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NATIONAL DAM INSPECTION PROGRAM. LAKE ALTOONA DAM. NDI ID NUMBE--ETC(U)
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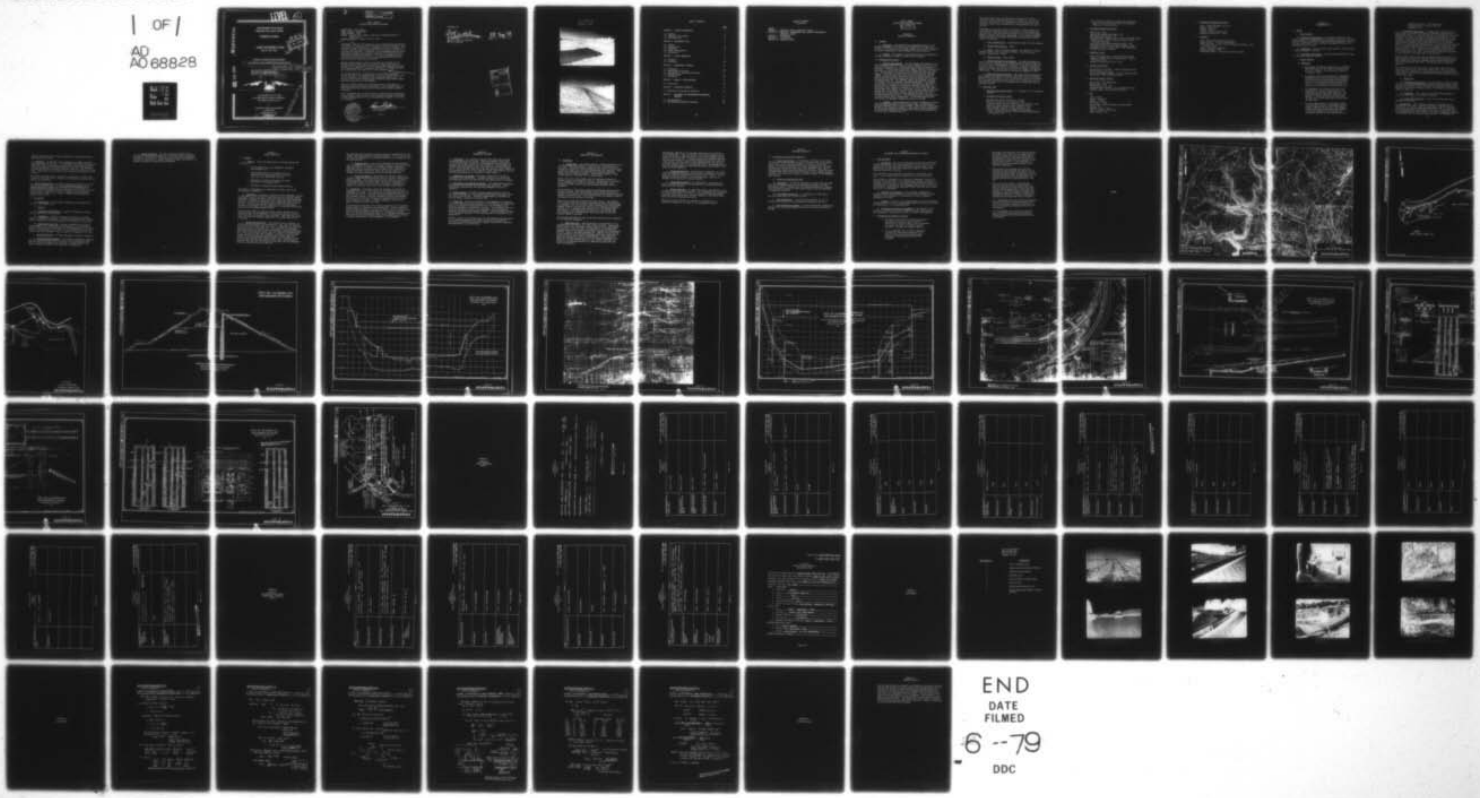

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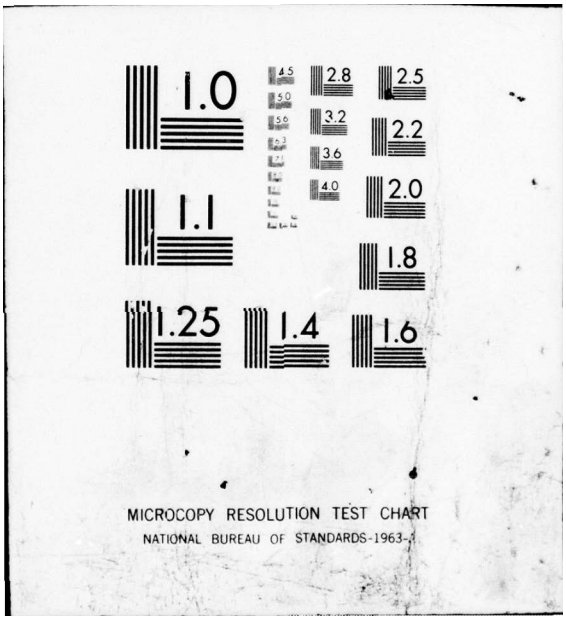
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LAKE ALTOONA DAM
NDI I.D. NO: 532

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

Lake Altoona Dam. NDI ID Number 532. Susquehanna River Basin. Burgoon Run, Blair County, Pennsylvania. Phase I Inspection Report.

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PREPARED FOR

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS
BALTIMORE, MARYLAND 21203

BY

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PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

NAME OF DAM: Lake Altoona
STATE LOCATED: Pennsylvania
COUNTY LOCATED: Blair
STREAM: Burgoon Run, secondary tributary to Beaverdam Branch of Juniata River
DATE OF INSPECTION: August 9 and 16, 1978

ASSESSMENT: Based on the evaluation of the conditions as they existed on the dates of inspection and as revealed by visual observation, the condition of Lake Altoona Dam is considered to be fair. However, city personnel reported that the upstream controls for the lake blow-off valve are not functional. Therefore, it is recommended that the owner immediately evaluate the functional condition of the blow-off valve and perform necessary maintenance. It is also recommended that the ponded water below the toe of the dam be drained and that the flow from this area be monitored and recorded.

Because sudden release of water in the event of a failure of the Fabridam spillway gates may cause property damage downstream and because of the unique nature of these gates, this appurtenance should be frequently inspected by personnel experienced in design, construction, maintenance, and operation of such equipment.

The spillway capacity is classified to be "seriously inadequate" (48 percent PMF if the Fabridam gates deflate, 29 percent PMF if they do not), because it is estimated that overtopping would result in failure of the dam and damage potential would be significantly higher than would exist prior to overtopping.

Since the spillway capacity was determined based on the Corps of Engineers' approximate analysis procedure, it is recommended that the owner reevaluate the spillway capacity using more accurate analysis techniques.

It is recommended that the owner provide around-the-clock surveillance during unusually heavy runoff to detect possible problems and develop a formal warning system to alert the downstream residents in the event of an emergency.

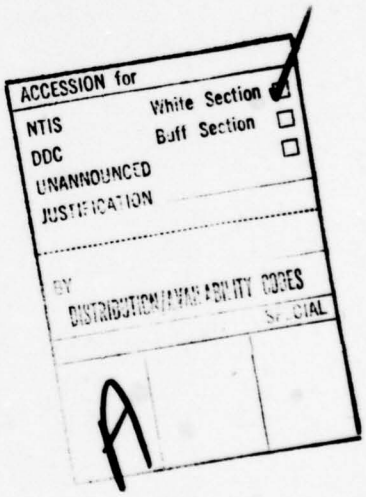
Lawrence D. Andersen, P.E.
Vice President

APPROVED BY:

28 Sep 78

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

Date



LAKE ALTOONA DAM
NDI I.D. NO. 532
AUGUST 9, 1978

Upstream Face

Downstream Face

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM
LAKE ALTOONA DAM
NDI I.D. NO. 532
DER I.D. NO. 7-8

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. The inspection was performed pursuant to the authority granted by The National Dam Inspection Act, Public Law 92-367, to the Secretary of the Army, through the Corps of Engineers, to conduct inspections of dams throughout the United States.

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

1.2 Description of Project

a. Dam and Appurtenances. The Lake Altoona Dam consists of an earth embankment 1600 feet long and with a maximum height of 73 feet from the downstream toe. The dam essentially forms an offstream reservoir. A 20-foot-wide trapezoidal channel along the north side of the reservoir diverts the normal flow of Burgoon Run past the reservoir. The reservoir receives controlled inflow from the diversion channel. The reservoir would also receive any discharge from the primary spillway of Lower Dam, which in turn receives controlled inflow from the diversion channel and from the spillway of the Upper Kittanning Reservoir. The combined primary and emergency spillway is located on the left abutment (looking downstream). As designed, the spillway is an overflow section 8.5 feet below the dam crest. The spillway is equipped with inflatable Fabridam gates which can be raised four feet, leaving a freeboard of 4.5 feet to the dam crest. The spillway exit channel is a trapezoidal concrete channel which discharges into the diversion channel. The outlet works for the dam consist of an intake tower, 60-inch-diameter blow-off pipe, and 36-inch-diameter supply line. Flow from these pipes is controlled by the valve located in the intake tower. The 60-inch blow-off pipe constitutes the emergency drawdown facility for the dam.

b. Location. Lake Altoona Dam is located in Burgoon Run Valley, about one mile downstream from the tunnels under the Penn-Central railroad Horseshoe Curve in Logan Township, Blair County, Pennsylvania. The dam is the lowermost reservoir in the series of three reservoirs in the Burgoon Valley and is located about three miles upstream from the city line of Altoona (Plate 1).

The normal runoff from the Burgoon Run watershed is diverted through a channel bypassing the reservoir (Plate 2). The excess flow into the reservoir is discharged over the spillway into the diversion channel which terminates at a plunge pool at the toe of the dam.

Downstream from the dam, Burgoon Run follows a rocky channel and flows through residential areas of Altoona. It is estimated that the failure of this dam would cause large loss of life and property damage in Altoona and further downstream. It is further estimated that the failure of the upper two reservoirs would result in the failure of this dam.

c. Size Classification. Intermediate (based on 73-foot height).

d. Hazard Classification. High.

e. Owner. City of Altoona (address: Mr. William L. Cochran, Director, Water, Parks, and Public Property, City of Altoona, Altoona, Pennsylvania 16601).

f. Purpose of Dam. Water supply.

g. Design and Construction History. The dam was designed in 1906 by Mr. C. W. Knight, a consulting engineer from Rome, New York, to be a 90-foot-high embankment. However, it was only completed to a 73-foot height. The dam was constructed by O'Rorke Construction Company of Altoona and Carothers Construction Company of Greensburg, Pennsylvania. The construction of the dam was completed in 1913.

h. Normal Operating Procedure. The normal operating procedure is to maintain the lake level at the crest level of the inflatable gates, which would leave 4.5 feet of freeboard to the top of the dam. The flow occurring when the pool level is at or above the crest of the inflatable gates will be discharged over the spillway into the diversion channel.

1.3 Pertinent Data

a. Drainage Area (square miles) - 1.7 (direct) + 11.2 (diversion channel)

b. Discharge at Dam Site (cfs)

Maximum known flood at dam site - Unknown
Warm water outlet at pool elevation - N/A
Diversion tunnel low pool outlet at pool elevation - N/A
Diversion tunnel outlet at pool elevation - N/A
Gated spillway capacity at pool elevation - N/A
Gated spillway capacity at maximum pool elevation - 9,300 (without Fabridam), 5200 (with Fabridam inflated) at Elevation 1364

Total spillway capacity at maximum pool elevation - 9,300 (without Fabridam), 5200 (with Fabridam inflated) at Elevation 1364

c. Elevation (USGS Datum) (feet)

Top of dam - 1364
Maximum pool-design surcharge - N/A
Full flood control pool - N/A
Recreation pool (normal pool) - 1355.5 (spillway crest)
Spillway crest - 1355.5 (concrete crest); 1359.5 (Fabridam inflated)
Upstream portal invert diversion tunnel - N/A
Downstream portal invert diversion tunnel - N/A
Streambed at center line of dam - 1285 (estimated)
Minimum tailwater - Unknown

d. Reservoir (feet)

Length of maximum pool - 2700 at Elevation 1364
Length of recreation pool (normal pool) - 2500 at Elevation 1355.5
Length of flood control pool - N/A

e. Storage (acre-feet)

Recreation pool (normal) - 1842 at Elevation 1355.5
Flood control pool - N/A
Design surcharge (maximum) - 2790 at Elevation 1364
Top of dam - 2790 at Elevation 1364

f. Reservoir Surface (acres)

Top of dam - 107± (estimated)
Maximum pool - N/A
Flood control pool - N/A
Recreation pool (normal) - 85 at Elevation 1355.5
Spillway crest - 85 at Elevation 1355.5

g. Dam

Type - Earth
Length - 1650 feet
Height - 73 feet
Top width - 20 feet
Side slopes - 2H:1V (upstream and downstream)
Zoning - Yes
Impervious core - None
Cutoff - Concrete cutoff wall
Grout curtain - No

h. Diversion and Regulating Tunnel

Type - 60-inch-diameter cast iron
Length - 200± feet
Closure - Valve
Access - Gates at intake tower
Regulating facilities - Gates

i. Spillway

Type - Broad-crested overflow section
Length of weir - 132 feet (as measured)
Crest elevation - 1359.5 (top of inflated Fabridams), 1355.5 (concrete crest)
Gates - Inflatable Fabridams
Upstream channel - Lake
Downstream channel - Trapezoidal concrete channel

SECTION 2
ENGINEERING DATA

2.1 Design

a. Data Available

(1) Hydrology and Hydraulics. No original design data were found relative to the hydrology and hydraulics for the dam. A report prepared by Hazen, Whipple and Fuller Consulting Engineers of New York, New York, dated May 27, 1921, includes a recommended capacity for enlargement of the spillway.

