommended that the Owner modify his operational procedures as follows:

(1) Develop a detailed emergency operation and warning system for Winola Mill Pond Dam.

(2) Provide round-the-clock surveillance of Winola Mill Pond Dam during periods of unusually heavy rains.

(3) When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency operation and warning system procedures.

(4) As presently required by the Commonwealth, institute a program of detailed annual inspections by a professional engineer experienced in the design and construction of dams. Use the results to determine if remedial measures are necessary.

(5) Institute a maintenance program to properly maintain all features of the dam.

SUSQUEHANNA RIVER BASIN

TRIBUTARY TO BEAVER CREEK, WYOMING COUNTY

PENNSYLVANIA

WINOLA MILL POND DAM

NDI ID No. PA-00893
DER ID No. 66-35

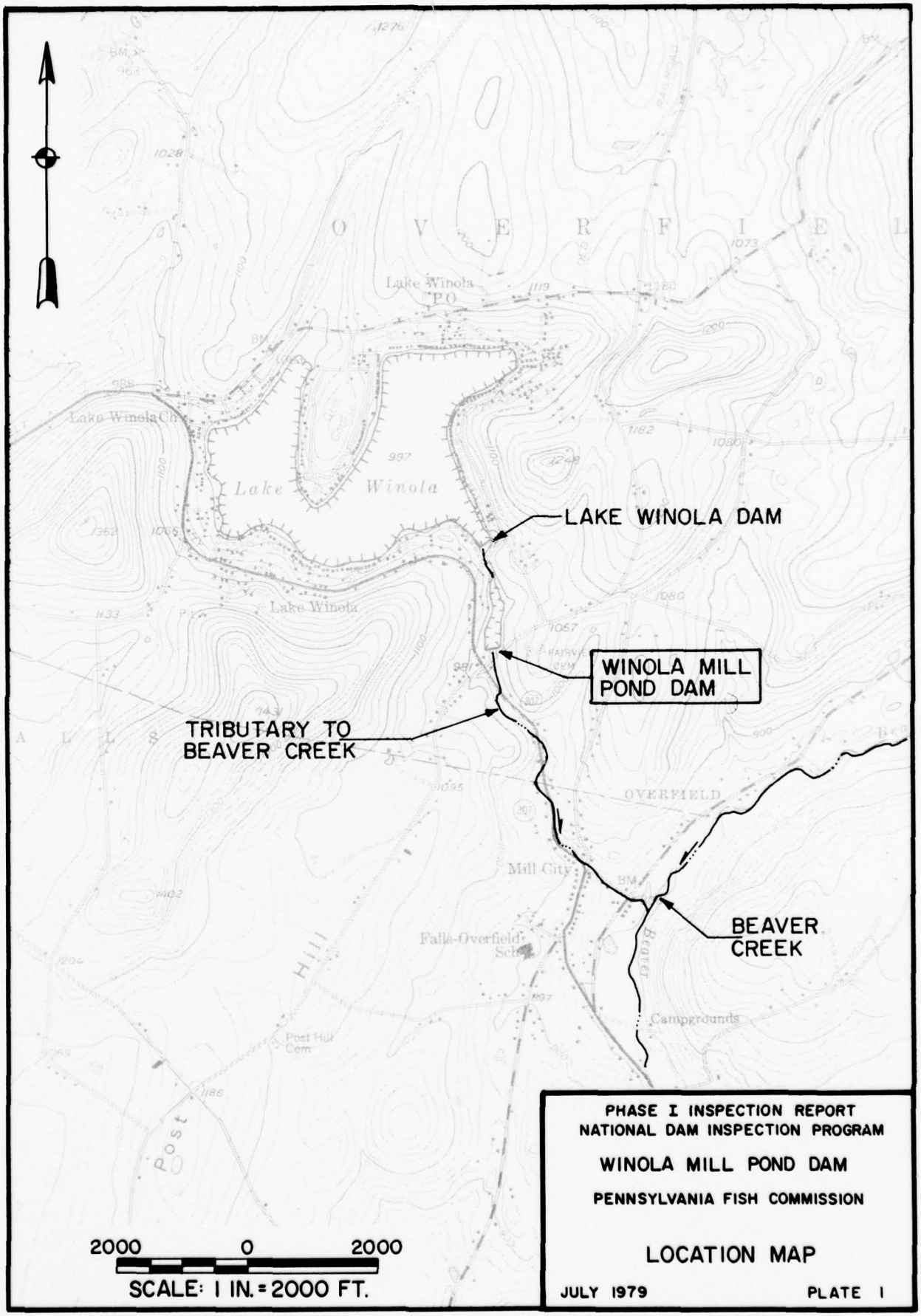
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JULY 1979

PLATES



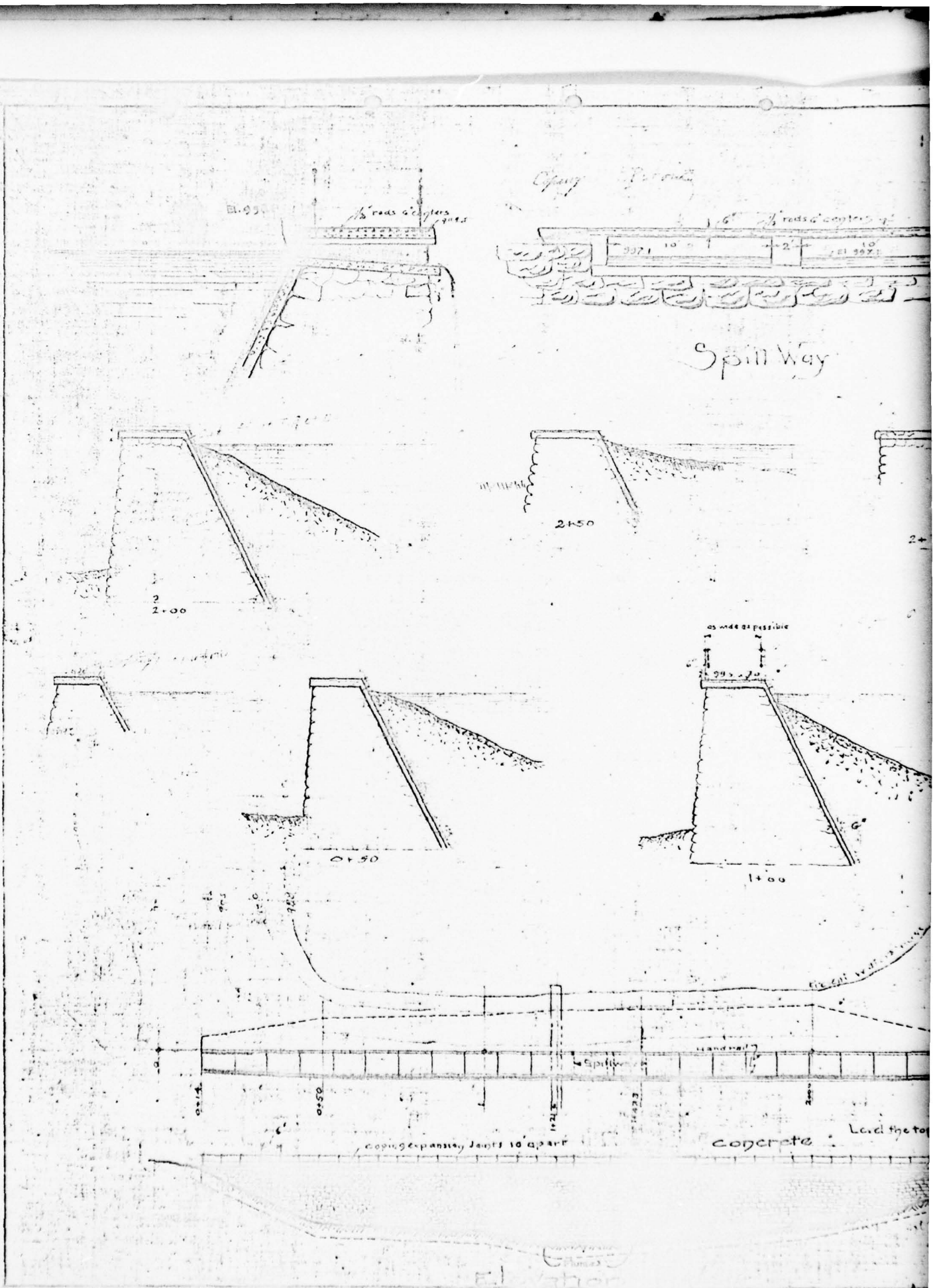
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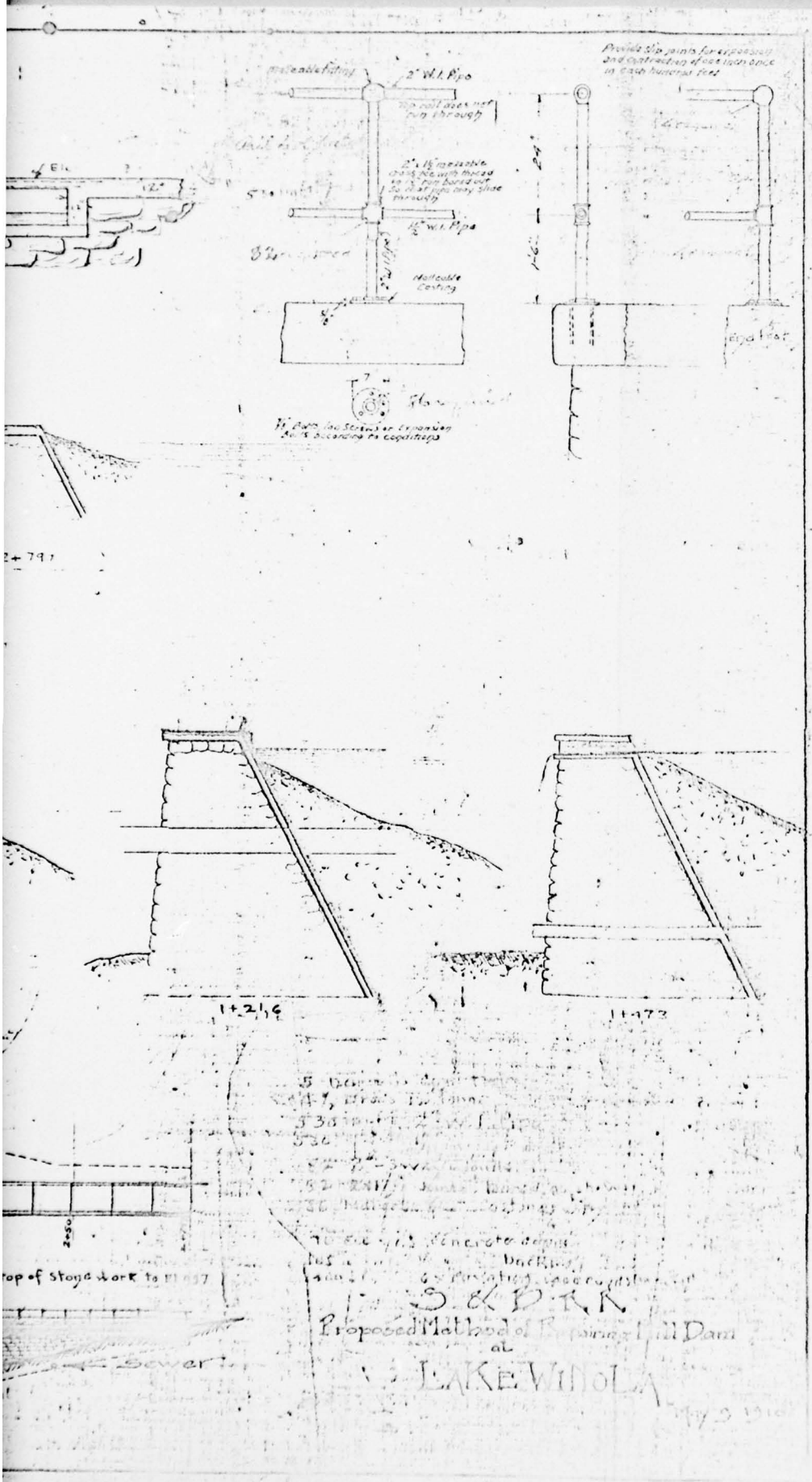
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PENNSYLVANIA FISH COMMISSION

LOCATION MAP

JULY 1979 PLATE 1


Spill Way
2+50
2+00
0+50
1+00
as wide as possible
coping & expansion Joints 10 apart
concrete



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WINOLA MILL POND DAM

PENNSYLVANIA FISH COMMISSION

PROFILE AND SECTIONS

JULY 1979 PLATE 2

SUSQUEHANNA RIVER BASIN

TRIBUTARY TO BEAVER CREEK, WYOMING COUNTY

PENNSYLVANIA

WINOLA MILL POND DAM

NDI ID No. PA-00893
DER ID No. 66-35

PENNSYLVANIA FISH COMMISSION

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

JULY 1979

APPENDIX A

CHECKLIST - ENGINEERING DATA

CHECKLIST

ENGINEERING DATA

DESIGN, CONSTRUCTION, AND OPERATION
PHASE I

NAME OF DAM: Winola Mill Pond
NDI ID NO.: PA-00893 DER ID NO.: 66-35

Sheet 1 of 4

ITEM	REMARKS
AS-BUILT DRAWINGS	PLATE 2 - DESIGN DRAWING FOR 1910 MODIFICATION TO DAM. NO OTHER DRAWINGS AVAILABLE
REGIONAL VICINITY MAP	SEE PLATE 1
CONSTRUCTION HISTORY	UNKNOWN
TYPICAL SECTIONS OF DAM	SEE PLATE 2 - THEY DID NOT CORRELATE PERFECTLY WITH FIELD DATA
OUTLETS: Plan Details Constraints Discharge Ratings	SEE PLATE 2 - THEY HAVE BEEN MODIFIED SINCE.