(2) Embankment. State and owner files include a limited number of design drawings for the dam.

(3) Appurtenant Structures. Limited design drawings were found for the outlet works and spillway.

b. Design Features

(1) Embankment

a. As designed, the dam was supposed to be a 90-foot-high embankment with its crest at Elevation 1383 (Plate 3). However, the dam was only completed to Elevation 1364.

b. As designed, the dam is essentially a homogeneous embankment with a concrete cutoff wall extending from six feet below the present crest elevation to about 20 feet into the original ground level (Plate 4). As constructed the cutoff wall is about 20 feet downstream of the dam center line.

c. The embankment, as it exists, has two to one (horizontal to vertical) slopes on both the downstream and upstream slopes (Plate 5). The downstream slope of the dam is broken by two benches: a 40-foot-wide bench 33 feet below the dam, and a 25-foot-wide bench 58 feet below the dam crest.

d. A design drawing (Plate 6) indicates at least six holes were drilled to investigate the subsurface conditions at the site. The borings indicate that the typical subsurface condition at the site consists of 10 to 30 feet of overburden underlain by alternating layers of

sandstone and shale. The borings were extended from 30 to 70 feet into the foundation rock.

c. Appurtenant Structures. The appurtenant structures for the dam consist of the combined primary and emergency spillway and the outlet works (Plate 7). The spillway crest is equipped with inflatable Fabridams which were installed to increase storage capacity of the reservoir. The combined primary and emergency spillway for the dam is located on the left abutment and discharges into the diversion channel which terminates at a plunge pool at the toe of the dam (Plate 8). The inflatable Fabridam gates on the spillway were designed by N. M. Imberson and Associates, Inc., of Burbank, California, and were installed in 1968. These gates were designed to be inflated either by water or air. However, city personnel reported that only air has been used in the past. Controls for the gates are located in a control house on the right side of the spillway.

Design reports indicate that when the Fabridam gates are under automatic operation, they start to deflate when the water depth over the bags reaches six inches and completely deflate when the water depth over the bags reaches three feet. The bags may also be deflated manually.

The outlet works for the dam consist of an intake tower, a 60-inch cast-iron blow-off pipe, and 36-inch supply line. The flows through these lines are controlled by valves and sluice gates located at the intake tower. Plates 9 and 10 illustrate the cross section and details of the intake tower.

d. Design Data

(1) Hydrology and Hydraulics. The 1921 report by Hazen, Whipple and Fuller Consulting Engineers recommended the design capacity of the spillway be increased to 3000 cubic feet per second (cfs) which would bring the total flood discharge capacity of the reservoir and diversion channel to 4000 cfs.

(2) Embankment. Other than the available design drawings, no other data were found on the design of the dam.

(3) Appurtenant Structures. There are no design data on the appurtenant structures.

2.2 Construction. Very limited information is available on the construction of the dam. Available information indicates that construction of the dam was under the supervision of Mr. C. W. Knight, the consulting engineer and designer of the dam. To the extent that can be determined, the construction of the dam was apparently conducted in accordance with the plans and specifications. No reference was

found to indicate that any unusual problems were encountered during construction of the dam.

2.3 Operation. As reported by city personnel, no formal operating procedures exist for the dam. It is understood that when the reservoir level rises above the concrete spillway level, the spillway gates are inflated to increase the storage capacity of the dam. The Fabridams are deflated when the reservoir level falls below the concrete spillway level. These gates are controlled from a control house adjacent to the spillway.

The 60-inch blow-off pipe for the dam is controlled by a sluice gate located in the intake tower. However, city personnel reported that the gate is not functional.

2.4 Other Investigations. Available information includes the following two investigation reports: Altoona Water Works Report on the Spillway and Flood Channels, May 27, 1921, by Mr. Allen Hazen of Hazen, Whipple and Fuller Consulting Engineers, New York, New York; and a letter report addressed to the Water Commission of Pennsylvania, dated October 4, 1920, by Mr. Arthur E. Morgan, Morgan Consulting Company, Dayton, Ohio.

2.5 Evaluation

a. Availability. The available information was obtained from the owner and PennDER files.

b. Adequacy

(1) Hydrology and Hydraulics. Available information includes design capacities of the spillways.

(2) Embankment. Available information consists of a limited number of construction drawings. No quantitative geotechnical information is available to aid the assessment of the adequacy of the design.

(3) Appurtenant Structures. Limited information is available on the design of the outlet works and the spillway. Plates 9 and 10 show the details of the intake tower and the arrangements of the control valves. No information is available on the structural details of the pipes through the embankment, such as concrete encasements or the like.

c. Operating Records. No formal operating records are available.

d. Post-Construction Changes. The available information indicates that the present spillway for the reservoir was constructed in 1929, about 13 years after completion of the dam. No other reference was found to indicate changes to the dam after its completion.

e. Seismic Stability. The dam is located in Seismic Zone 1, and based on visual observations, the static stability of the dam is considered to be adequate. Therefore, according to the recommended criteria for evaluation of seismic stability of dams, the structure is presumed to present no hazard from earthquakes.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. The on-site inspection of the Lake Altoona Dam consisted of:

1. Visual inspection of the embankment, abutments, and embankment toe.

2. Visual examination of the spillway and its components, the downstream end of the outlet pipe, and other appurtenant features.

3. Observation of factors affecting the runoff potential of the drainage basin.

4. Evaluation of downstream area hazard potential.

The specific observations are illustrated in Plate 7 and in the photographs in Appendix C.

b. Embankment. The general inspection of the embankment consists of searching for indications of structural distress, such as cracks, subsidence, bulging, wet areas, seeps and boils, and observing general maintenance conditions, vegetative cover, erosion and other surficial features. Extensive wet areas were found downstream from the toe of the dam. The wet areas included numerous pools of perched water. Although no significant flow was observed, it is possible that perched water is fed by seepage through the dam.

Although large trees and brush have been recently removed from the downstream face of the embankment, in some areas the brush is two to three feet high and requires further clearing. High brush and fallen trees obstructed the adequate inspection of the area below the toe of the dam.

c. Appurtenant Structures. The spillway crests, channels, and plunge pool were examined for deterioration, other signs of distress, and any obstruction that would limit flow. In general, the structures were found to be in fair condition. The concrete in the spillway discharge channel was found to be deteriorating, requiring maintenance. The concrete and diversion channel was also found to be deteriorating due to the action of acid mine drainage. A portion of the spillway channel wall was missing, and the dam tender reported that this section of the wall had been removed during the construction of the Fabridam gates and has never been replaced. This condition poses a potential for flow from the spillway to discharge over the embankment which may cause erosion on the dam face.

The operation of the Fabridam spillway gates was explained by the dam tender, identifying manual deflation procedures. It was reported that although the Fabridams can be inflated either by air or water only the air is being used.

d. Reservoir Area. A map review indicates that the watershed area is predominantly covered by woodland; however, some portions have been strip mined. A review of the regional geology (Appendix E) indicates that the shorelines are not likely to be susceptible to massive landslides which would affect the storage volume of the reservoir or cause overtopping of the dam by displaced water.

e. Downstream Channel. Downstream from the dam, Burgoon Run follows a course through residential areas of Altoona, obstructed by numerous bridges. The stream joins Mill Run, which is a tributary of Beaverdam Branch of Juniata River, three miles downstream of Altoona Dam, south of the city limits of Altoona. Photographs in Appendix C illustrate the course of the stream through Altoona.

3.2 Evaluation. In general, while the condition of the dam is considered to be good, the condition of the operating facilities is considered to be poor. City maintenance personnel reported that the blow-off valve is not functional, requiring immediate maintenance and necessary repairs. Although extensive wet areas were observed below the toe of the dam, the amount of seepage from these areas was considered to be small. Observed seepage was clear and no signs of internal erosion were found.

The maintenance condition of the control equipment for the Fabridam spillway gate is considered to be satisfactory. However, because a sudden release of water in the event of failure of the spillway gates may cause property damage downstream and considering the unique nature of the Fabridam spillway gates, it is considered advisable that these facilities be periodically inspected by engineers experienced in design, installation, and maintenance of such equipment.

SECTION 4
OPERATIONAL FEATURES

4.1 Procedures. City personnel reported that there are no formal operating procedures for the dam. When the reservoir level rises to the spillway crest elevation, the Fabridam gates are inflated to increase the storage capacity for the reservoir. The Fabridams are deflated when the reservoir level falls below the concrete spillway level. Two operational features of the dam which may affect safety are the drainpipe valve, if it is required to lower the reservoir, and the Fabridam spillway gates in the event of large floods.

4.2 Maintenance of the Dam. The general condition of the dam is considered to be satisfactory. Periodic removal of the brush from the downstream face of the dam and the area below the toe is required.

4.3 Maintenance of Operating Facilities. City maintenance personnel reported that the blow-off valve has not been functional. Visual observations indicate that the operating equipment is in poor condition.

4.4 Warning System. No formal warning system exists for the dam. The dam is maintained by city personnel operating from Altoona, about four miles from the site. Telephone communication is available at the dam tender's residence at the dam site.

4.5 Evaluation. While the condition of the embankment is considered to be fair, requiring periodic removal of the brush from the downstream face of the dam and the area below the toe, the condition of the operating equipment is considered to be poor. It is reported that the valve for the blow-off pipe is not functional, and this requires immediate maintenance and necessary repairs. The maintenance condition of the operating equipment for the Fabridam gates is considered to be satisfactory.

However, in view of the unique nature of these Fabridam spillway gates, it is considered advisable that these facilities be periodically inspected by personnel experienced in design, construction, operation, and maintenance of such facilities.

SECTION 5
HYDRAULICS AND HYDROLOGY

5.1 Evaluation

a. Design Data. Lake Altoona Dam has a direct watershed area of 1.7 square miles and impounds a reservoir with a surface area of 107 acres. A diversion channel along the left side of the reservoir carries the normal flow from the watershed past the reservoir. Under normal flow conditions, the reservoir only receives controlled inflow from the diversion channel. The diversion channel at Lake Altoona Dam has a watershed of 11.2 square miles.

Excess inflow into Lake Altoona would be discharged through the combined primary and emergency spillway. The capacity of the spillway is estimated to be 5200 cfs with the spillway gates fully inflated and 9300 cfs with the spillway gates deflated, with no freeboard.

In the event of a flood which exceeds the discharge capacity of the diversion channel, Lake Altoona would receive uncontrolled inflow through the spillway of Lower Kittanning Dam and the diversion overflow section on Scotch Gap Run. The flood flow into the reservoir would be discharged over the spillway of the dam.

There are two reservoirs upstream from Lake Altoona. The combined full storage volume of the Upper Kittanning and Lower Kittanning Dams is estimated to be 1380 acre-feet which is greater than the surcharge storage volume of Lake Altoona (920 acre-feet, Fabridams deflated). Therefore, it is estimated that failure of one of the upper dams would result in the overtopping and failure of Lake Altoona Dam. The combined flood discharge would cause large loss of life and property damage in Altoona.

The spillway capacities of the two upstream reservoirs were classified to be "seriously inadequate."

b. Experience Data. Lake Altoona Dam is classified to be an "intermediate" size dam in the "high" hazard category. Under recommended criteria for evaluating spillway capacity, such impoundments are required to pass full PMF. The adequacy of the spillway was analyzed based on the simplified procedure developed by the Baltimore District, Corps of Engineers (Appendix D). Based on this procedure, it was determined that the PMF hydrograph would have a peak flow of 28,000 cfs and a total volume of approximately 17,800 acre-feet. Since the surcharge storage volume of the upstream reservoirs (320 acre-feet) is much smaller than the total volume of the PMF, the effect of the upstream reservoirs in reducing the peak flow rate would be negligible.

The spillway capacity of the upstream reservoirs was determined to be 28 percent PMF. Since the failure of the upper reservoir would result in failure of Lake Altoona Dam, the flood discharge capacity would also be 28 percent. A further analysis was conducted assuming that the overtopping of the upstream reservoirs would not result in a dam failure. In that event, it was determined that the spillway can pass a maximum flow of 48 percent PMF without overtopping the dam when the spillway gates are fully deflated and 29 percent PMF if the gates are fully inflated.

c. Visual Observations. On the dates of inspection, no conditions were observed that would indicate that the spillway of the dam would not function satisfactorily in the event of a flood. If the automatic deflation systems of the Fabridams fail, they can be deflated by the operation of manual controls.

d. Overtopping Potential. As stated above, the spillway can pass 48 percent PMF without overtopping when the Fabridam spillway gates are fully deflated.

e. Spillway Adequacy. As previously stated, the capacity of the spillway is less than 50 percent PMF. It is estimated that overtopping of the dam would result in failure of the dam and downstream damage potential would significantly increase compared to that which would exist just before overtopping failure.

Based on the above results, the spillway is classified to be "seriously inadequate" according to the recommended criteria.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. As discussed in Section 3, the field observations did not reveal any signs of distress that would significantly affect the short-term stability of the dam at this time. Review of available information and visual observations in the field indicate that the dam has been built with reasonable care, and no unsatisfactory conditions were reported in the past. Extensive areas of ponded water exist downstream of the dam, but the seepage quantity appeared to be small and no signs of internal erosion of the embankment were observed.

b. Design and Construction Data

(1) Embankment. The dam was designed at a time (1906 and 1913) when limited understanding of the geotechnical behavior of earth structures existed. Consequently, the available design and construction information includes no quantitative data to aid the assessment of embankment stability.

(2) Appurtenant Structures. No information is available on the structural design of the outlet works.

c. Operating Records. The structural stability is not considered to be affected by the operational features of the dam.

d. Post-Construction Changes. No post-construction changes were reported that would significantly affect the structural stability of the dam.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment

a. Assessment. The visual observations and review of available information indicate that Lake Altoona Dam is in fair condition. It appears that the dam was constructed with reasonable care. Field observations did not reveal any significant signs of distress and none were reported in the past.

The condition of the operational facilities is considered to be poor. It was reported that the blow-off valve is not functional.

The spillway is considered to be "seriously inadequate" because its capacity (48 percent PMF if the Fabridam gates deflate, 29 percent if the gates do not deflate) is less than 50 percent PMF and because it is estimated that overtopping of the embankment would result in failure, significantly increasing the downstream hazard potential which existed just prior to overtopping.

b. Adequacy of Information. The available information in conjunction with visual observations and previous experience of the inspectors are considered to be sufficient to make a reasonable assessment of the dam.

c. Urgency. The first four recommendations should be implemented immediately and the other recommendations should be acted upon as soon as practicable or on a continuing basis.

d. Necessity for Further Investigation. The adequacy of the spillway is considered to require immediate further investigation. The embankment is considered to require no further investigation.

7.2 Recommendations/Remedial Measures

1. The owner should initiate additional hydrology and hydraulic studies to more accurately ascertain the spillway capacity and to determine the nature and extent of remedial measures required to increase the spillway capacity.

2. It is recommended that the owner immediately evaluate the operational condition of the blow-off pipe valve and perform necessary maintenance and adequately maintain the equipment.

3. Brush and trees below the toe of the dam should be cleared to the limit of the ponded area and this area regraded to drain the ponded water. The quantity of flow from this area should be measured and recorded, and the turbidity of the flow should be noted. If flow increases, a detailed study and necessary remedial action should be undertaken.

4. The portion of the spillway wall that was reported as removed during the construction of the Fabridam gates should be replaced to eliminate the potential threat of high flows from the spillway discharging over the embankment and causing erosion of the downstream face of the dam.

5. Due to the unique nature of the Fabridam spillway gates and since a sudden release of water in the event of their failure may cause property damage downstream by overflowing the channel in a residential area of Altoona, this appurtenance should be frequently inspected by personnel experienced in design, construction, maintenance, and operation of such equipment.

6. It is recommended that the owner provide around-the-clock surveillance during unusually heavy runoff and develop a formal warning system to alert the downstream residents in the event of an emergency.

7. It is recommended that the owner be advised that the dam and appurtenant structures be inspected regularly and necessary maintenance be performed.

PLATES

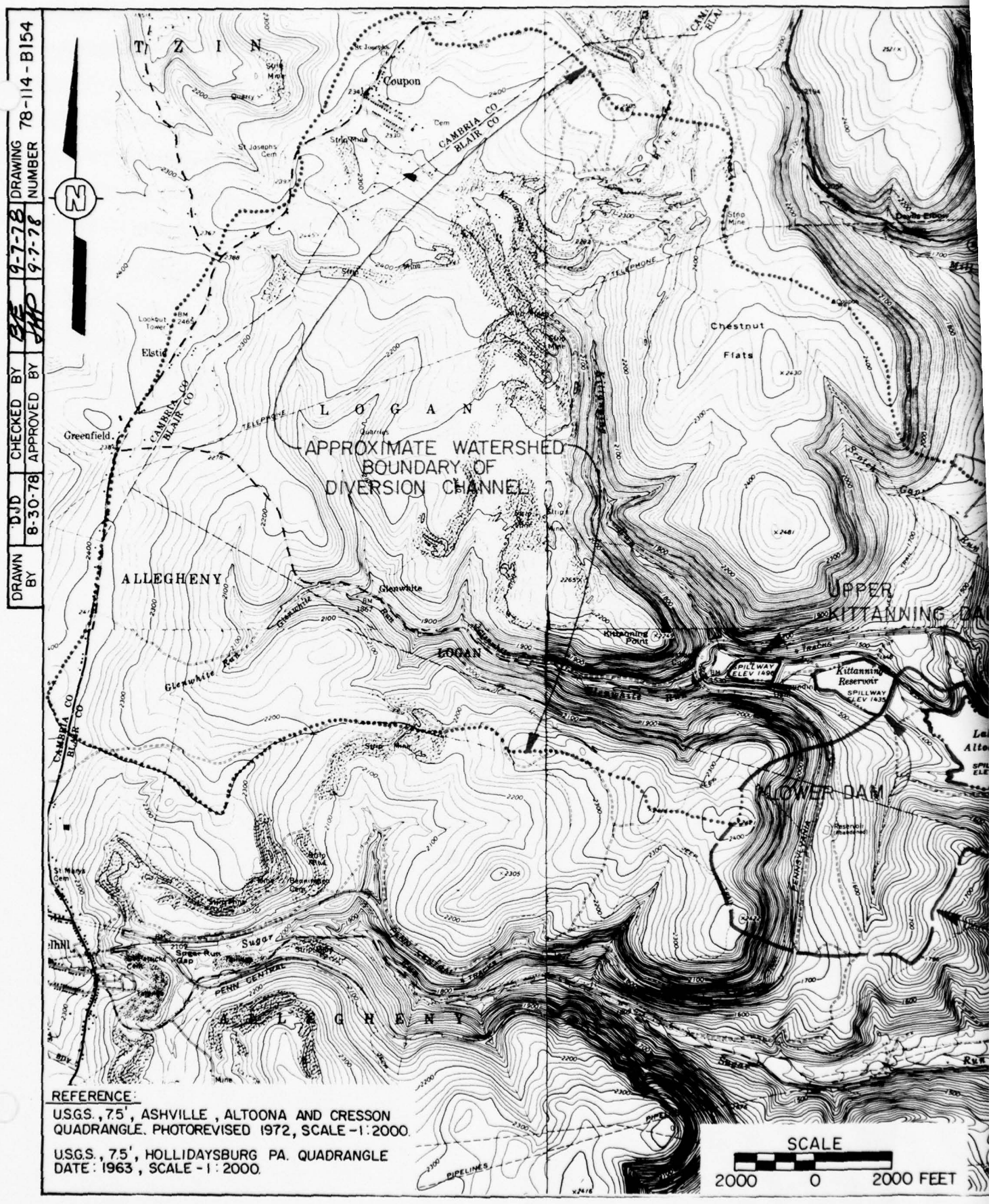

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PLATE I

LAKE ALTOONA DAM
VICINITY, FLOOD PLAIN AND WATERSHED MAP

D'APPOLONIA

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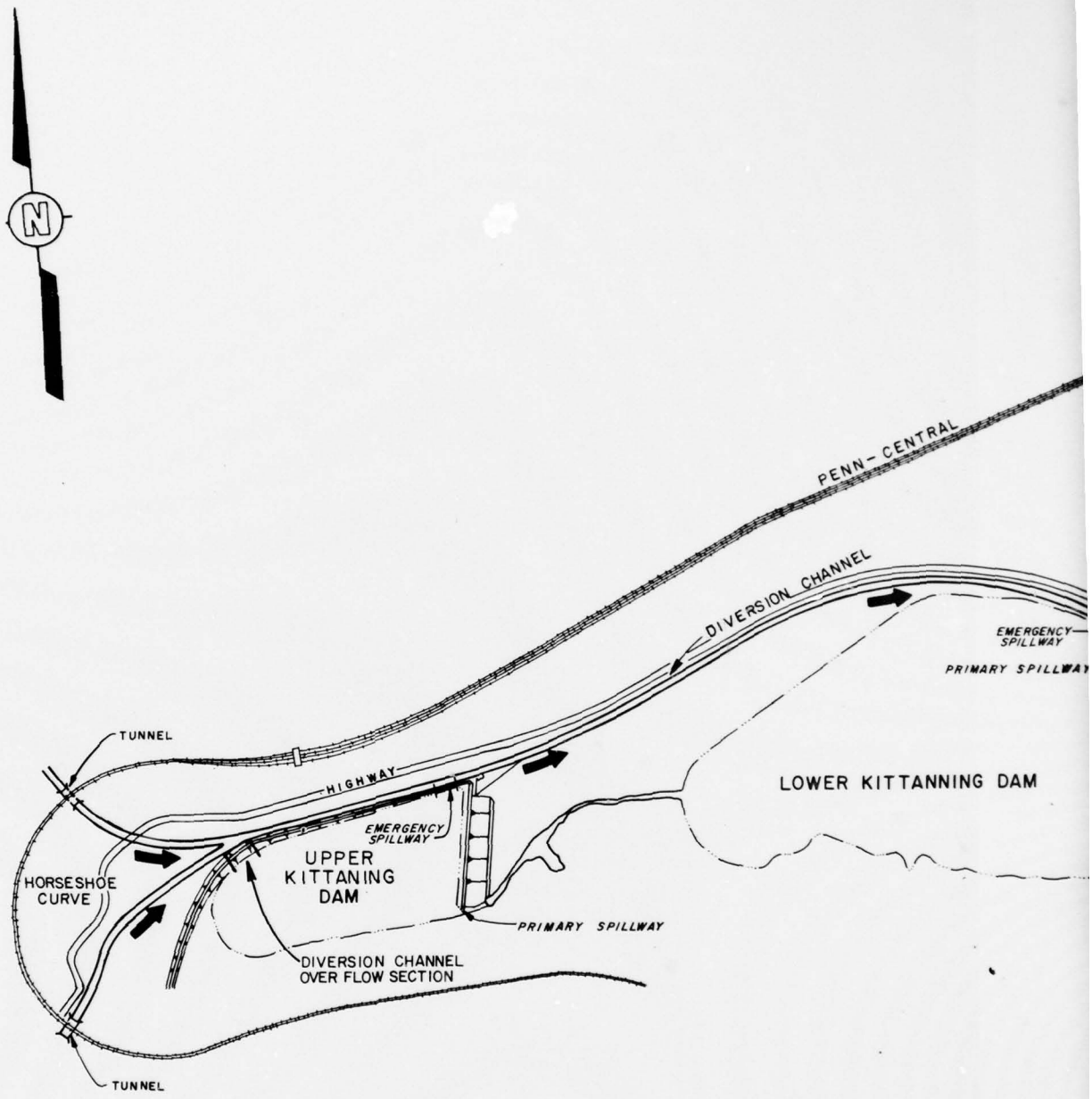
	9-5-78	APPROVED BY	JHP	9-7-78		



LEGEND

→ COURSE OF NORMAL FLOW

DO NOT SCALE THIS DRAWING.