A-1

ENGINEERING DATA

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	NONE
DESIGN REPORTS	NONE
GEOLOGY REPORTS	NONE
DESIGN COMPUTATIONS: Hydrology and Hydraulics (H&H) Dam Stability Seepage Studies	STABILITY - 1919 Report by PENNSYLVANIA WATER SUPPLY COMMISSION. (H&H) 1919 by PWSC (PWSC), 1964 by PennDER NO SEEPAGE STUDIES.
MATERIALS INVESTIGATIONS: Boring Records Laboratory Field	NONE
POSTCONSTRUCTION SURVEYS OF DAM	NONE

ENGINEERING DATA

ITEM	REMARKS
BORROW SOURCES	UNKNOWN
MONITORING SYSTEMS	NONE
MODIFICATIONS	1910 - CONCRETE LINER WALL AND UPSTREAM EARTHFILL. 1964 - NEW SPILLWAY AND REPAIRS TO UPSTREAM EARTHFILL
HIGH POOL RECORDS	NONE
POSTCONSTRUCTION ENGINEERING STUDIES AND REPORTS	NONE
PRIOR ACCIDENTS OR FAILURE OF DAM: Description Reports	PRE-1964 REPAIRS, A 8-INCH HOLE IN UPSTREAM EARTHFILL AND EXCESSIVE LEAKAGE WAS REPORTED.

ENGINEERING DATA

ITEM	REMARKS
MAINTENANCE AND OPERATION RECORDS	NONE
SPILLWAY: Plan Sections Details	NONE
OPERATING EQUIPMENT: Plans Details	NONE
PREVIOUS INSPECTIONS Dates Deficiencies	1924 (by OWNER) - SMALL LEAKAGE, WHICH HAS NOT CHANGED IN RECENT YEARS. 1924 - SLIGHT LEAKAGE 1928 - SIX-INCH VALVE CRACKED, SMALL STREAM APPEARS AT RIGHT END OF DAM AND A LARGE STREAM APPEARS JUST TO RIGHT OF CENTER. ALSO CONSIDERABLE FLOW FROM HILLSIDE AT LEFT END. WATER AT SPILLWAY
(CONTINUED)	1930 - SMALL STREAM RIGHT OF CENTER WATER 6' below SPILLWAY. 1938 - WATER 2" below SPILLWAY. LEAKAGE UNDER DAM ALONG TOE. LEAKING 6" VALVE.

ITEM	REMARKS
PREVIOUS INSPECTIONS (CONTINUED)	1940 - WATER 2" below spillway. SETTLEMENT ALONG TOP OF STONE WALL. LEAKING 6-INCH VALVE. WATER IS LEAKING FROM UNDER THE TOE ALONG ENTIRE LEFT SIDE. SMALL STREAM OF WATER ALL ALONG LEFT
	SIDE. ONLY TWO LEAKS APPEAR ON THE RIGHT SIDE NEAR RIGHT END, BUT A SMALL STREAM FLOWS ALONG THIS SIDE OF LOWER TOE AS SEEN ON LEFT SIDE.
	1941 - LEAKAGE PER 1940, NO FURTHER SETTLEMENT 1941 - TOP VERY UNEVEN, BULGES IN DOWNSTREAM FACE, LARGE SINKHOLE
	ON TOP. VALVES LEAKING. WATER 4.5' below spillway; SLIGHT LEAKAGE AT TOE. 1948 - WATER 4'2 below spillway. SLIGHT DISINTEGRATION OF CONCRETE LINER. HEAVY LEAKAGE ALONG TOE. OUTLETS NOT APPARENT.
	STONES REMOVED FROM DAM TOP. 1949 - (PENN DER MEMORANDUM) WATER 6' below spillway. HOLE (8" dia) AT LEFT END IS 2' below spillway. OUTLET WORKS GATE DISINTEGRATED. NO HEAVY LEAKAGE. 1960 (PENN DER MEMO) - "ROUGH SHAPE"
	NOTES PREVIOUS OVERTOPPINGS DURING HIGH FLOW. SOME LEAKAGE ALONG LEFT TOE. (CONTINUED NEXT SHEET

A-5

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1962 - (PENNDER MEMORANDUM) LAKE HAS BEEN DRAINED TO JUST ABOVE OUTLET PIPE. "APPARENTLY THE CONCRETE AND MATERIAL THAT HAD BEEN PLACED IN THE PIPE AS REPORTED BY MR. PECK IN ANOTHER LETTER HAD NOT BEEN COMPLETELY REMOVED. THERE WAS ONLY A SMALL FLOW COMING FROM THE END OF THE OUTLET PIPE.

1964 - (PENNDER MEMORANDUM). ROCKS TORN FROM CREST. A PORTION OF THE DOWNSTREAM CREST BACKFILLED WITH EARTH. NOTES NEW SPILLWAY. "THE END OF THE OUTLET PIPE HAD BEEN FILLED WITH CONCRETE AND A HOLE HAD TO BE BROKEN IN THE PIPE TO DRAIN THE POND". (THE INSPECTOR REQUESTED THAT THE MAIN SPILLWAY WALLS BE RAISED AND THAT THE STONES BE REPLACED ON THE TOP OF THE DAM).

1965 - NO DEFICIENCIES.

6313

SUSQUEHANNA RIVER BASIN

TRIBUTARY TO BEAVER CREEK, WYOMING COUNTY

PENNSYLVANIA

WINOLA MILL POND DAM

NDI ID No. PA-00893
DER ID No. 66-35

PENNSYLVANIA FISH COMMISSION

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

JULY 1979

APPENDIX B

CHECKLIST - VISUAL INSPECTION

CHECKLIST

VISUAL INSPECTION

PHASE I

Name of Dam: WINOLA MILL POND County: WYOMING State: PENNSYLVANIA

NDI ID No.: PA-00893 DER ID No.: 66-35

Type of Dam: DRY MASONRY W/EARTHFILL & LINED WALL Hazard Category: HIGH

Date(s) Inspection: 13 JUNE 1979 Weather: CLEAR Temperature: 70°F

SOIL CONDITIONS: DAMP TO MOIST

B-1

Pool Elevation at Time of Inspection: 994.2 msl/Tailwater at Time of Inspection: NOT ABLE TO BE DETERMINED BUT LOW. msl

Inspection Personnel:

E. J. GRINDALL (PFC - PROJ ENG) D. EBERSOLE (GFCC)

J. CHARLES (PFC - AREA MANAGER)

D. WILSON (GFCC)

A. WHITMAN (GFCC) Recorder

CONCRETE/MASONRY DAMS (DRY MASONRY)

Sheet 1 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	NONE - DEBRIS AT TOE below MAIN AND AUXILIARY SPILLWAY OBSCURES LOWEST AREA OF TOE.	
JUNCTION OF STRUCTURE WITH: Abutment Embankment Other Features	LEFT ABUTMENT - 10' LONG AREA OF LINER WALL BULGED AND CRACKED. RIGHT ABUTMENT - 5° UPSTREAM DEFLECTION, ORIGIN OF DEFLECTION UNCERTAIN.	
DRAINS	NONE	
WATER PASSAGES	NONE	
FOUNDATION	UNKNOWN	

B-2

CONCRETE/MASONRY DAMS

Sheet 2 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SURFACES: Surface Cracks Spalling	STONES REMOVED FROM TOP OF DRY MASONRY. AREA LEFT OF MAIN SPILLWAY COVERED WITH GRASS.	TREES GROWING NEAR TOE, ESPECIALLY LEFT OF MAIN SPILLWAY.
STRUCTURAL CRACKING	NEAR VERTICAL CRACKS IN LINER WALL, EXTENDING THROUGH WALL, SPACING VARIES 6' TO 35'	EARTHFILL UNEVEN, SOME BRUSH ON UPSTREAM SLOPE
ALIGNMENT: Vertical Horizontal	HORIZONTAL - SEE ABUTMENTS VERTICAL - SEE SURVEY DATA FOLLOWING INSPECTION FORMS.	
MONOLITH JOINTS	NO JOINTS IN LINER WALL.	
CONSTRUCTION JOINTS	NONE	
STAFF GAGE OR RECORDER	NONE	

OUTLET WORKS

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	N/A METAL PIPES	
INTAKE STRUCTURE	NO EVIDENCE OF STRUCTURES	
OUTLET STRUCTURE	24" CIP - FREE OUTFALL LEAKING 1gpm TWO - 10" CIP - ASSUMED BURIED BENEATH DEBRIS	
OUTLET CHANNEL	NO OUTLET CHANNEL	
EMERGENCY GATE	NO EVIDENCE OF ANY OPERATING FEATURES.	

MAIN
~~UNGATED~~ SPILLWAY

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	No deficiencies	
APPROACH CHANNEL	Reservoir	
DISCHARGE CHANNEL	Walls 1' high extending across dry masonry.	Shelter constructed to right of main spillway
BRIDGE AND PIERS	None	

B-5

AUXILIARY ~~CNTRD~~ SPILLWAY

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	No deficiencies	
APPROACH CHANNEL	Reservoir	
DISCHARGE CHANNEL	2 cracks through walls. Spalling at left wall near upstream end.	
BRIDGE AND PIERS	N/A	
GATES AND OPERATION EQUIPMENT	N/A	

INSTRUMENTATION

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	NONE	
OBSERVATION WELLS	NONE	
WEIRS	NONE	
PIEZOMETERS	NONE	
OTHER	NONE	

RESERVOIR AND WATERSHED

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Rolling Hills	
SEDIMENTATION	No reported or observed problems.	
WATERSHED DESCRIPTION	Mostly wooded except for minor development around lake borders	Lake Winola Dam controls almost 90% of watershed - see Appendix C.

DOWNSTREAM CHANNEL

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION: Obstructions Debris Other	NONE	
SLOPES	NARROW, FAIRLY STEEP STREAM.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	AT LEAST 15 DWELLINGS ADJACENT TO CREEK, NEAREST IS ABOUT 300' DOWNSTREAM.	

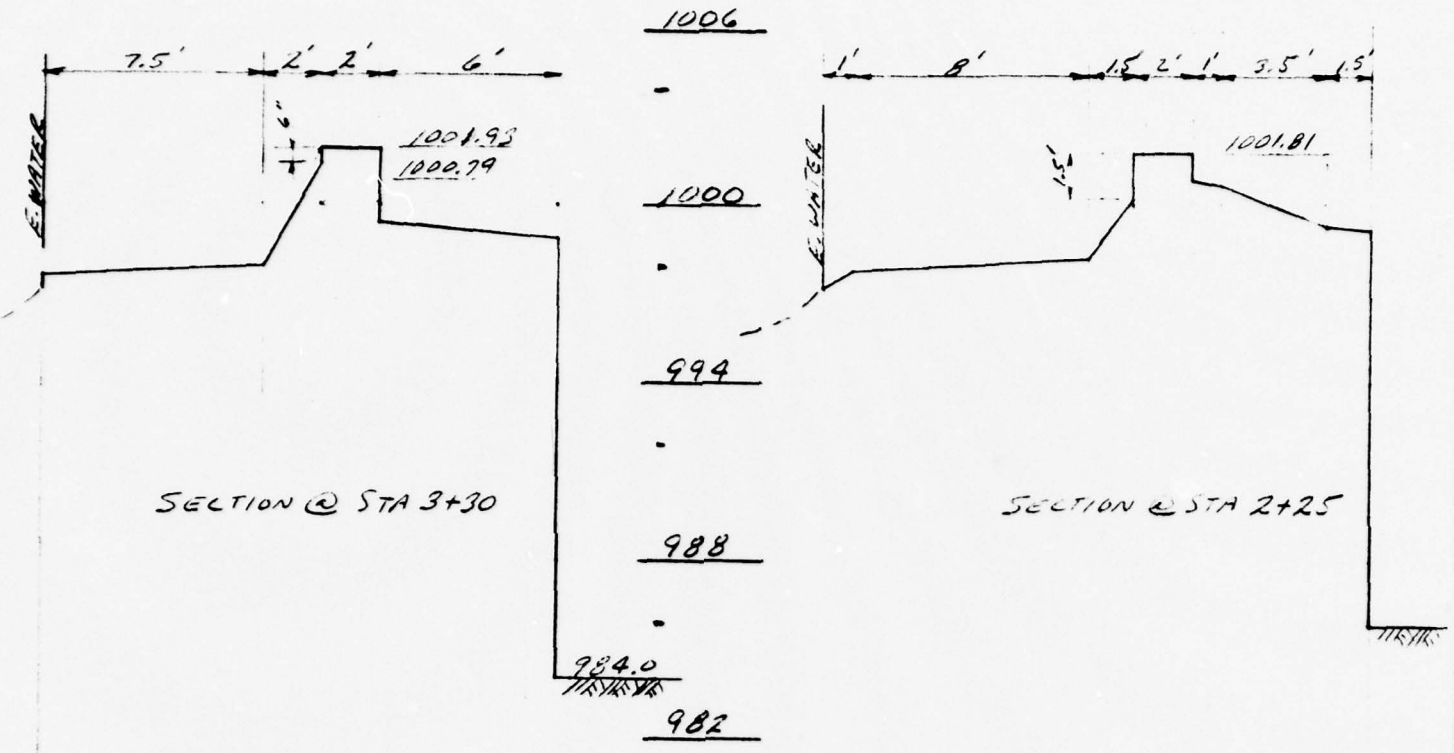
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SURVEY NOTE:

DATUM AT WINOLA MILL POND WAS ORIGINALLY TAKEN AT EL 997.1, THE SAME AS LAKE WINOLA. A REVIEW OF PLATE 2 AND THE RECORDS INDICATES THAT THE SPILLWAY AT WINOLA MILL POND USED TO BE AT EL 997.1, 1' below TOP OF dam. USING 1' between SPILLWAY CREST AND TOP OF dAM, AS STATED IN THE RECORDS, THE design TOP OF dam IS EL 998.1. The RECORDS STATE THAT THE NEW SPILLWAY IS 5' below TOP OF dAM, OR EL 993.1. THEREFORE SUBTRACT 4.0' FROM ELEVATIONS ON NEXT TWO SHEETS TO OBTAIN "CORRECTED" ELEVATIONS.

8513



SECTION @ STA 3+30

SECTION @ STA 2+25

B-11

SEE SURVEY NOTE RE DATUM ON PRECEEDING PAGE

WINOLA MILL POND DAM

EMB. SECTIONS

SCALE: 1"=6'

NOTE: DEBRIS AT TOE OF SPILLWAY ASSUME STREAM IS 2' BELOW TOE AT STATION 2+30

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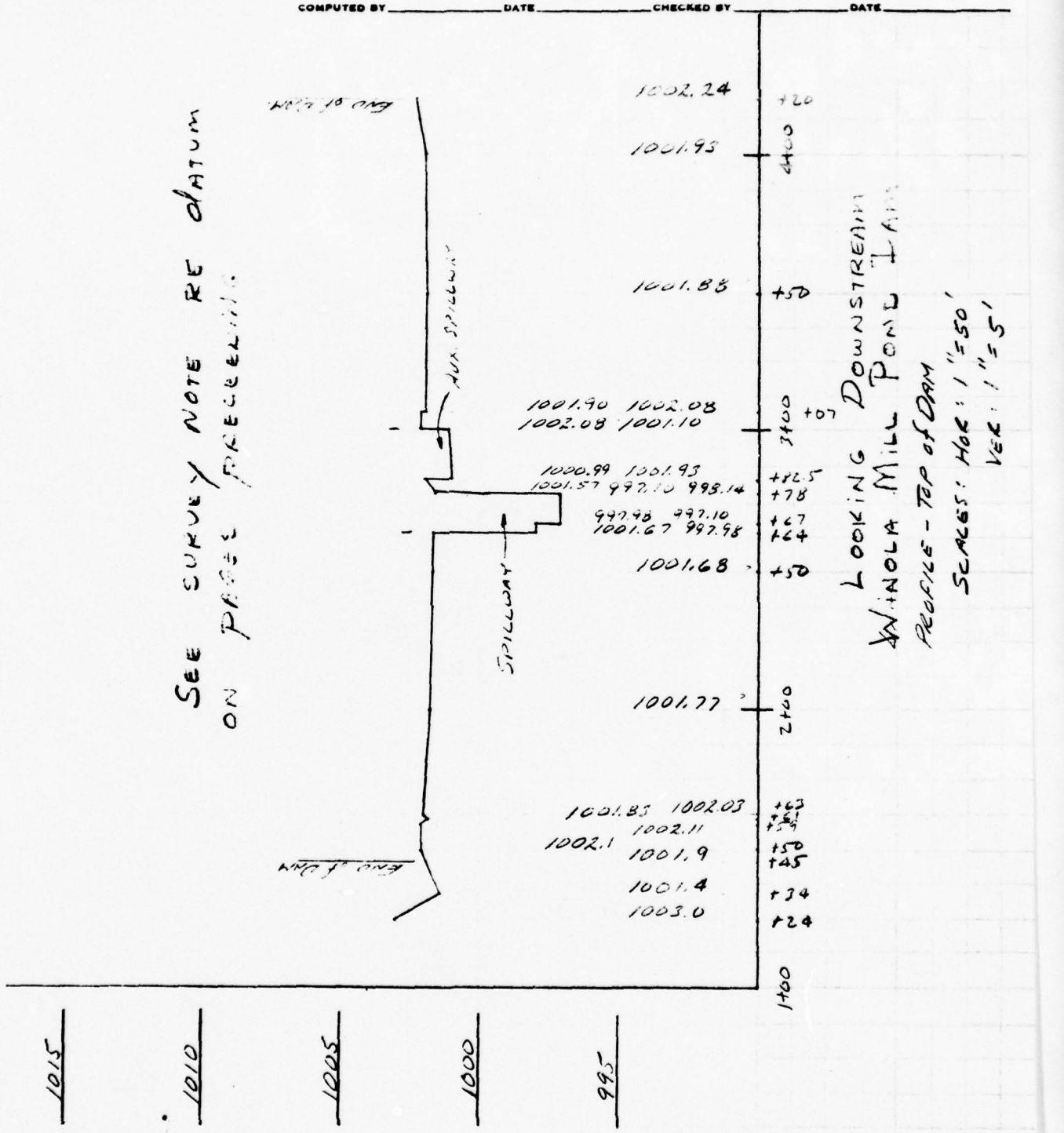
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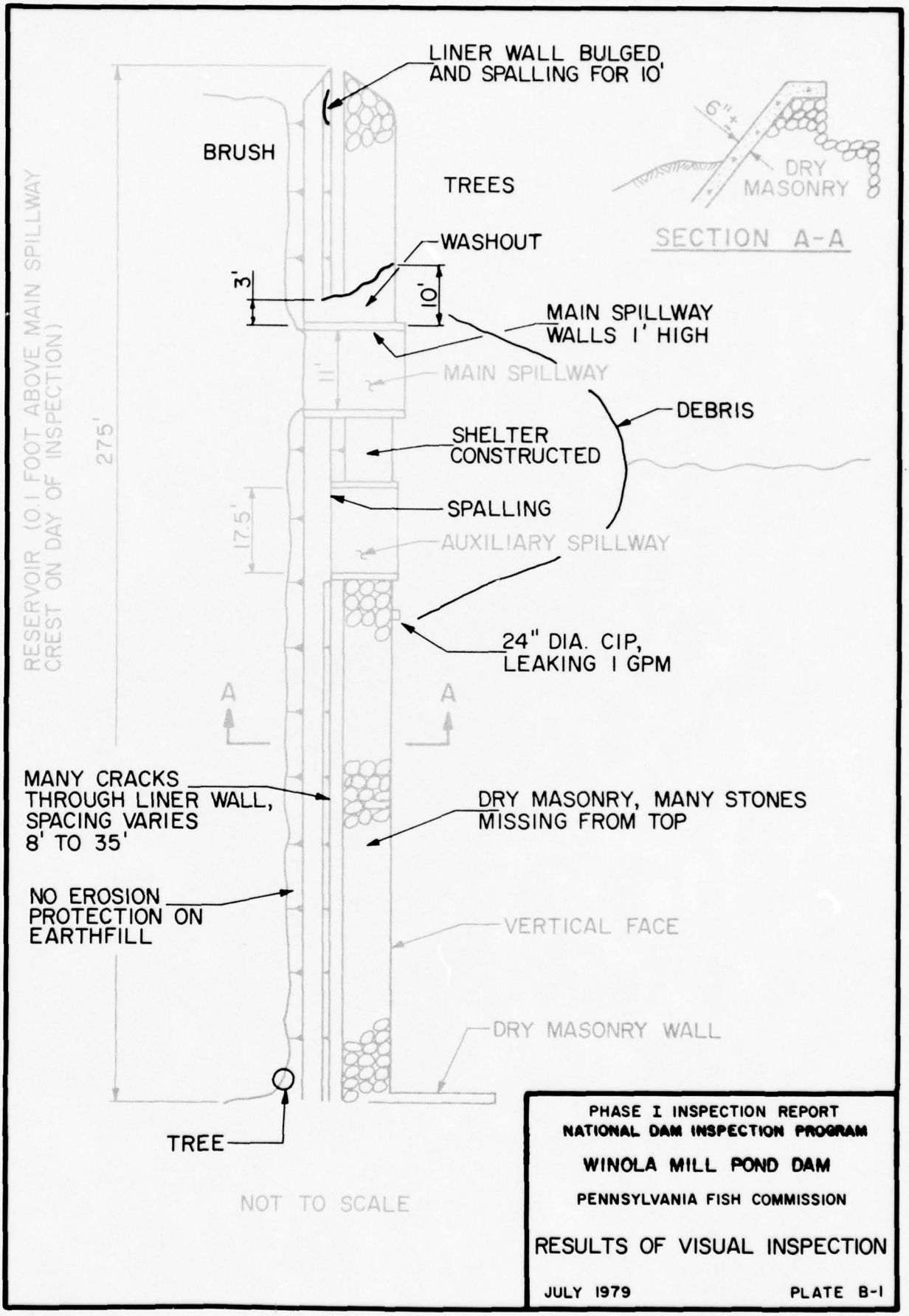
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B-12

6513



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NATIONAL DAM INSPECTION PROGRAM

WINOLA MILL POND DAM

PENNSYLVANIA FISH COMMISSION

RESULTS OF VISUAL INSPECTION

JULY 1979 PLATE B-1

SUSQUEHANNA RIVER BASIN

TRIBUTARY TO BEAVER CREEK, WYOMING COUNTY

PENNSYLVANIA

WINOLA MILL POND DAM

NDI ID No. PA-00893
DER ID No. 66-35

PENNSYLVANIA FISH COMMISSION

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

JULY 1979

APPENDIX C

HYDROLOGY AND HYDRAULICS

APPENDIX C

HYDROLOGY AND HYDRAULICS

In the recommended Guidelines for Safety Inspection of Dams, the Department of the Army, Office of the Chief of Engineers (OCE), established criteria for rating the capacity of spillways. The recommended Spillway Design Flood (SDF) for the size (small, intermediate, or large) and hazard potential (low, significant, or high) classification of a dam is selected in accordance with the criteria. The SDF for those dams in the high hazard category varies between one-half of the Probable Maximum Flood (PMF) and the PMF. If the dam and spillway are not capable of passing the SDF without overtopping failure, the spillway capacity is rated as inadequate. If the dam and spillway are capable of passing one-half of the PMF without overtopping failure, or if the dam is not in the high hazard category, the spillway capacity is not rated as seriously inadequate. A spillway capacity is rated as seriously inadequate if all of the following conditions exist:

(a) There is a high hazard to loss of life from large flows downstream of the dam.