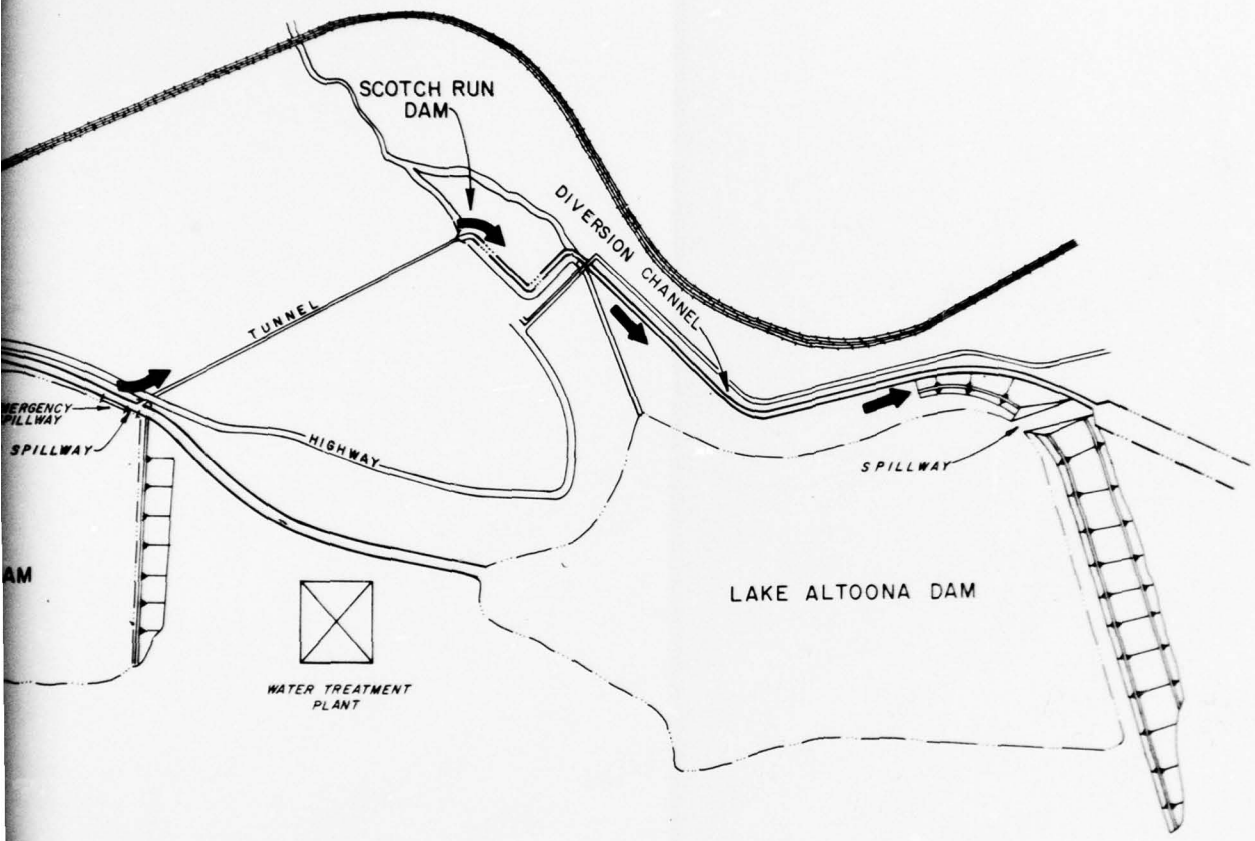


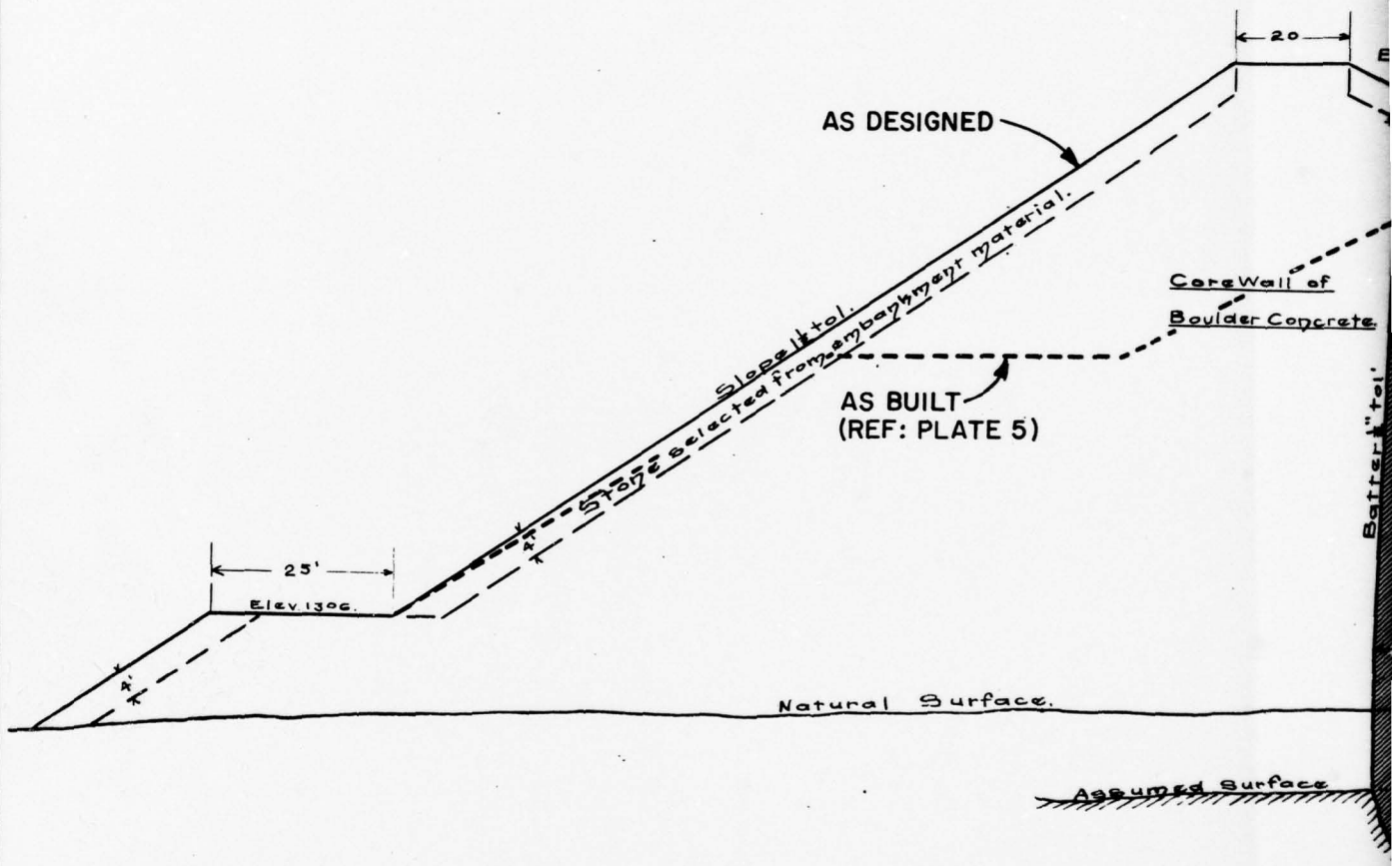
PLATE 2

LAKE ALTOONA DAM

DIVERSION CHANNEL PLAN

D'APPOLONIA

DRAWN BY	Trs	CHECKED BY		9-7-78	DRAWING NUMBER 78-14-B161
	9-5-78	APPROVED BY		9-7-78	

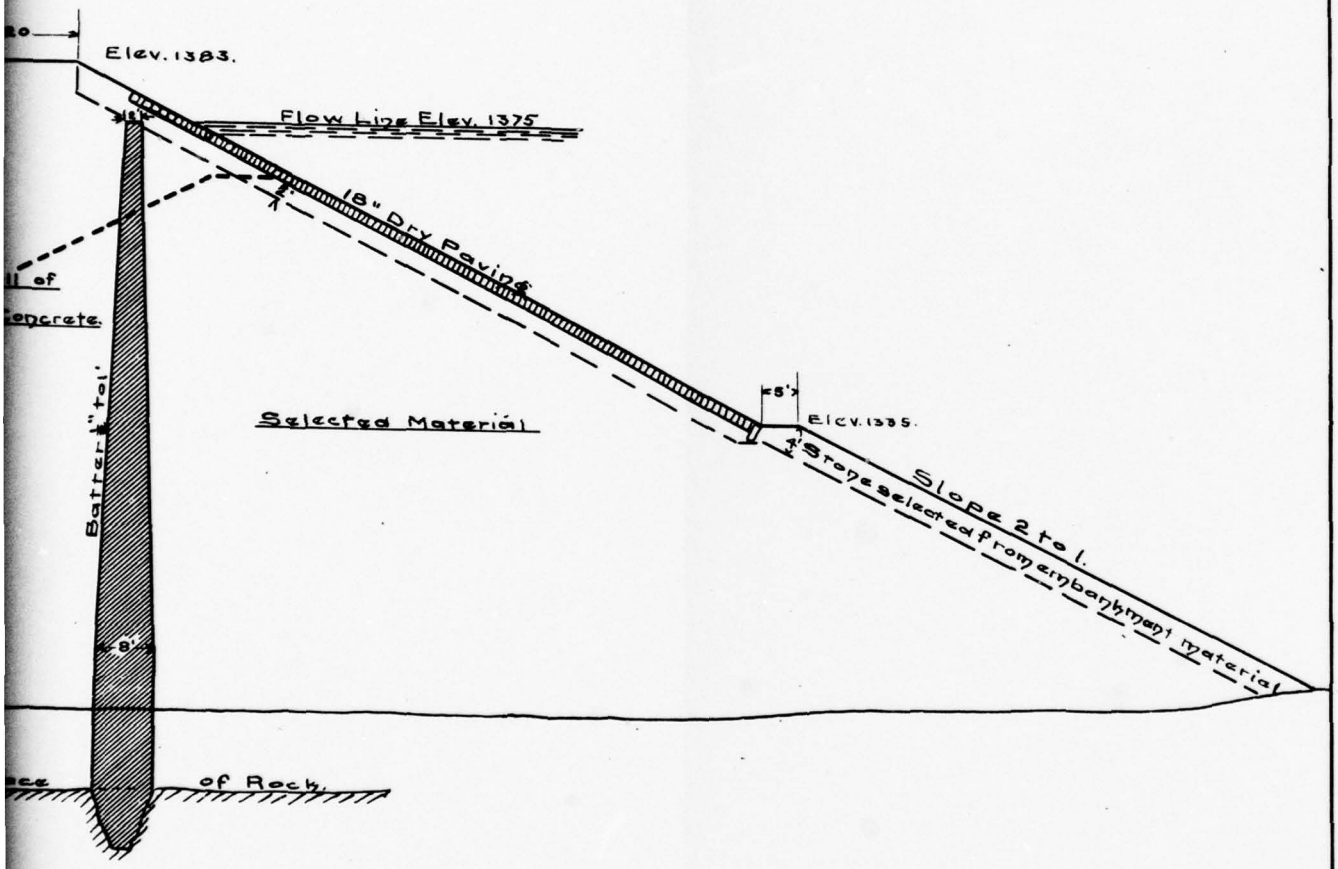


Section of E

Sta 11+00

Scale 1"

CITY OF ALTOONA, PA.
DEPARTMENT OF WATER.



of Embankment.

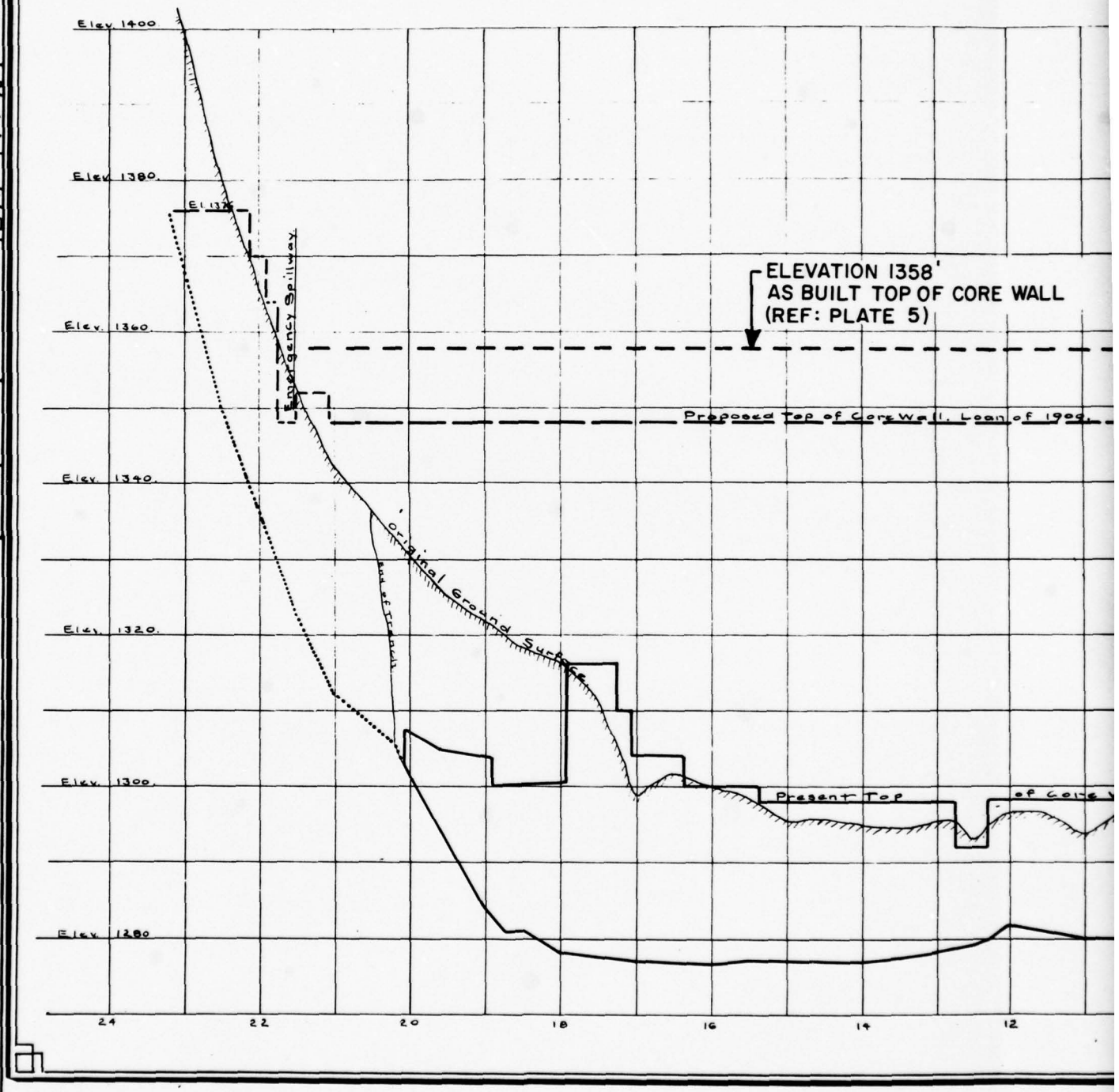
11+00 Dr. 3003.

Scale 1" = 16'.