(b) Dam failure resulting from overtopping would significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure.

(c) The dam and spillway are not capable of passing one-half of the PMF without overtopping failure.

APPENDIX C

SUSQUEHANNA River Basin

Name of Stream: TRIBUTARY TO BEAVER CREEK

Name of Dam: WINOLA MILL POND

NDI ID No.: PA-00893

DER ID No.: 66-35

Latitude: N 41° 30' 20" Longitude: W 75° 50' 30"

Top of Dam ~~(low spot)~~ Elevation: 998.1

Streambed Elevation: 978± Height of Dam: 20 ft

Reservoir Storage at Top of Dam Elevation: 61 acre-ft

Size Category: SMALL

Hazard Category: HIGH (see Section 5)

Spillway Design Flood: VARIES 1/2 PMF TO PMF

SELECT PMF BECAUSE OF DOWNSTREAM POPULATION

UPSTREAM DAMS

Name	Distance from Dam (miles)	Height (ft)	Storage at top of Dam Elevation (acre-ft)	Remarks
LAKE WINOLA	0.3	3.2		

DOWNSTREAM DAMS

NONE				

SUSQUEHANNA River Basin

Name of Stream: TRIBUTARY TO BEAVER CREEK

Name of Dam: WINOLA MILL POND

~~NDS ID No.~~: _____

~~DER ID No.~~: _____

Latitude: N 41° 30' 20" Longitude: W 75° 50' 30"

DETERMINATION OF PMF RAINFALL

For Area A

which consists of Subareas A1 of 1.7 sq. mile

A2 0.22

_____ _____

_____ _____

_____ _____

Total Drainage Area 1.92 sq. mile

PMF Rainfall Index = 22.15 in., 24 hr., 200 sq. mile

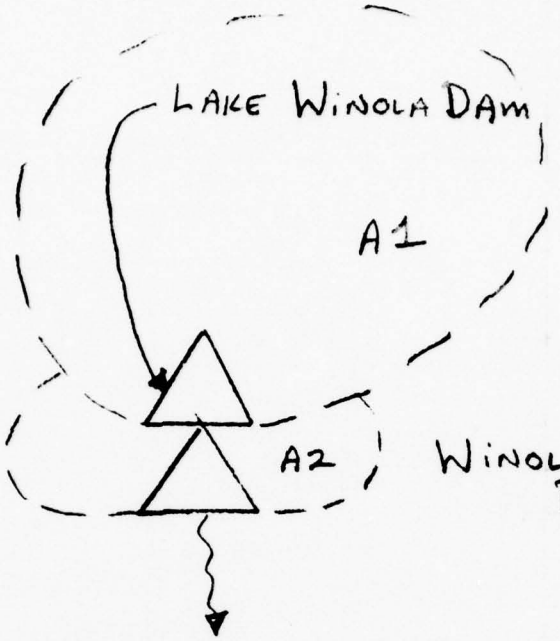
	Hydromet. 40 (Susquehanna Basin)	Hydromet. 33 (Other Basins)
Zone	N/A	_____
Geographic Adjustment Factor	96%	1.0
Revised Index Rainfall	21.3	_____

RAINFALL DISTRIBUTION (percent)

Time	Percent
6 hours	118
12 hours	127
24 hours	136
48 hours	142
72 hours	145
96 hours	N/A

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COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____



SKETCH OF SYSTEM

0313

Data for Dam at Outlet of Subarea A1
(see Sketch on Sheet C-4)

Name of Dam: LAKE WINOLA

Height: 3.2 (existing)

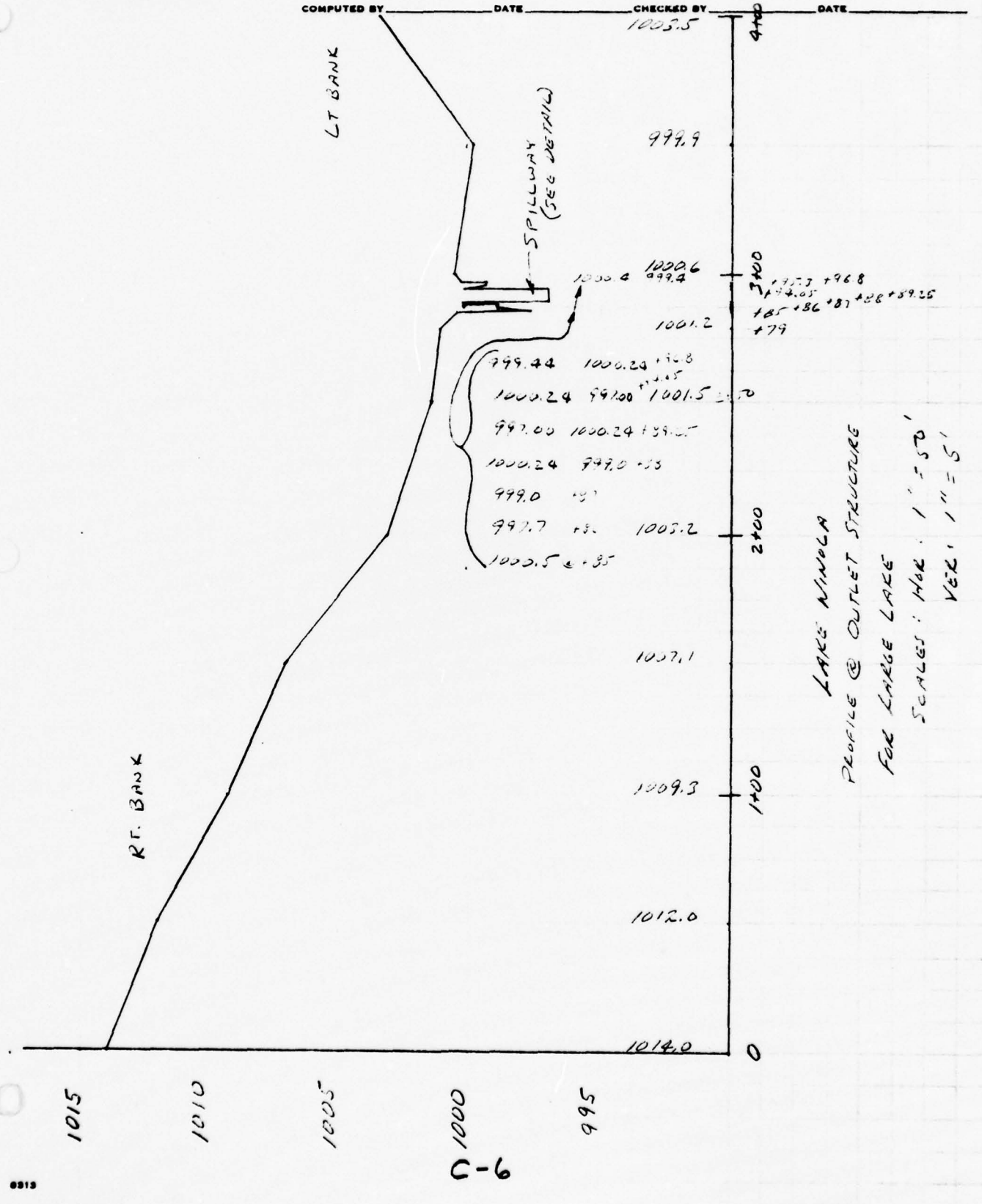
Spillway Data:	Existing Conditions	Design Conditions
Top of Dam Elevation	SEE FOLLOWING SHEETS	
Spillway Crest Elevation		
Spillway Head Available (ft)		
Type Spillway		
"C" Value - Spillway		
Crest Length - Spillway (ft)		
Spillway Peak Discharge (cfs)		
Auxiliary Spillway Crest Elevation		
Auxiliary Spillway Head Available (ft)		
Type Auxiliary Spillway		
"C" Value - Auxiliary Spillway		
Crest Length - Auxiliary Spillway (ft)		
Auxiliary Spillway Peak Discharge (cfs)		
Combined Spillway Discharge (cfs)		

Spillway Rating Curve: SEE NEXT SHEETS

Elevation	Q Spillway (cfs)	Q Auxiliary Spillway (cfs)	Combined (cfs)
997.0			0
997.9			4
999.7			59
1000.8			127
1002.0			730
1003.0			750
1003.3			790
1004.0			1050
1005.0			1630
1006.0			2600
1007.0			4150

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT _____ FILE NO. _____
SHEET NO. _____ OF _____ SHEETS
FOR _____
COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____

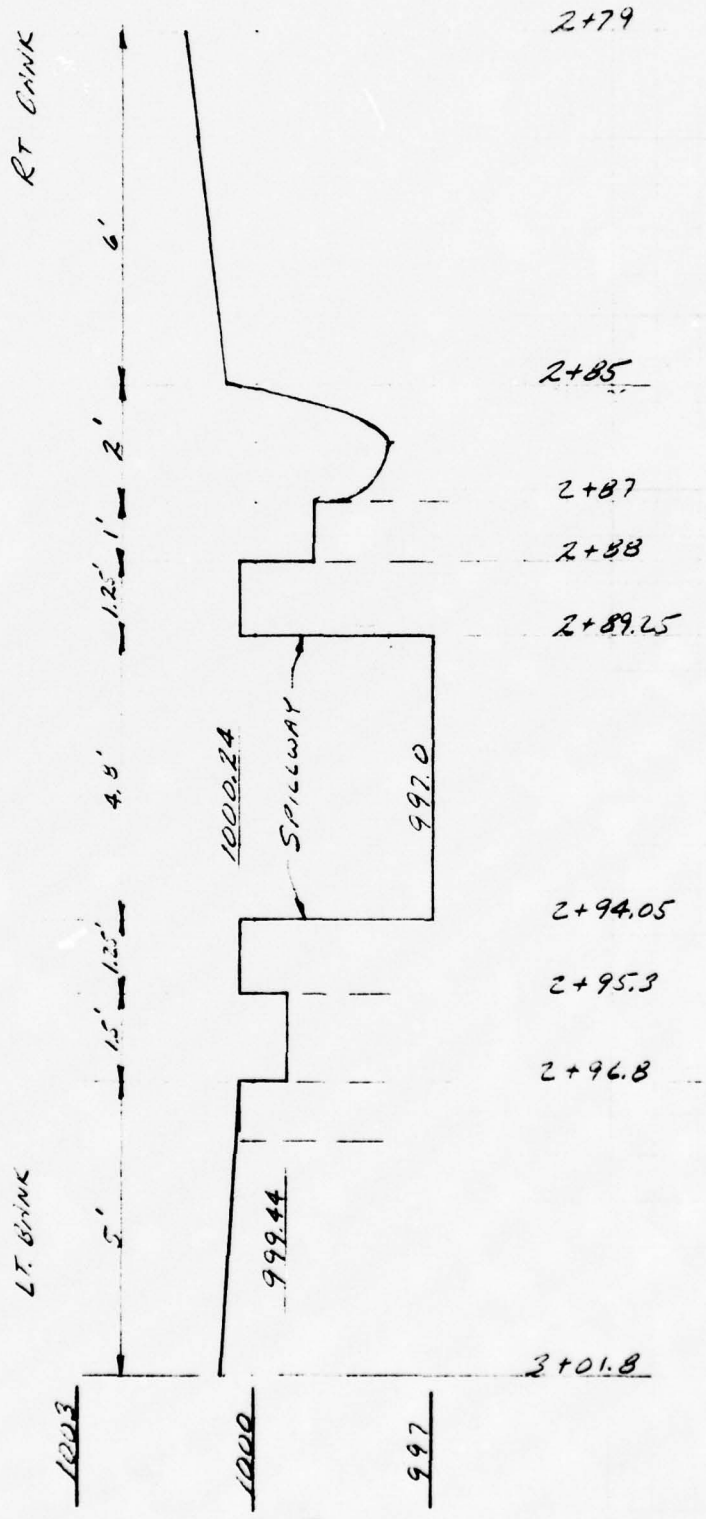


C-6

6513

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HARRISBURG, PA.

SUBJECT _____ FILE NO. _____
SHEET NO. ____ OF ____ SHEETS
FOR _____
COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____



LAKE LAKE
DETAIL OF LAKE NINOLA OUTLET
SCALE: 1" = 5'

6513

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HARRISBURG, PA.

SUBJECT _____ FILE NO. _____
SHEET NO. ____ OF ____ SHEETS
FOR _____
COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____

SECTION AT LAKE WINOLA OUTLET

ELEV	T	ΔA	A	Q	AV	POOL	
997	4.8		0	0		997	
		1.44					
997.7	4.8		1.44	4	.2	997.9	
		7.54					
999.0	6.8		8.98	59	.7	999.7	
		3.12					
999.4	8.8		12.1	80	.7	1000.1	
		4.48					
999.9	9.1		16.58	127	.9	1000.8	UNSTABLE AREA
		7.67					
1000.24	36		24.25	113	.4	1000.6	
		98.28					
1001.5	120		122.53	702	.5	1002.0	
		267.75					
1003.2	195		390.28	3132	1.0	1004.2	
		59.7					
1003.5	203		449.98	3800	1.1	1004.6	
		815.4					
1007.1	250		1265.38	16,149	2.5	1009.6	
		605					
1009.3	300		1870.38	26,493	3.1	1012.4	

8313

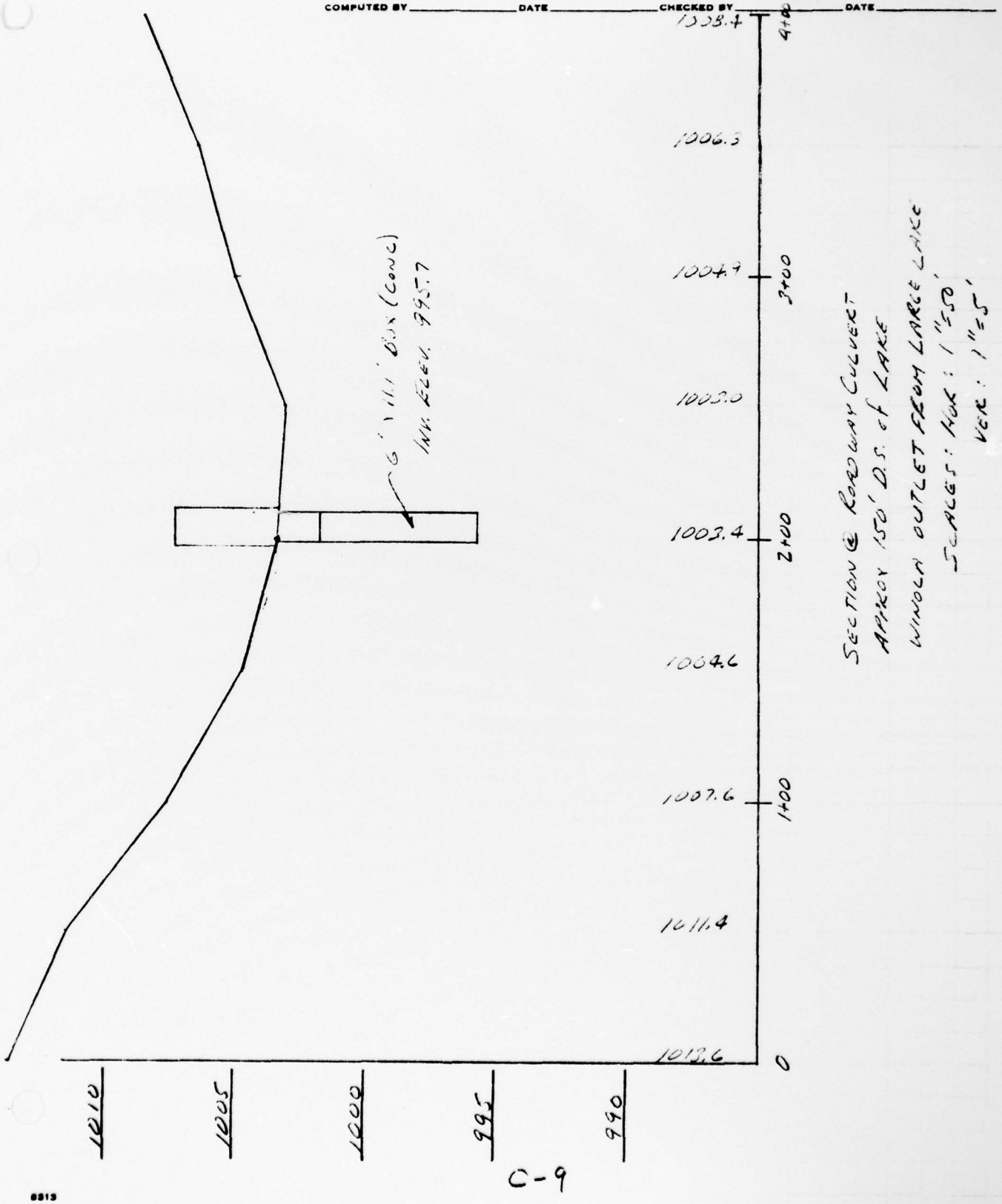
GANNETT FLEMING CORDDRY
AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT _____ FILE NO. _____

SHEET NO. _____ OF _____ SHEETS

FOR _____

COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____



SECTION @ ROADWAY CULVERT
APPROX 150' D.S. OF LAKE
WINOLA OUTLET FROM LARGE LAKE
SCALES: HOR: 1"=50'
VER: 1"=5'

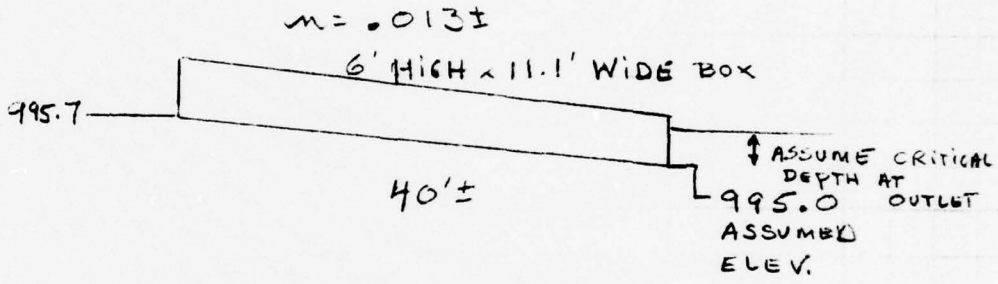
C-9

6513

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT _____ FILE NO. _____
SHEET NO. _____ OF _____ SHEETS
FOR _____
COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____

LAKE WINOLA DAM
CULVERT COMPUTATION
150'± DOWNSTREAM OF DAM



$A = 6 \times 11.1 = 66.6$

$P = 6 \times 2 + 11.1 \times 2 = 34.2$

$R = 1.947$

$K_s = \frac{29.1\, n^2 L}{R^{4/3}} = .08$

$K_{ENTRANCE} + K_{EXIT} + K_s = 0.5 + 1.0 + .08 = 1.58$

$Q = A\sqrt{\frac{2gH}{K}}$ H = HEADWATER − TAILWATER

$Q = 4.25\sqrt{H}$ $d_c = \sqrt[3]{\frac{q^2}{g}}$ $q = Q/11.1$

Q	d_c	H	HEADWATER	
0	N/A		995.7	
200	2.16	.22	997.4	
400	3.43	.89	999.3	
600	4.49	1.99	1001.5	← START PRESSURE FLOW ±
800	5.44	3.54	1004.0	
1000	6.00	5.54	1006.5	
2000	6.00	22.1	1023.1	
3000	6.00	49.8	1050.8	
4000	6.00	88.6	1089.6	
5000	6.00	138.4	1139.40	

6313

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT _____ FILE NO. _____
SHEET NO. ____ OF ____ SHEETS
FOR _____
COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____

AT SECTION 150'± DOWNSTREAM
ASSUME CRITICAL DEPTH AT SECTION

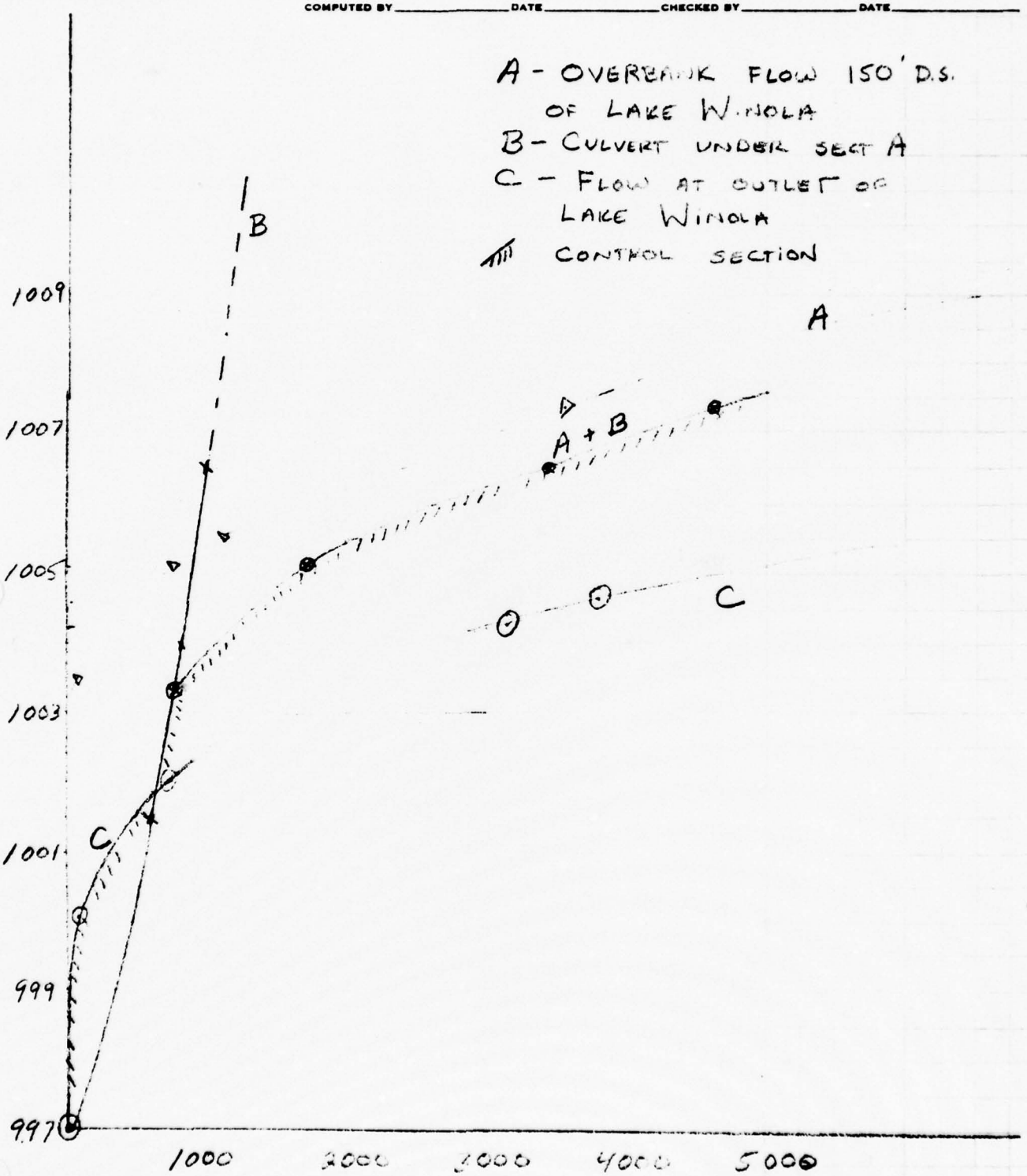
ELEV	T	ΔA	A	Q	bv	Pool
1003.0	0		0	0		1003.0
		12.4				
1003.4	62		12.4	31	0.1	1003.5
		124.2				
1004.6	145		136.6	752	.5	1005.1
		45				
1004.9	155		181.6	1115	.6	1005.5
		267.4				
1006.3	227		449	3582	1.0	1007.3
		328.25				
1007.6	278		777.25	7372	1.4	1009.0

6813

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT _____ FILE NO. _____
SHEET NO. ____ OF ____ SHEETS
FOR _____
COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____

A - OVERBANK FLOW 150' D.S. OF LAKE WINOLA
B - CULVERT UNDER SECT A
C - FLOW AT OUTLET OF LAKE WINOLA
CONTROL SECTION



C-12

8315

Data for Dam at Outlet of Subarea A1

Name of Dam: LAKE WINOLA

Storage Data:

Elevation	Area (acres)	Storage million gals	Storage acre-ft	Remarks
906.8 = ELEVO*	0	0	0	
997 = ELEV1	190 = A1	1862	5715 = S1	
1000	203			
1020	285			
**				

* ELEVO = ELEV1 - $(3S_1/A_1)$

** Planimetered contour at least 10 feet above top of dam

Reservoir Area at Top of Dam is 17 percent of watershed.