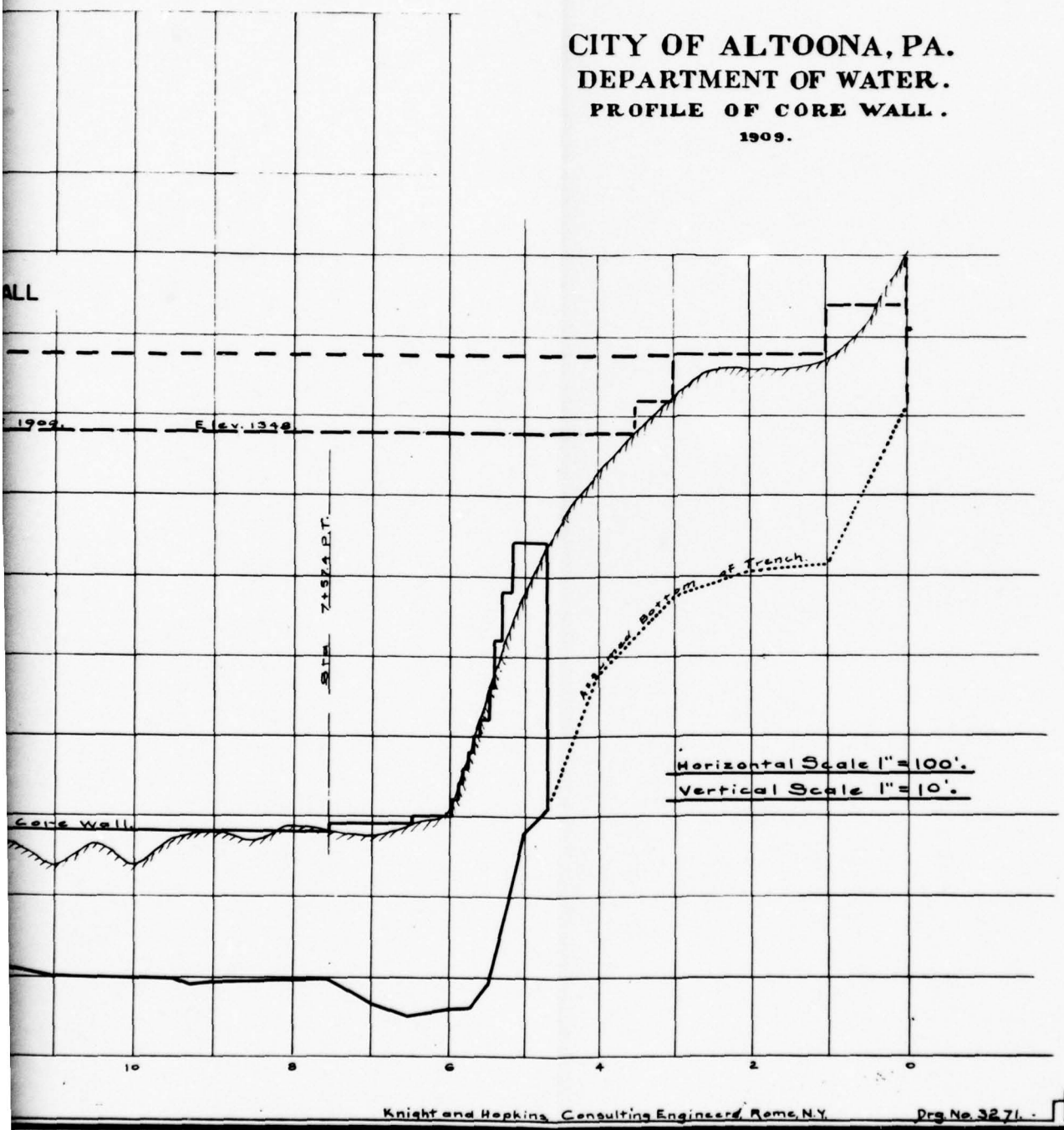
PLATE 3

D'APPOLONIA

DRAWN BY	D.J.D.	CHECKED BY		DRAWING NUMBER	78-4-B140
	8-30-78	APPROVED BY			
			9-1-78		
			9-1-78		



CITY OF ALTOONA, PA.
DEPARTMENT OF WATER.
PROFILE OF CORE WALL.
1909.

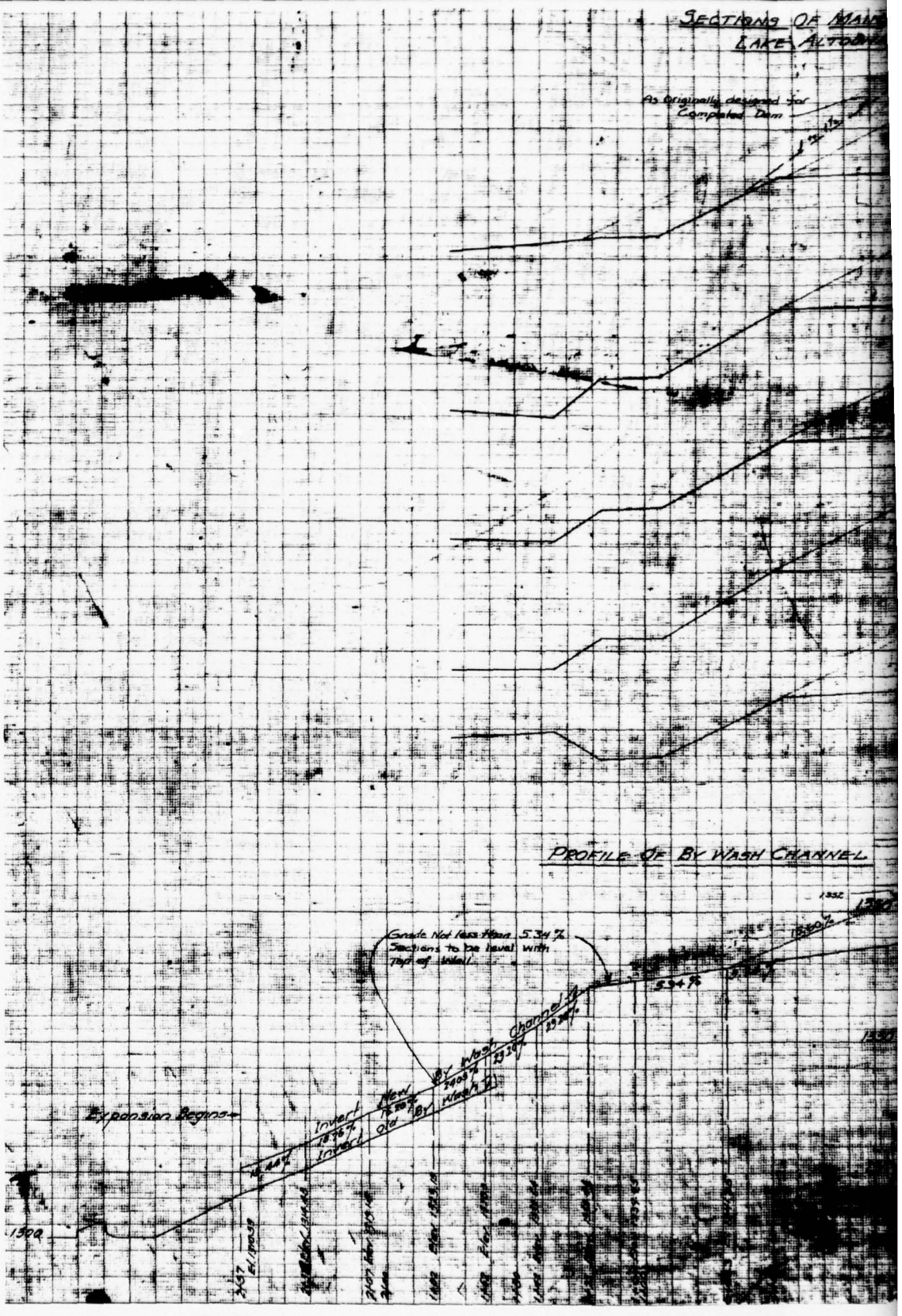


Knight and Hopkins, Consulting Engineers, Rome, N.Y. Drg. No. 3271.

PLATE 4

D'APPOLONIA

DRAWN BY	D.J.D.	CHECKED BY	RE	9-7-78	DRAWING NUMBER 78-114-B148
	8-30-78	APPROVED BY	THP	9-7-78	



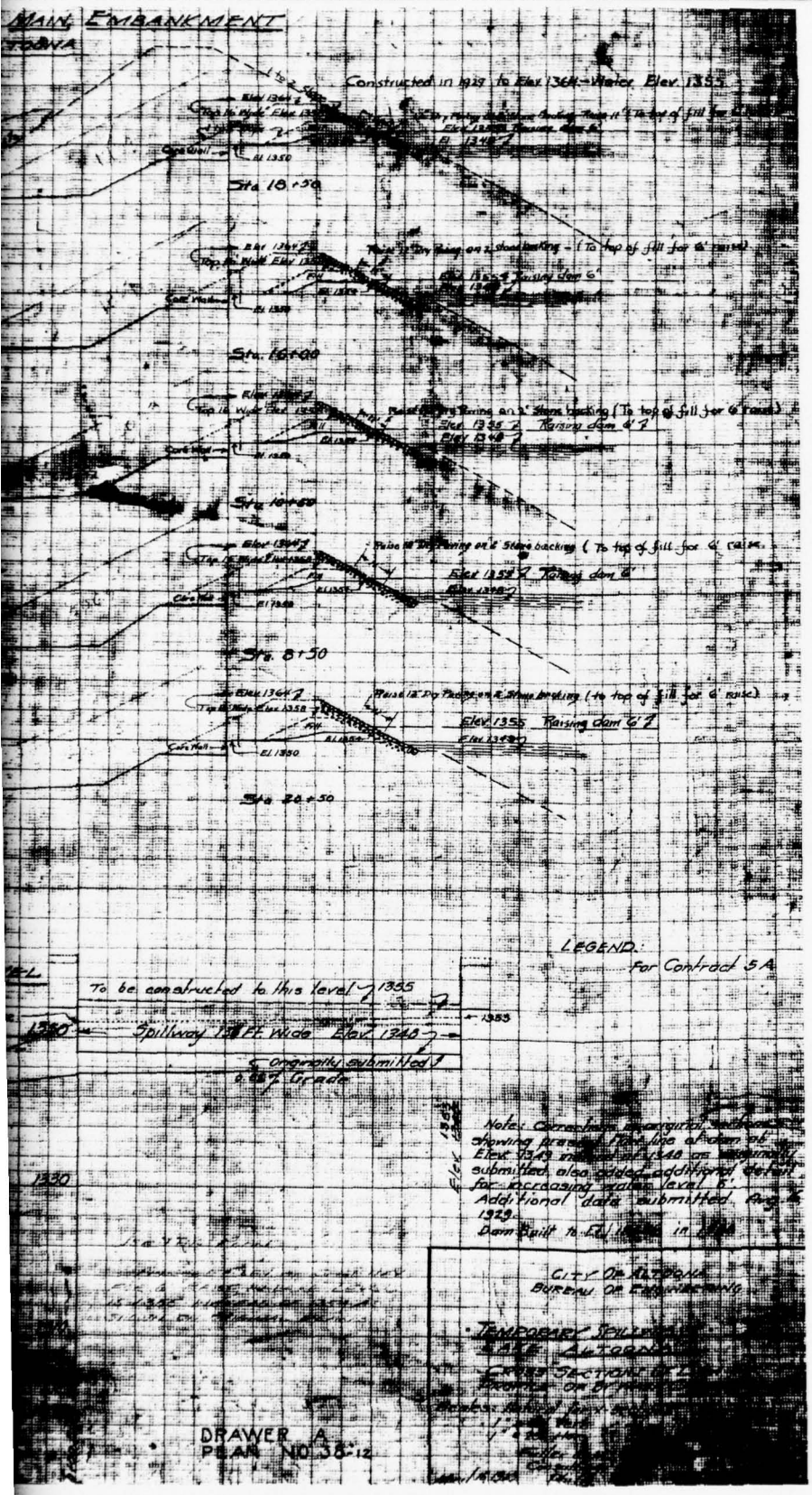
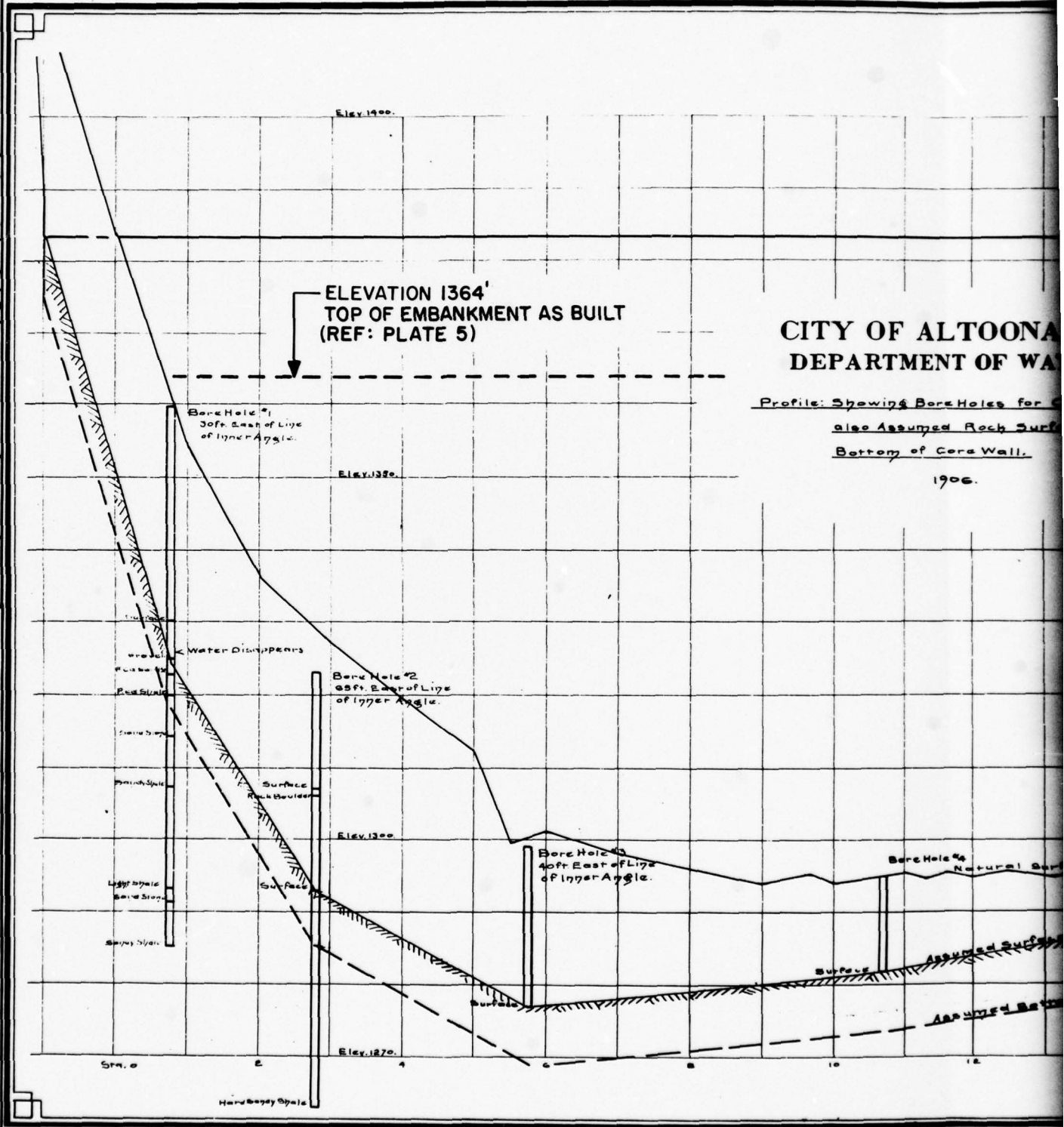
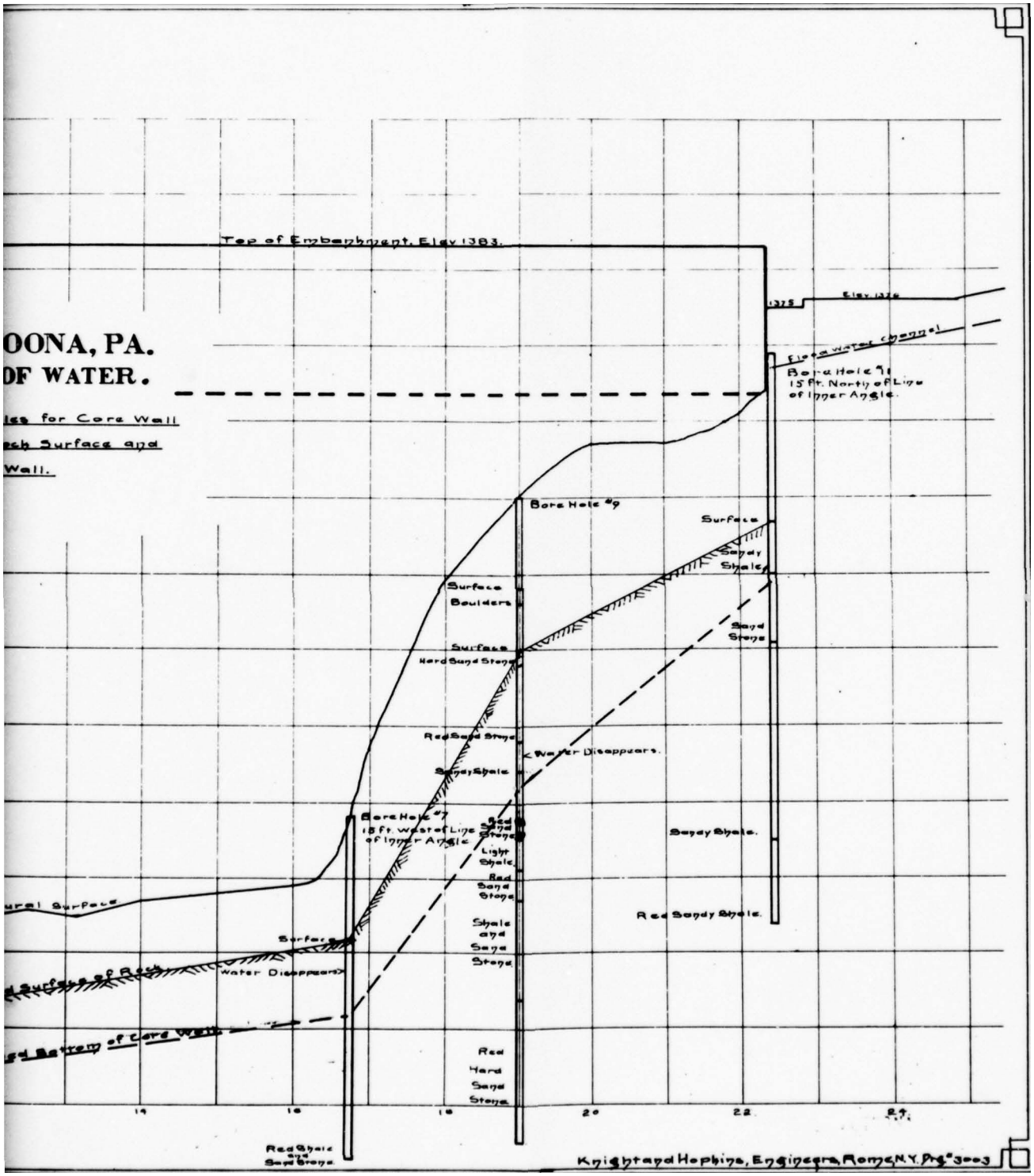


PLATE 5

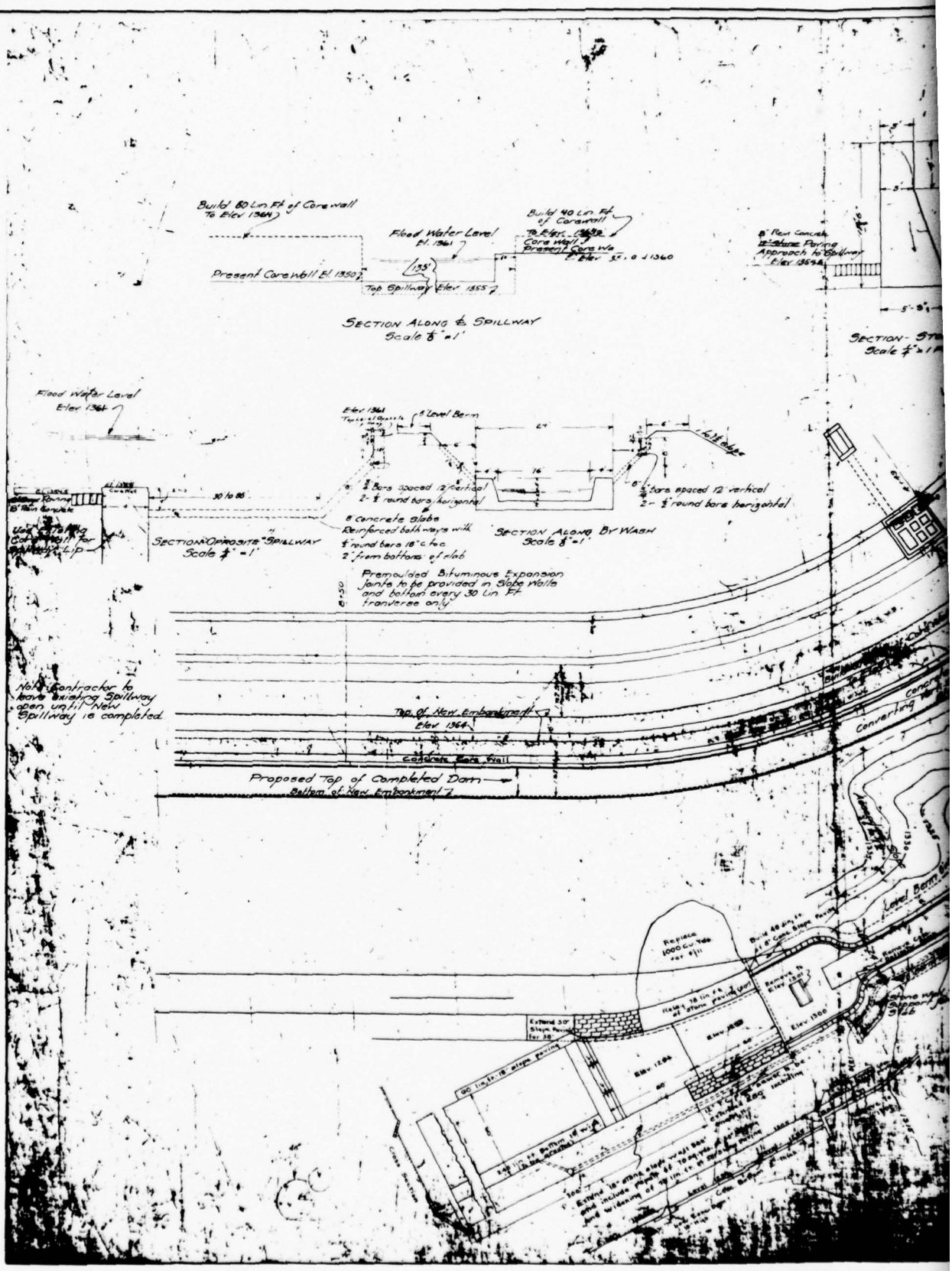
D'APPOLONIA

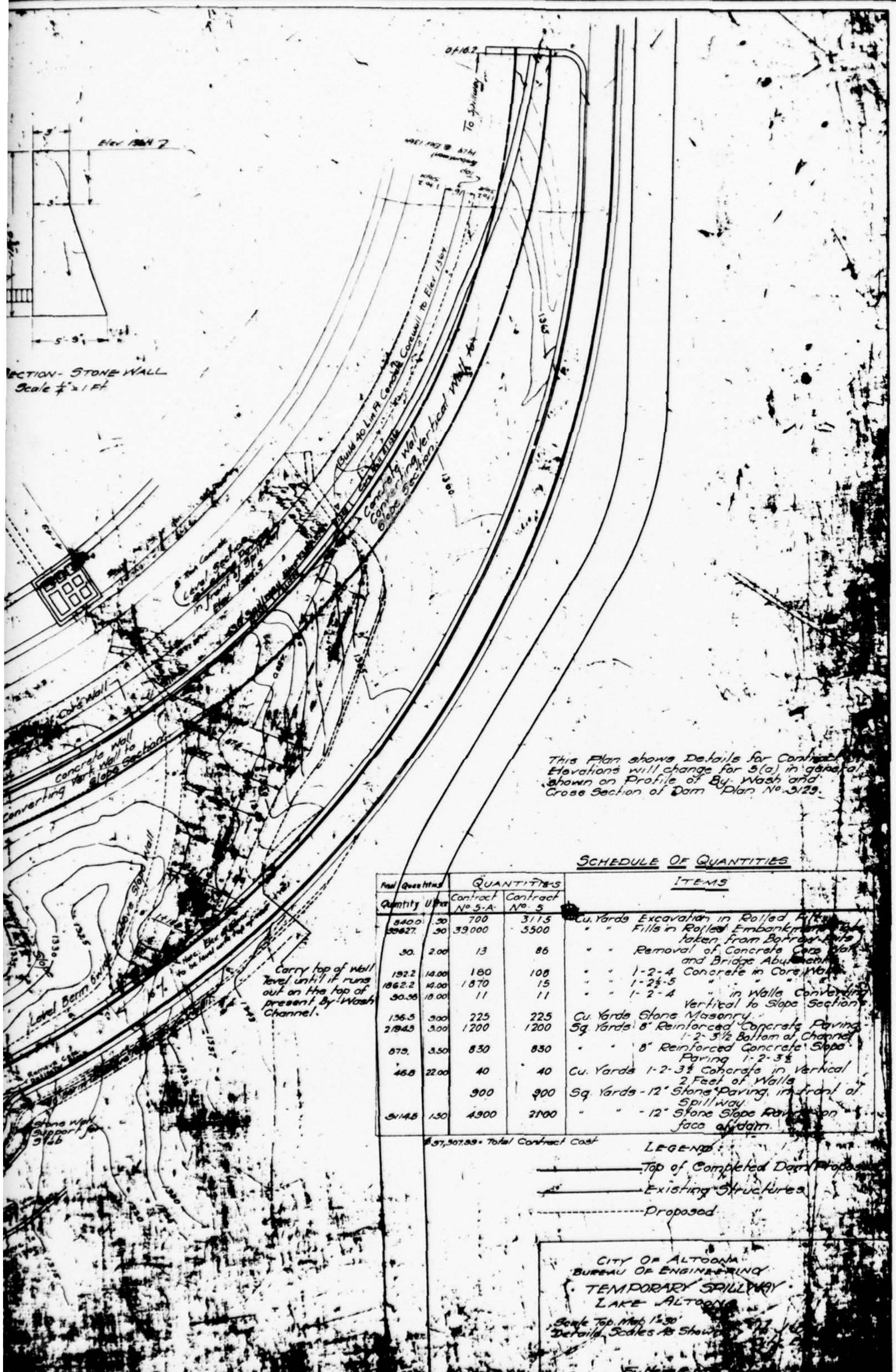
DRAWN BY	D.J.D.	CHECKED BY	BE	9-7-78	DRAWING NUMBER	78-,14-B144
	8-30-78	APPROVED BY	JHD	9-7-78		




OONA, PA.
OF WATER.
ss for Core Wall
sh Surface and
Wall.
Top of Embankment, Elev 1383.
1378
Elev 1376
Elev of water channel
Bore Hole #8
15 Ft. North of Line of Inner Angle.
Bore Hole #9
Surface
Sandy Shale
Surface
Boulders
Sand Stone
Surface
Hard Sand Stone
Red Sand Stone
Water Disappears
Sandy Shale
Bore Hole #7
15 Ft. West of Line of Inner Angle
Red Sand Stone
Light Shale
Red Sand Stone
Shale and Sand Stone
Red Hard Sand Stone
Sandy Shale.
Red Sandy Shale.
ural Surface
Surface
Water Disappears
d Surface of Rock
d Bottom of Core Wall
Red Shale and Sand Stone
Knight and Hopkins, Engineers, Rome, N.Y. Dec. 3003

DRAWN BY	D.J.D.	CHECKED BY	RE	9-7-78	DRAWING NUMBER	78-114-B147
	8-30-78	APPROVED BY	JHO	9-7-78		





This Plan shows Details for Contract ... Elevations will change for 5(a) in general shown on Profile of By-Wash and Cross Section of Dam Plan No. 3129.