Remarks:

SUSQUEHANNA River Basin

Name of Stream: TRIBUTARY TO BEAVER CREEK

Name of Dam: WINOLA MILL POND

~~NDS ID No.~~: _____

~~DER ID No.~~: _____

Latitude: N 41°30'20" Longitude: W 75°50'30"

Drainage Area: 1.92 sq. mile

Data for Subarea: A1 (see Sketch on Sheet C-4)

Name of Dam at Outlet of Subarea: LAKE WINOLA

Drainage Area of Subarea: 1.7 sq. mile

Subarea Characteristics:

Assumed Losses: 1.0-inch initial abstraction + 0.05 in/hr

The following are measured from outlet of subarea to the point noted:

L = Length of Main Watercourse extended to the divide = 2.1 mile

L_{CA} = Length of Main Watercourse to the centroid = 1.1 mile

From NAB Data: AREA 11, PLATE E

CENTROID FALLS ADJACENT TO RESERVOIR $L_{RESERVOIR-DIVIDE} = 0.85$ mi

Cp = 0.62

C_T = 1.5

NOT USED

$T_P = C_T (L)^{0.6} = 1.36$ HRS USED

Tp = $C_T \times (L \times L_{CA})^{0.3}$ = 1.93 (hrs)

Flow at Start of Storm = 1.5 cfs/sq. mile x Subarea D.A = 2.6 cfs

Computer Data:

QRCSN = -0.05 (5% of peak flow)

RTIOR = 2.0

Remarks: _____

Data for Dam at Outlet of Subarea A2
(see Sketch on Sheet C-4)

Name of Dam: WINOLA MILL POND

Height: 20 (existing)

Spillway Data:	Existing Conditions	Design Conditions
Top of Dam Elevation	997.7	998.1
Spillway Crest Elevation	993.1	993.1
Spillway Head Available (ft)	4.6	5.0
Type Spillway	BROAD CRESTED SKI-JUMP	
"C" Value - Spillway		
Crest Length - Spillway (ft)		
Spillway Peak Discharge (cfs)	SEE NEXT SHEET	
Auxiliary Spillway Crest Elevation		
Auxiliary Spillway Head Available (ft)		
Type Auxiliary Spillway	BROAD CRESTED SKI-JUMP	
"C" Value - Auxiliary Spillway		
Crest Length - Auxiliary Spillway (ft)		
Auxiliary Spillway Peak Discharge (cfs)		
Combined Spillway Discharge (cfs)		

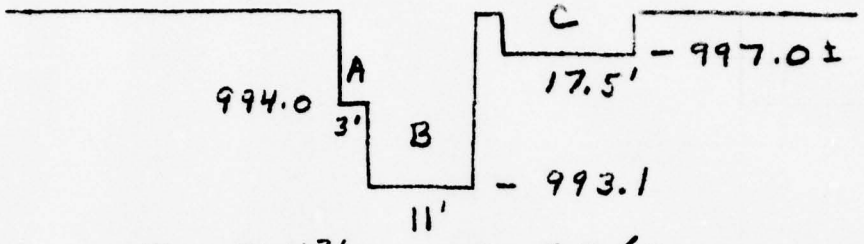
Spillway Rating Curve: SEE NEXT SHEET

Elevation	Q Spillway (cfs)	Q Auxiliary Spillway (cfs)	Combined (cfs)

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT _____ FILE NO. _____
SHEET NO. ____ OF ____ SHEETS
FOR _____
COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____

WINOLA MILL POND
SPILLWAY CAPACITY



$Q = CLH^{3/2}$ $C = 2.7$ (BROAD CRESTED WEIR)

POOL	H_A	Q_A	H_B	Q_B	H_C	Q_C	ΣQ
993.1	0	0	0	0	0	0	0
994.0	0	0	.9	25	0	0	25
994.1	.1	NEGL	1.0	30	0	0	30
995.0	1.0	8	1.9	78	0	0	86
996.0	2.0	23	2.9	147	0	0	170
997.0	3.0	42	3.9	229	0	0	271
997.4	3.4	51	4.3	265	.4	12	328
998.1	4.1	67	5.0	332	1.1	55	454
999.0	5.0	91	5.9	426	2.0	134	651
1000.0	6.0	119	6.9	538	3.0	246	903
1005.0	11.0	296	11.9	1219	8.0	1069	2584

6315

Data for Dam at Outlet of Subarea A2

Name of Dam: WINOLA MILL POND

Storage Data:

Elevation	Area (acres)	Storage million gals	Storage acre-ft	Remarks
978 = ELEVO*	0	0	0	
993.1 = ELEV1	4.2 = A1		32 = S1*	
998.1	7.7		61	
1000	9.3			
**				

S1 = (HT. x SURFACE AREA)/2 HT = ELEV 1 - ELEVO

* ~~ELEVO - ELEV1 (Top of Dam)~~ ARTIFICIAL ELEVO USED FOR COMPUTER ANALYSIS EL 970.2

** Planimetered contour at least 10 feet above top of dam

Reservoir Area at Top of Dam is NEGL percent of UNCONTROLLED watershed.

Remarks: _____

SUSQUEHANNA River Basin

Name of Stream: TRIBUTARY TO BEAVER CREEK

Name of Dam: WINOLA MILL POND

~~NDS ID No.~~: _____

~~DER ID No.~~: _____

Latitude: N 41° 30' 20" Longitude: W 75° 50' 30"

Drainage Area: 1.92 sq. mile

Data for Subarea: _____ (see Sketch on Sheet C-4)

Name of Dam at Outlet of Subarea: A2

Drainage Area of Subarea: 0.22 sq. mile

Subarea Characteristics:

Assumed Losses: 1.0-inch initial abstraction + 0.05 in/hr

The following are measured from outlet of subarea to the point noted:

L = Length of Main Watercourse extended to the divide = 0.70 mile

L_{CA} = Length of Main Watercourse to the centroid = 0.30 mile

From NAB Data: AREA 11, PLATE E

Cp = 0.62

C_T = 1.5

$Tp = C_T \times (L \times L_{CA})^{0.3}$ = 0.94 (hrs)

Flow at Start of Storm = 1.5 cfs/sq. mile x Subarea D.A = 0.3 cfs

Computer Data:

QRCSN = -0.05 (5% of peak flow)

RTIOR = 2.0

Remarks: _____

SELECTED COMPUTER OUTPUT

ITEM	PAGES
MULTIPERIOD ANALYSIS	
INPUT	C-20
SYSTEM PEAK FLOWS	C-21
LAKE WINOLA DAM	C-22
WINOLA MILL POND DAM	C-23

NOTE: ON THE COMPUTER INPUT, AN ARTIFICIALLY HIGH TOP OF DAM ELEVATION WAS INPUT FOR LAKE WINOLA DAM TO be CONSISTENT WITH THE SPILLWAY RATING CURVES USED.

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********
    1                 A1                                NATIONAL DAM INSPECTION PROGRAM
    2                 A2                                  TRIBUTARY TO BEAVER CREEK
    3                 A3                                      WINOLA MILL POND DAM
    4                 B     300        0       15        0        0        0        0        0       -4        0
    5                 B1      5
    6                 J       1        8        1
    7                 J1      1      0.5      0.4      0.3      0.2      0.1     0.05     0.02
    8                 K       0        1                                          1
    9                 K1        RUNOFF INTO HARVEYS LAKE
   10                 M       1        1      1.7                1.92                                1
   11                 P                21.3      118      127      136      142      145
   12                 T                                                          1.0      .05                .17
   13                 W    1.36     0.62
   14                 X    -1.5    -0.05      2.0
   15                 K       1        2                                          1
   16                 K1        ROUTE THROUGH LAKE WINOLA
   17                 Y                                  1
   18                 Y1      1                                                -997       -1
   19                 Y4    997    997.9    999.7   1000.8   1002.0     1003   1003.3     1004     1005     1006
   20                 Y4   1007
   21                 Y5      0        4       59      127      730      750      790     1050     1630     2600
   22                 Y5   4150
   23                 $A      0      190      203      285
   24                 $E  906.8      997     1000     1020
   25                 $$    997
   26                 $D   1019
   27                 K       0        2                                          1
   28                 K1        UNCONTROLLED RUNOFF INTO WINOLA MILL POND
   29                 M       1        1     0.22                1.92                                1
   30                 P                21.3      118      127      136      142      145
   31                 T                                                          1.0      .05
   32                 W    0.94     0.62
   33                 X    -1.5    -0.05      2.0
   34                 K       2        2                                          1
   35                 K1        COMBINE RUNOFF TO WINOLA MILL POND
   36                 K       1        2                                          1
   37                 K1        ROUTE THROUGH WINOLA MILL POND
   38                 Y                                  1
   39                 Y1      1                                              -993.1       -1
   40                 Y4  993.1      994    994.1      995      996      997    998.1      999     1000     1005
   41                 Y5      0       25       30       86      170      271      454      651      903     2584
   42                 $A      0      4.2      9.3
   43                 $E  970.2    993.1     1000
   44                 $$  993.1
   45                 $D  997.4
   46                 $L      1        8       71      115      232      252
   47                 $V  997.4    997.7    997.8    997.9      998     1000
   48                 K      99
```

C-20

E

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 1.00	RATIO 2 .50	RATIO 3 .40	RATIO 4 .30	RATIO 5 .20	RATIO 6 .10	RATIO 7 .05	RATIO 8 .02
HYDROGRAPH AT	1	1.70	1	5259.	2630.	2104.	1578.	1052.	526.	263.	105.
	(	4.40)	(	148.93)(	74.47)(	59.57)(	44.68)(	29.79)(	14.89)(	7.45)(	2.98)(
ROUTED TO	2	1.70	1	1358.	412.	123.	70.	36.	8.	2.	1.
	(	4.40)	(	38.47)(	11.67)(	3.48)(	1.97)(	1.03)(	.22)(	.07)(	.03)(
HYDROGRAPH AT	2	.22	1	820.	410.	328.	246.	164.	82.	41.	16.
	(	.57)	(	23.22)(	11.61)(	9.29)(	6.97)(	4.64)(	2.32)(	1.16)(	.46)(
2 COMBINED	2	1.92	1	1462.	447.	353.	259.	168.	84.	42.	17.
	(	4.97)	(	41.41)(	12.66)(	10.00)(	7.34)(	4.75)(	2.37)(	1.19)(	.47)(
ROUTED TO	2	1.92	1	1461.	434.	296.	212.	134.	63.	27.	11.
	(	4.97)	(	41.37)(	12.28)(	8.38)(	6.01)(	3.79)(	1.78)(	.75)(	.30)(

SUMMARY OF DAM SAFETY ANALYSIS

LAKE WINOLA DAM

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	997.00	997.00	1019.00
STORAGE	5713.	5713.	10876.
OUTFLOW	0.	0.	22750.

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
1.00	1004.53	0.00	7261.	1358.	0.00	44.00	0.00
.50	1001.37	0.00	6583.	412.	0.00	44.75	0.00
.40	1000.73	0.00	6452.	123.	0.00	46.50	0.00
.30	999.87	0.00	6276.	70.	0.00	47.25	0.00
.20	998.96	0.00	6094.	36.	0.00	48.00	0.00
.10	998.03	0.00	5910.	8.	0.00	51.00	0.00
.05	997.52	0.00	5812.	2.	0.00	53.00	0.00
.02	997.21	0.00	5752.	1.	0.00	53.00	0.00

SUMMARY OF DAM SAFETY ANALYSIS

WINOLA MILL POND DAM

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	993.10	993.10	997.40