SCHEDULE OF QUANTITIES

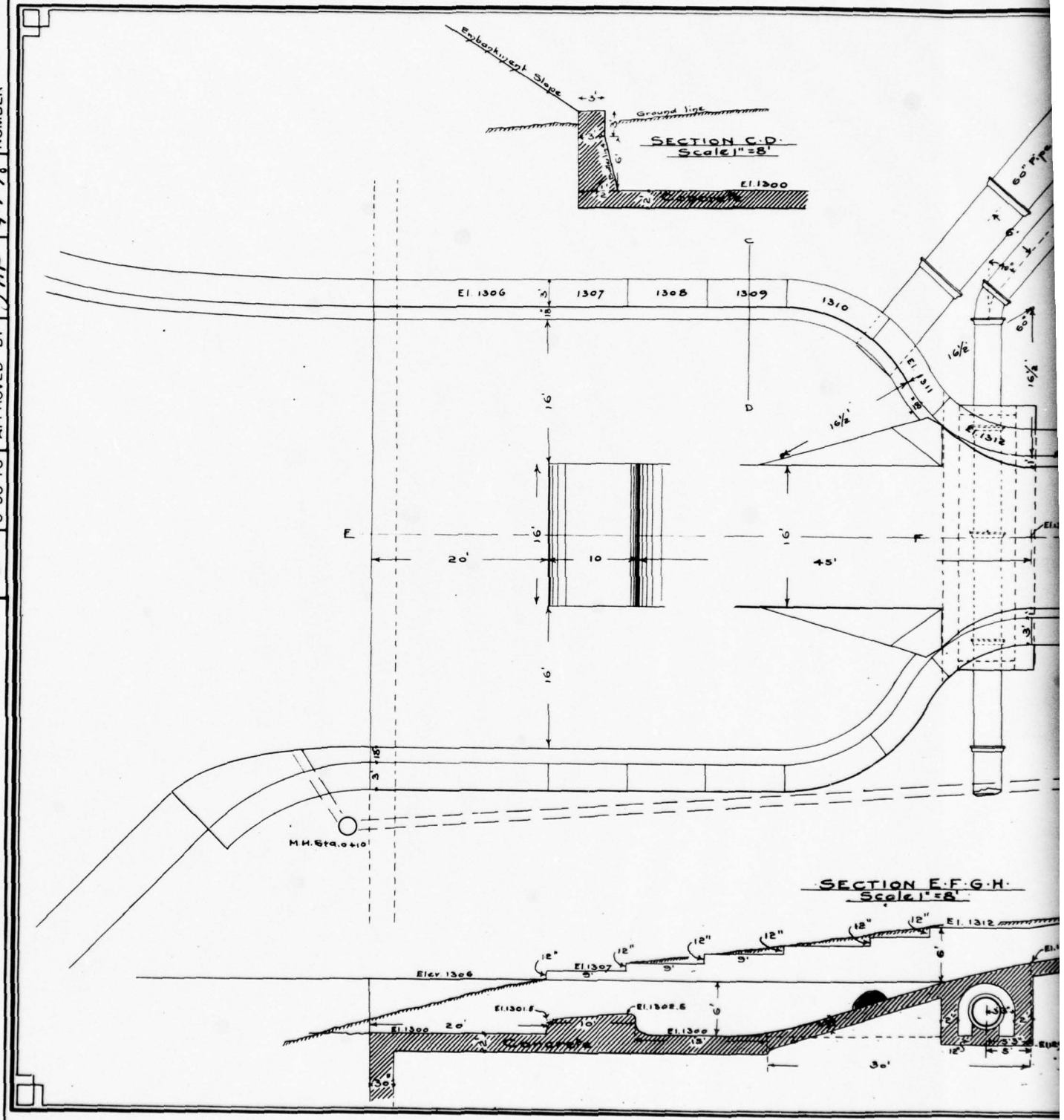
Final Quantities		Quantities		Items
Quantity	U. Price	Contract No. 5-A	Contract No. 5	
840.0	.30	700	3115	Cu. Yards Excavation in Rolled Fill ...
35627.	.30	39000	5500	" " Fills in Rolled Embankment ... taken from Borrow Pits
30.	2.00	13	86	" " Removal of Concrete Core Wall and Bridge Abutments
192.2	14.00	180	108	" " 1-2-4 Concrete in Core Wall
1862.2	14.00	1870	15	" " 1-2½-5 " " " "
30.36	18.00	11	11	" " 1-2-4 " in Walls Converting Vertical to Slope Sections
136.5	3.00	225	225	Cu. Yards Stone Masonry
2184.3	3.00	1200	1200	Sq. Yards 8" Reinforced Concrete Paving 1-2-3½ Bottom of Channel
875.	3.50	830	830	" " 8" Reinforced Concrete Slope Paving 1-2-3½
46.8	22.00	40	40	Cu. Yards 1-2-3½ Concrete in Vertical 2 Feet of Walls
		900	900	Sq. Yards - 12" Stone Paving in front of Spillway
3114.8	1.50	4900	2100	" " - 12" Stone Slope Paving on face of dam