STORAGE	32.	32.	56.
OUTFLOW	0.	0.	338.

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
1.00	998.95	1.55	68.	1461.	19.25	43.50	0.00
.50	997.88	.48	60.	434.	6.75	44.75	0.00
.40	997.15	0.00	54.	296.	0.00	41.25	0.00
.30	996.42	0.00	50.	212.	0.00	41.25	0.00
.20	995.57	0.00	44.	134.	0.00	41.25	0.00
.10	994.63	0.00	39.	63.	0.00	41.25	0.00
.05	994.03	0.00	36.	27.	0.00	41.75	0.00
.02	993.48	0.00	34.	11.	0.00	41.75	0.00

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AND CARPENTER, INC.
HARRISBURG, PA.

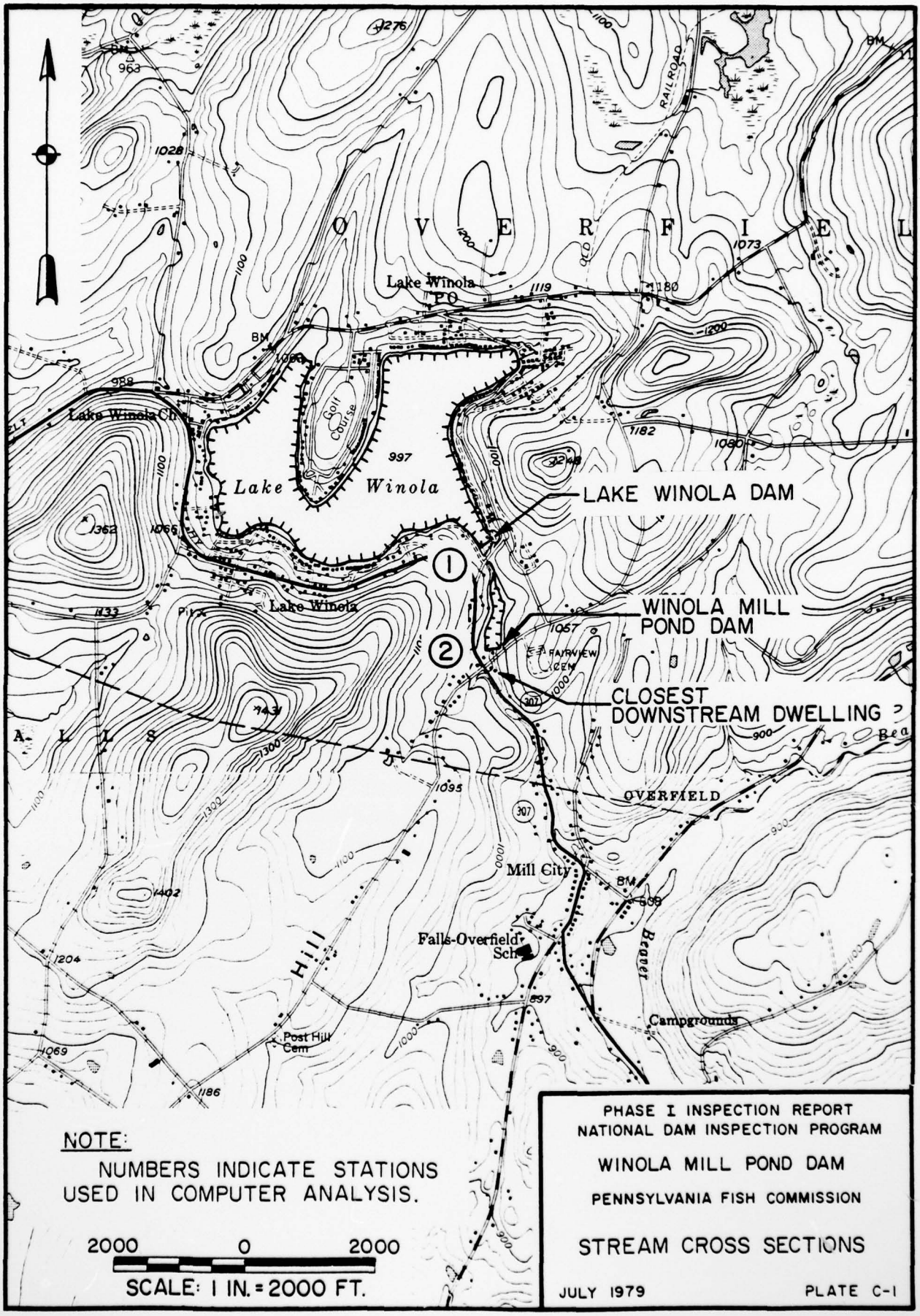
SUBJECT _____ FILE NO. _____
_____ SHEET NO. ____ OF ____ SHEETS
FOR _____
COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____

TABLE OF PERTINENT RESULTS

PMF RAINFALL = 24.71"

	PMF	½ PMF
RUNOFF (INCHES - APPROXIMATE)	22.5	11.2
LAKE WINOLA DAM		
INFLOW - CFS	5259	2630
OUTFLOW - CFS	1358	412
WINOLA MILL POND DAM		
INFLOW - CFS	1462	447
OUTFLOW - CFS	1461	434
DEPTH OF OVERTOPPING OVER TOP OF DAM (FT.)	1.55 (1)	0.48 (2)
DURATION OF OVERTOPPING OVER TOP OF DAM (HRS.)	19.25	6.75

(1) 4.85' OVER MAIN SPILLWAY WALLS
(2) 3.78' OVER MAIN SPILLWAY WALLS



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

WINOLA MILL POND DAM

PENNSYLVANIA FISH COMMISSION

STREAM CROSS SECTIONS

JULY 1979 PLATE C-1

SUSQUEHANNA RIVER BASIN

TRIBUTARY TO BEAVER CREEK, WYOMING COUNTY

PENNSYLVANIA

WINOLA MILL POND DAM

NDI ID No. PA-00893
DER ID No. 66-35

PENNSYLVANIA FISH COMMISSION

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

JULY 1979

APPENDIX D

PHOTOGRAPHS

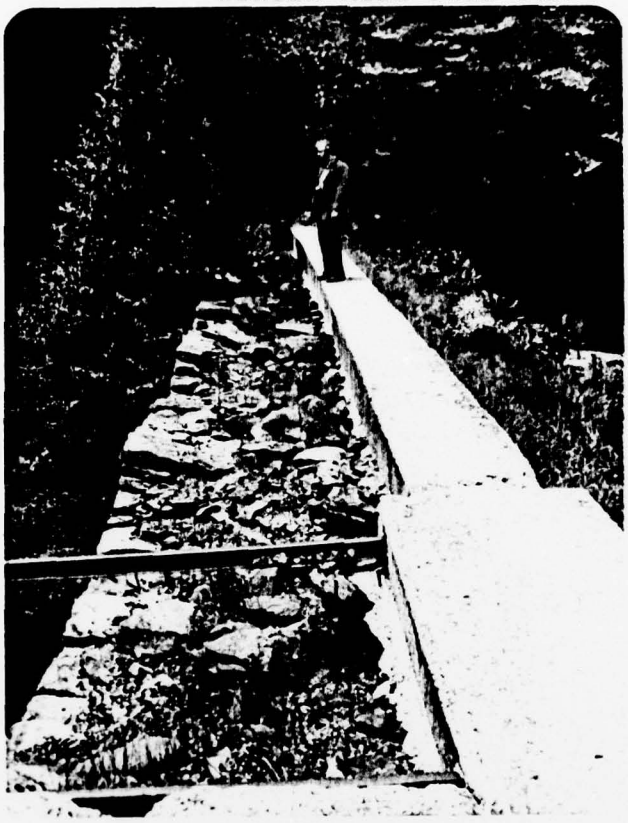
WINOLA MILL POND DAM



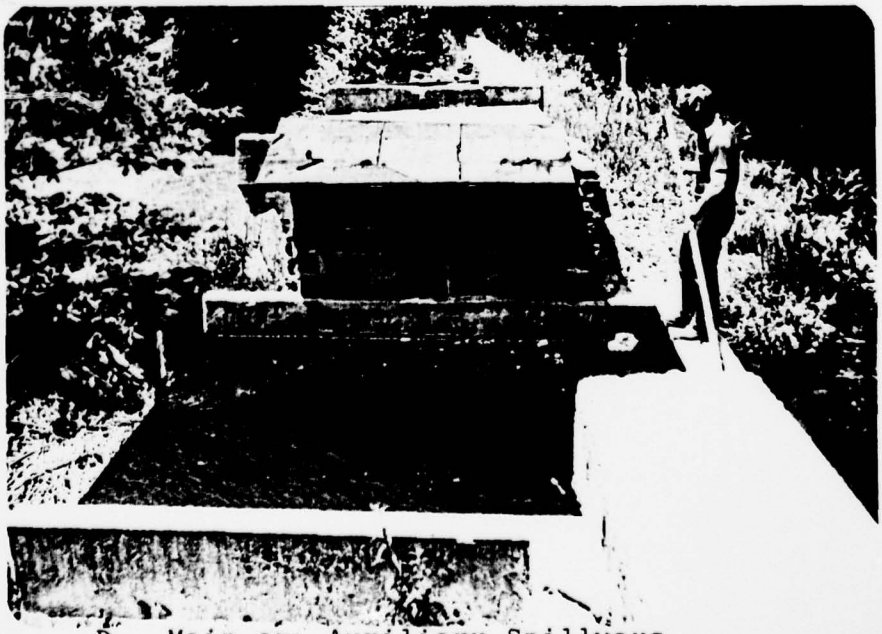
A. Downstream Face



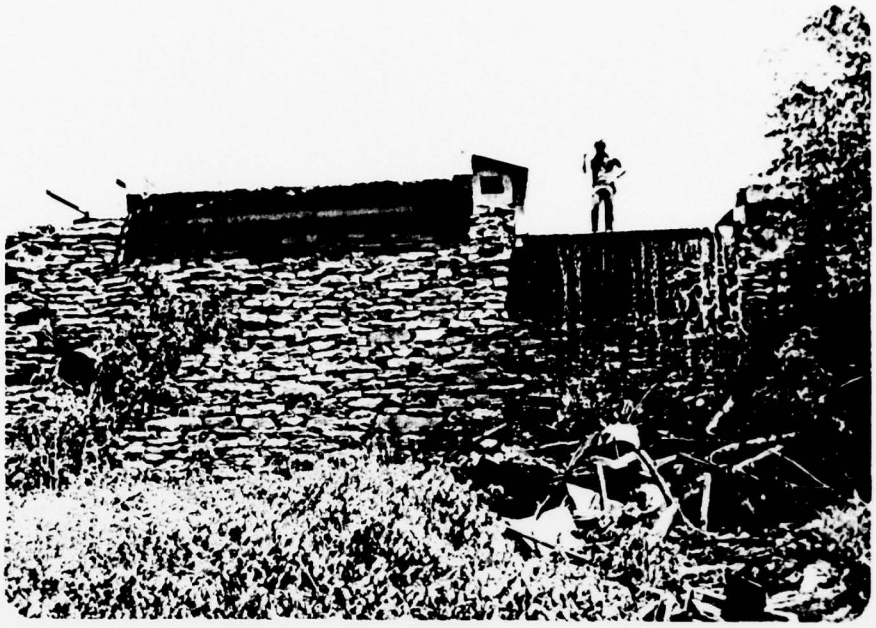
B. Top of Dam



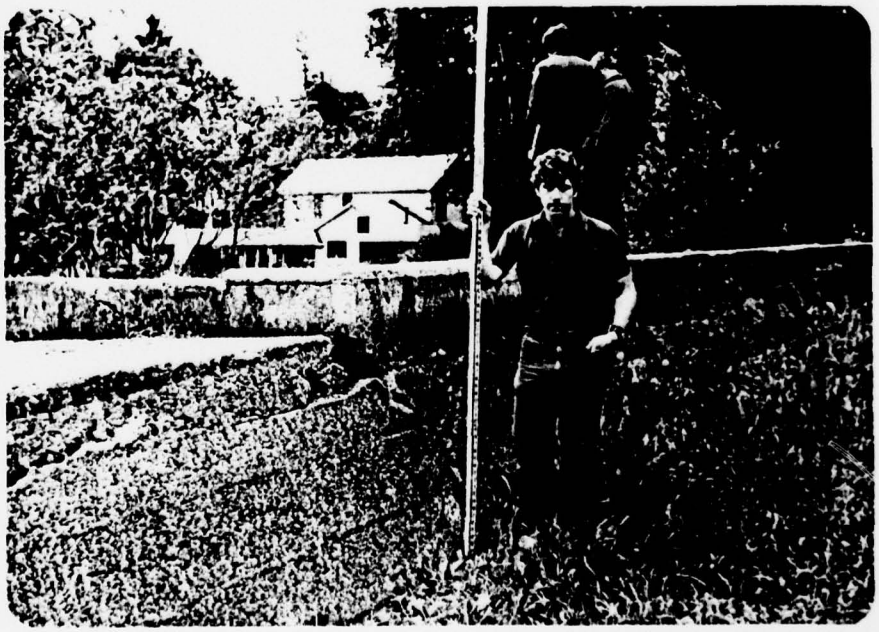
C. Top of Dam



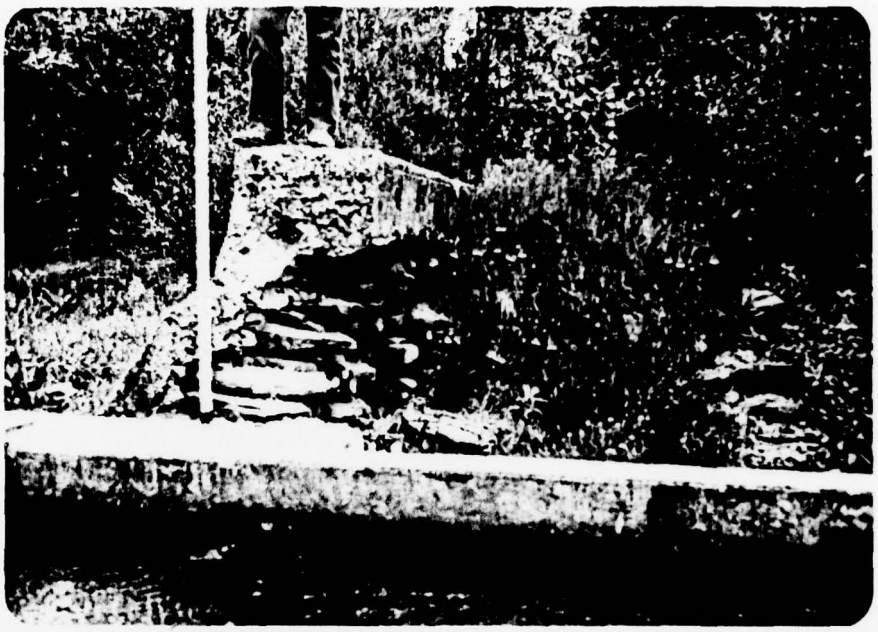
D. Main and Auxiliary Spillways



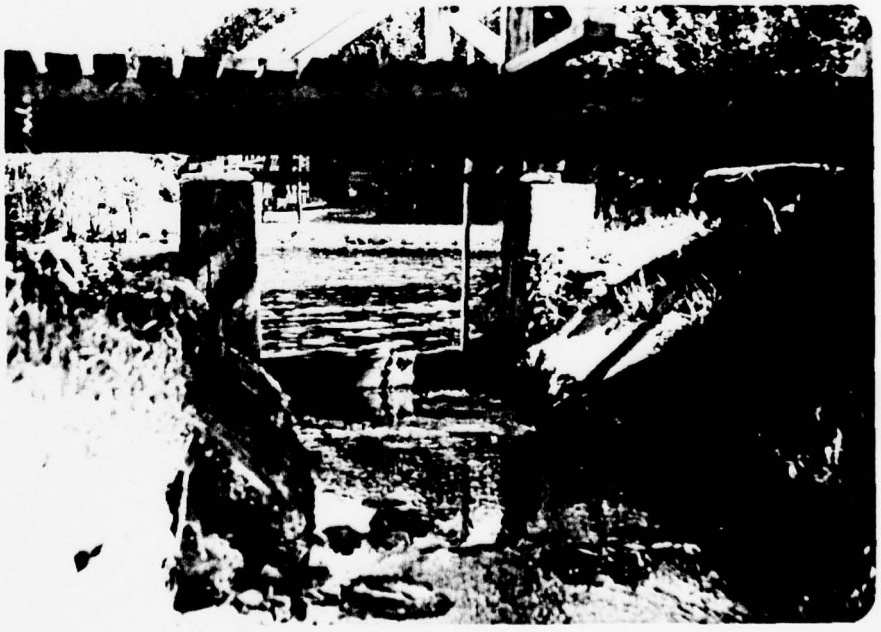
E. Main and Auxiliary Spillways



F. Cracking on Upstream Concrete Face



G. Area Left of Main Spillway



H. Lake Winola Dam - upstream
from Winola Mill Pond Dam

SUSQUEHANNA RIVER BASIN

TRIBUTARY TO BEAVER CREEK, WYOMING COUNTY

PENNSYLVANIA

WINOLA MILL POND DAM

NDI ID No. PA-00893
DER ID No. 66-35

PENNSYLVANIA FISH COMMISSION

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

JULY 1979

APPENDIX E

GEOLOGY

WINOLA MILL POND DAM

APPENDIX E

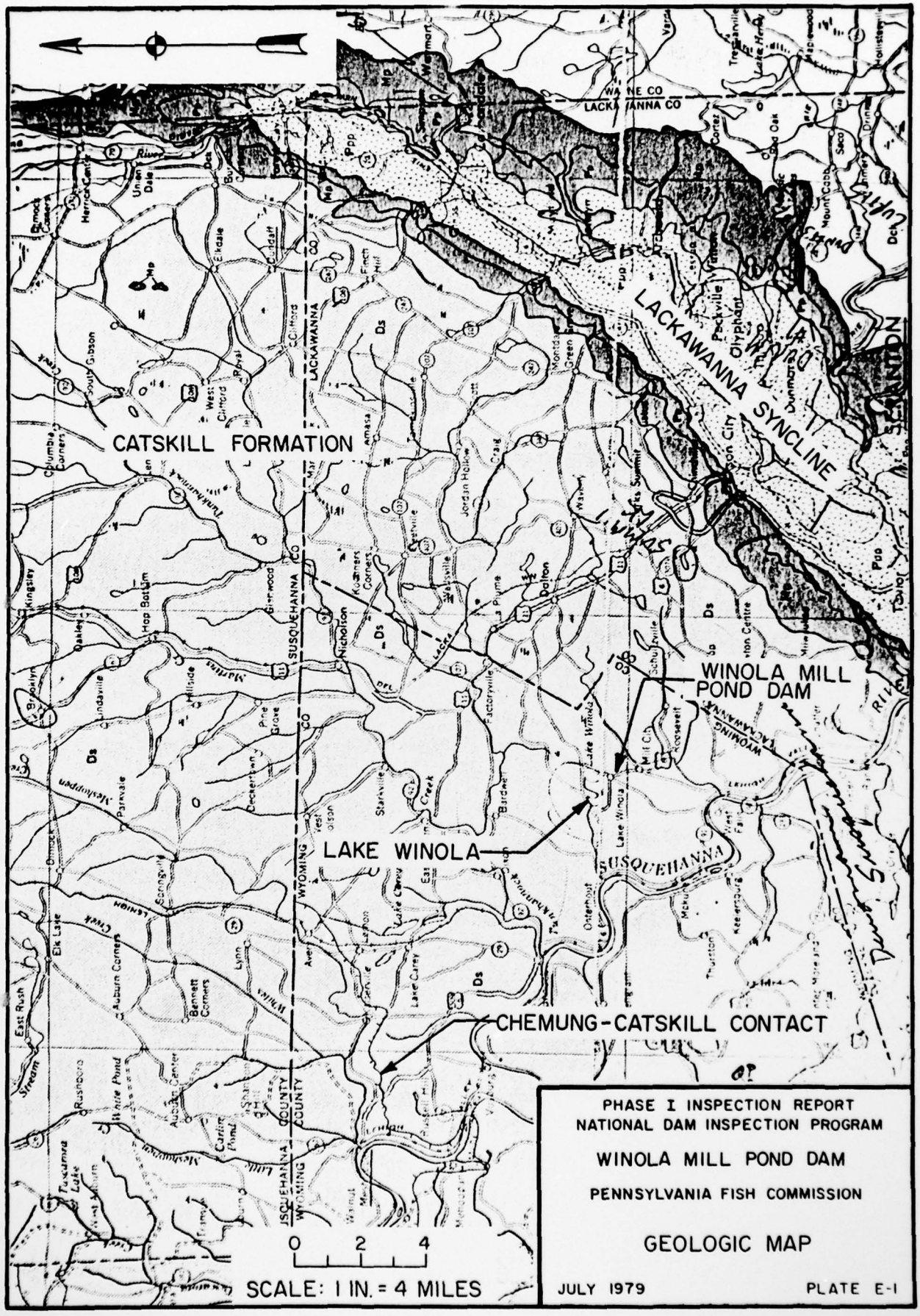
GEOLOGY

1. General Geology. The damsite and reservoir are located in Wyoming County. In general, the rocks of Wyoming County are practically horizontal, as there are no major folds. There are a number of minor anticlines and synclines, most of which trend in a northeasterly direction. At the northwest corner of the county, the Wilmot anticline crosses the North Branch of the Susquehanna River at Skinners Eddy, bringing up the top strata of the Chemung formation. The axis trends about N 65°E and the dips on both sides are very gentle, not exceeding 5° to 6°. The adjacent axis of the Bernice syncline passes across the top of Dutch Mountain in North Branch Township, forming the Mehoopany Coal Basin, and continues as a gentle fold across the county about 8 miles southeast of, and generally parallel to, the Wilmot anticline. The syncline leaves the county about 2 miles east of West Nicholson in Nicholson Township. Southeast of the Bernice Syncline, the rocks are nearly horizontal, except for minor undulations, as far as the eastwood extension of the White Deer anticline beyond the southeast corner of the county.

The Pottsville formation, Mauch Chunk shale and Pocono sandstone crop out only on the summits of the high mountains in the southwest corner of Wyoming County. The Pocono extends as far east as Tunkhannock. The greater part of the county is underlain by rocks belonging to the Catskill continental group.

2. SITE GEOLOGY. Lake Winola Dam is underlain by the Susquehanna Group of Devonian Age. The dam is situated in the glaciated low plateaus section on nearly horizontal strata. The Susquehanna group is a complex unit of conglomerates, sandstones, siltstones, and shales. From the base of this unit to the top, the following changes occur: 1) grain size increases from bottom to top; 2) average thicknesses of beds increases upwards; 3) percent red color in shales increases upwards; 4) in general, percent silica in rocks increases upwards. Bedding is usually well developed with thicknesses up to sixteen feet in the coarser

beds. Joints are usually open and steeply dipping or vertical. The shales air-slake rapidly when exposed to the atmosphere. The silt-stones, sandstones and conglomerates are moderately resistant to weathering. There are abundant swamps and lakes in the area. The actual foundation conditions beneath Winola Mill Pond Dam are unknown.



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WINOLA MILL POND DAM

PENNSYLVANIA FISH COMMISSION

GEOLOGIC MAP

JULY 1979

PLATE E-1