$37,307.39 = Total Contract Cost

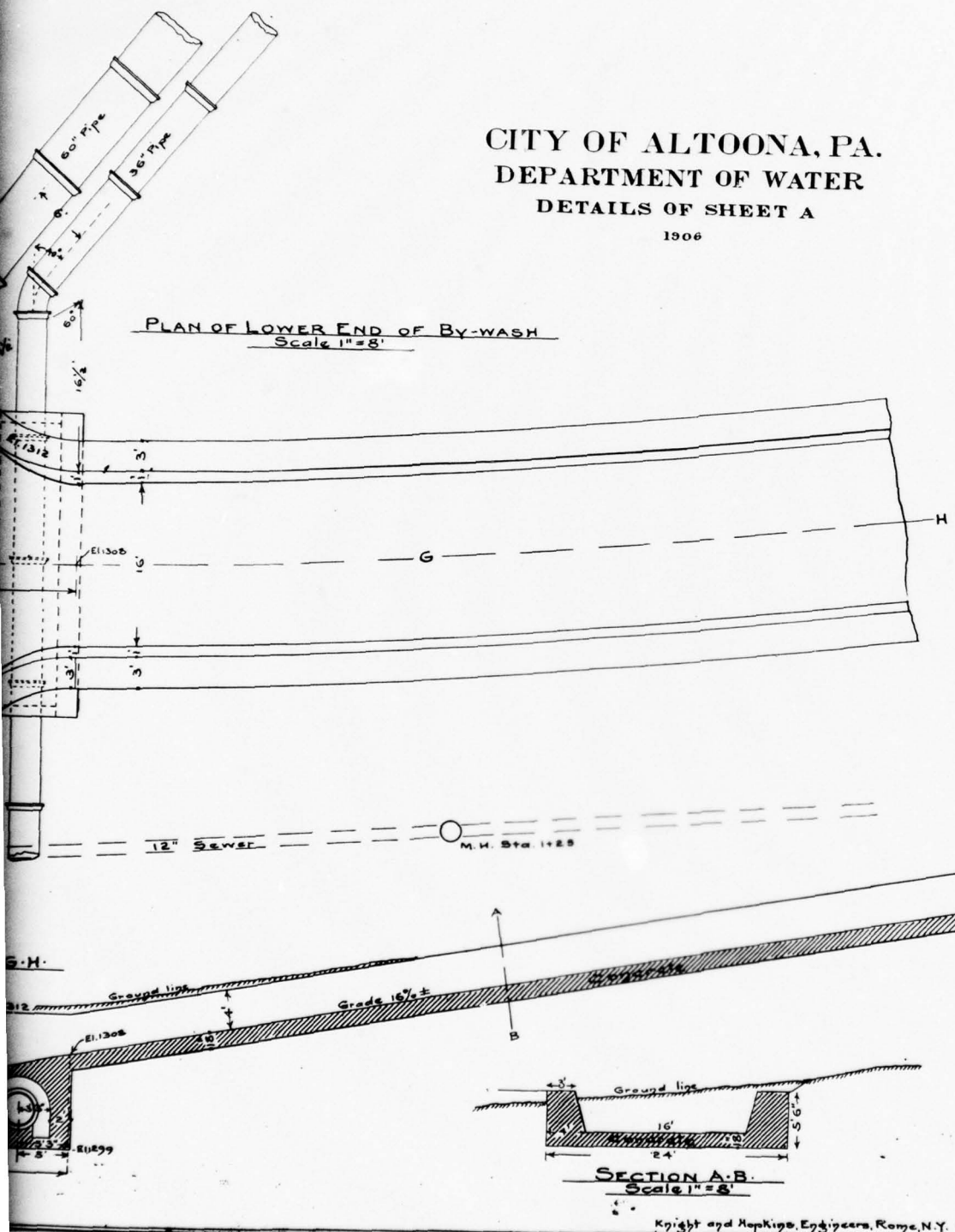
PLATE 7

D'APPOLONIA

DRAWN BY	D.J.D.	CHECKED BY	RE	9-7-78	DRAWING NUMBER	78-114-B143
	8-30-78	APPROVED BY	FHP	9-7-78		



CITY OF ALTOONA, PA.
DEPARTMENT OF WATER
DETAILS OF SHEET A
1906

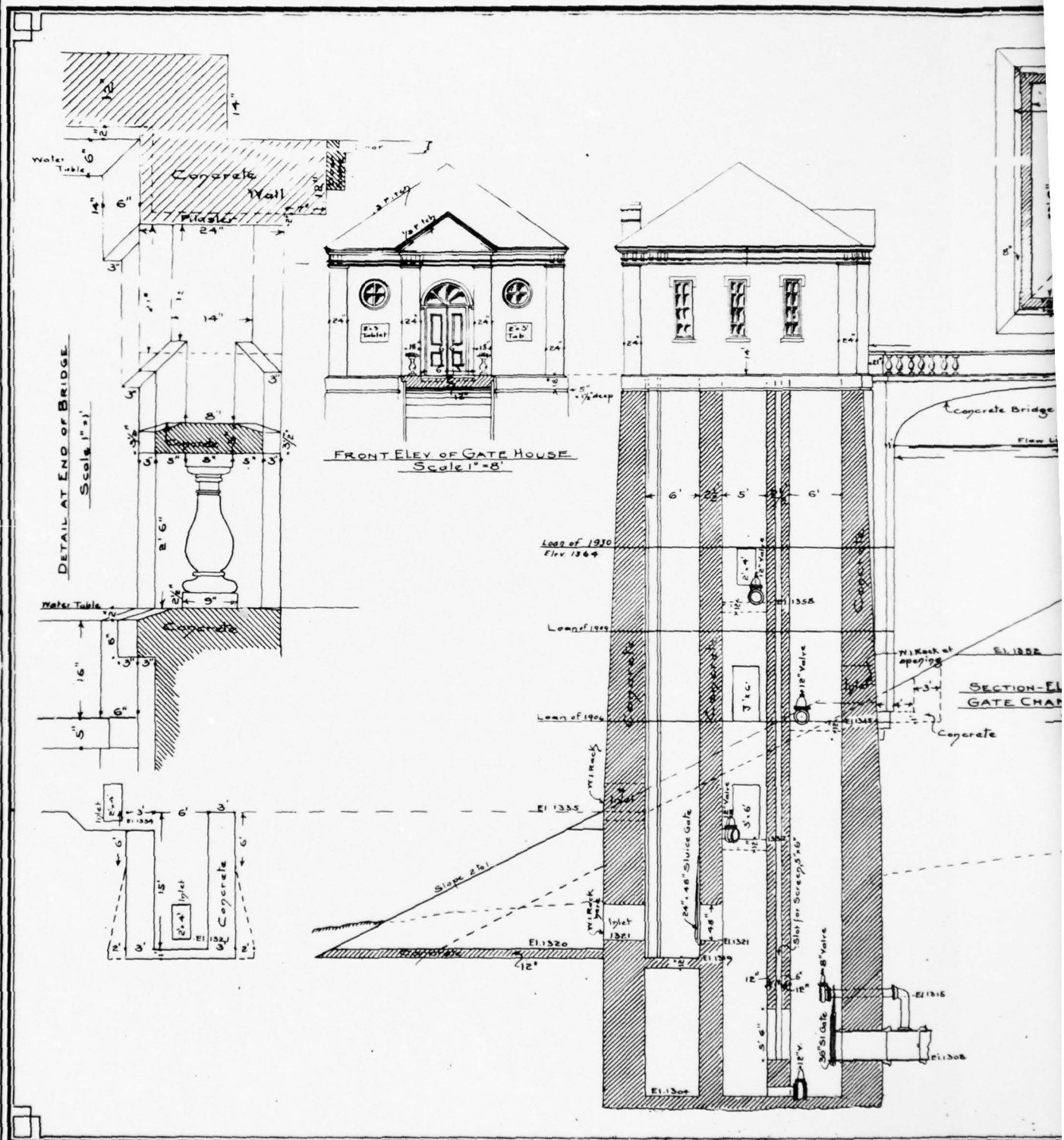


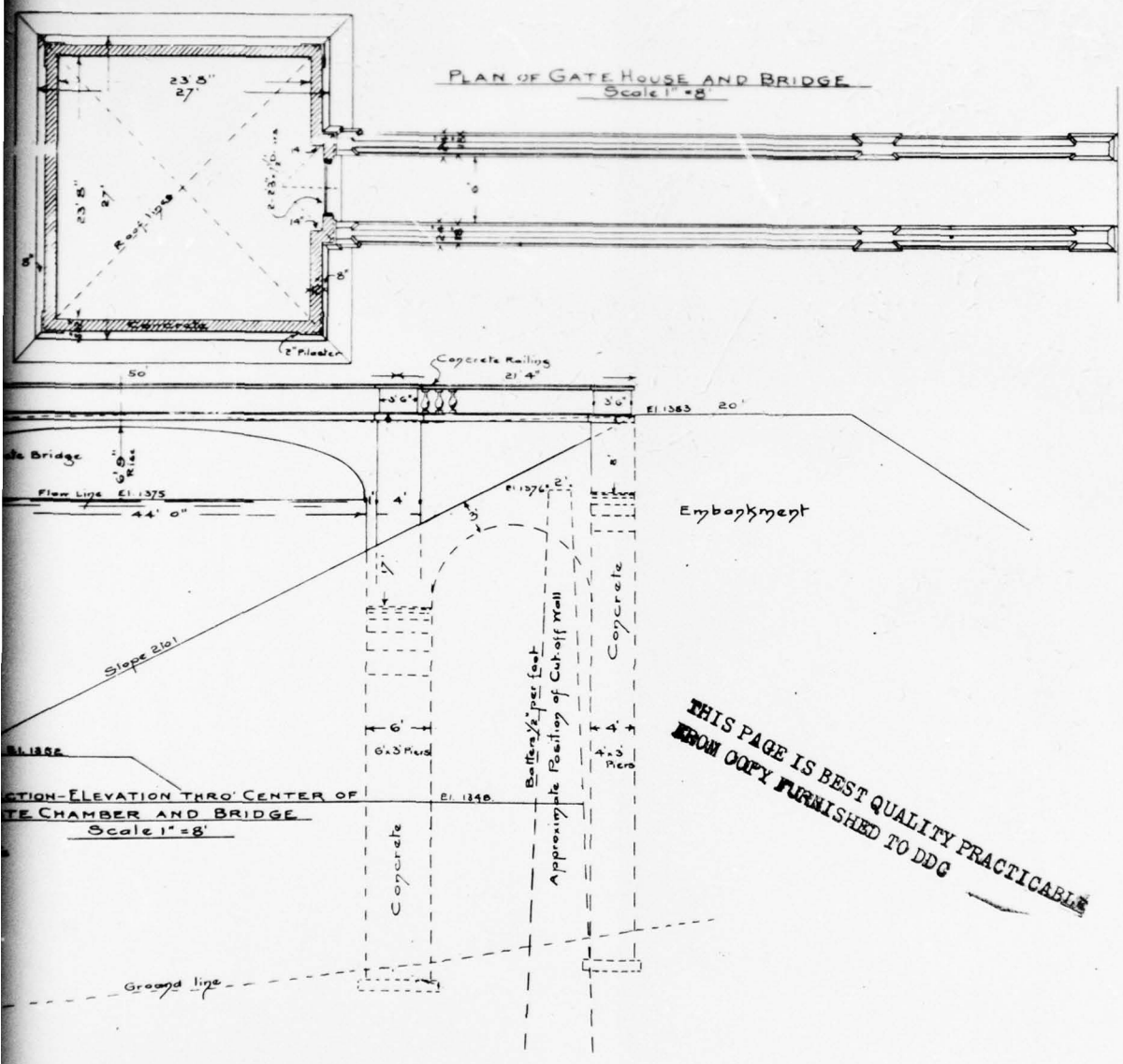
Knight and Hopkins, Engineers, Rome, N.Y. Drg. #2970

PLATE 8

D'APPOLONIA

DRAWING NUMBER	78-114-B142
APPROVED BY	9-7-78
CHECKED BY	9-7-78
DRAWN BY	DJD 8-30-78





CITY OF ALTOONA, PA.

DEPARTMENT OF WATER

DETAILS OF SHEET A

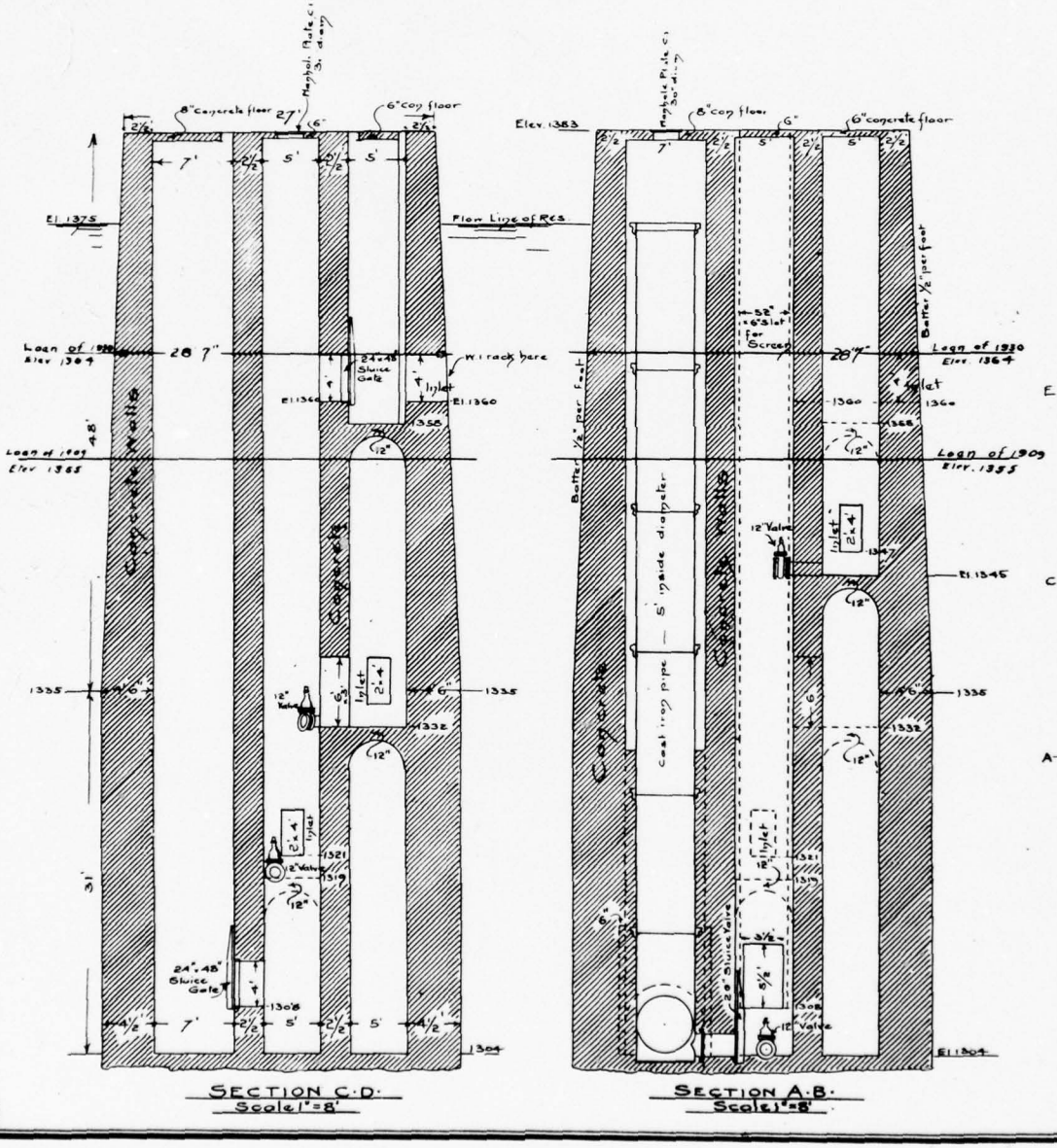
1906

Knight and Hopkins, Engineers, Rome, N.Y. Drg.# 2968

PLATE 9

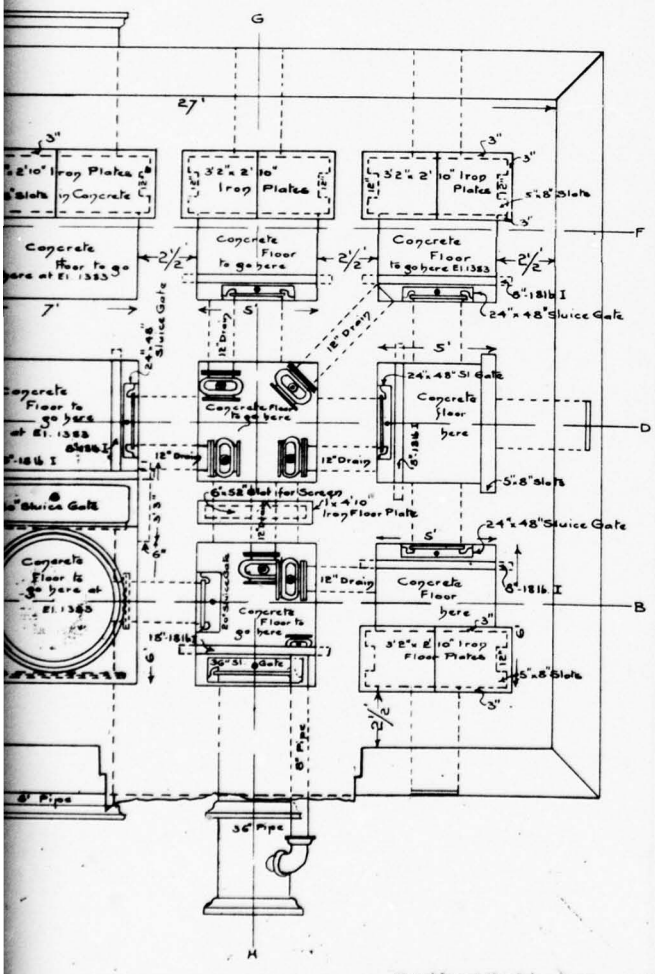
D'APPOLONIA

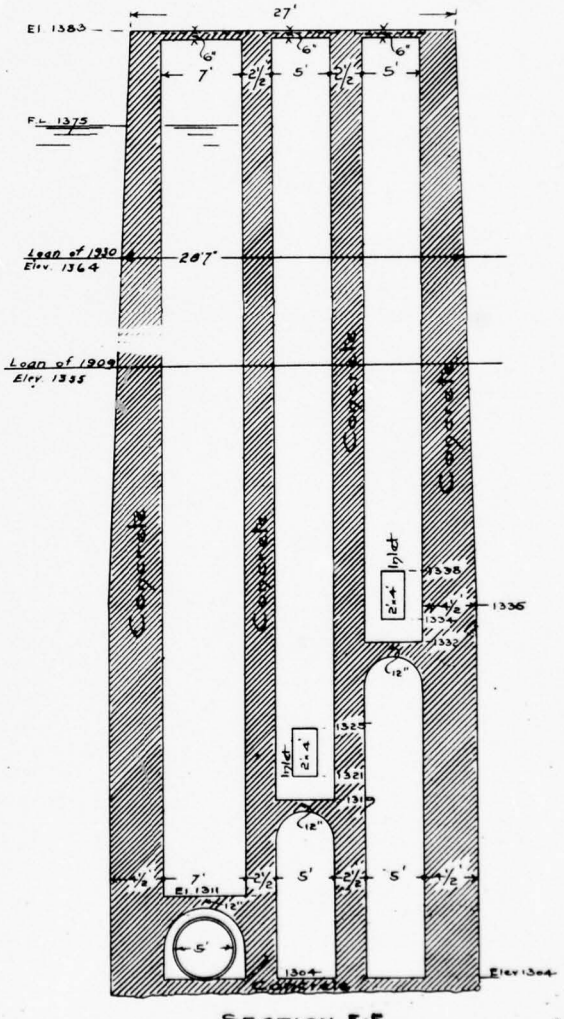
DRAWN BY	'D.J.D.	CHECKED BY		9-7-78	DRAWING
	8-30-78	APPROVED BY		9-7-78	NUMBER 78-114-B141



CITY OF ALTOONA, PA.
DEPARTMENT OF WATER
DETAILS OF SHEET A
1906

PLAN OF GATE CHAMBER
Scale 1" = 4'





SECTION E-F
Scale 1" = 8'

Knight and Hopkins, Engineers: Rome, N.Y. Drg.° 2966

PLATE 10

D'APPOLONIA

DRAWN BY	MBM	CHECKED BY		9-7-78	DRAWING NUMBER 78 14-A23
	8-21-78	APPROVED BY		9-7-78	

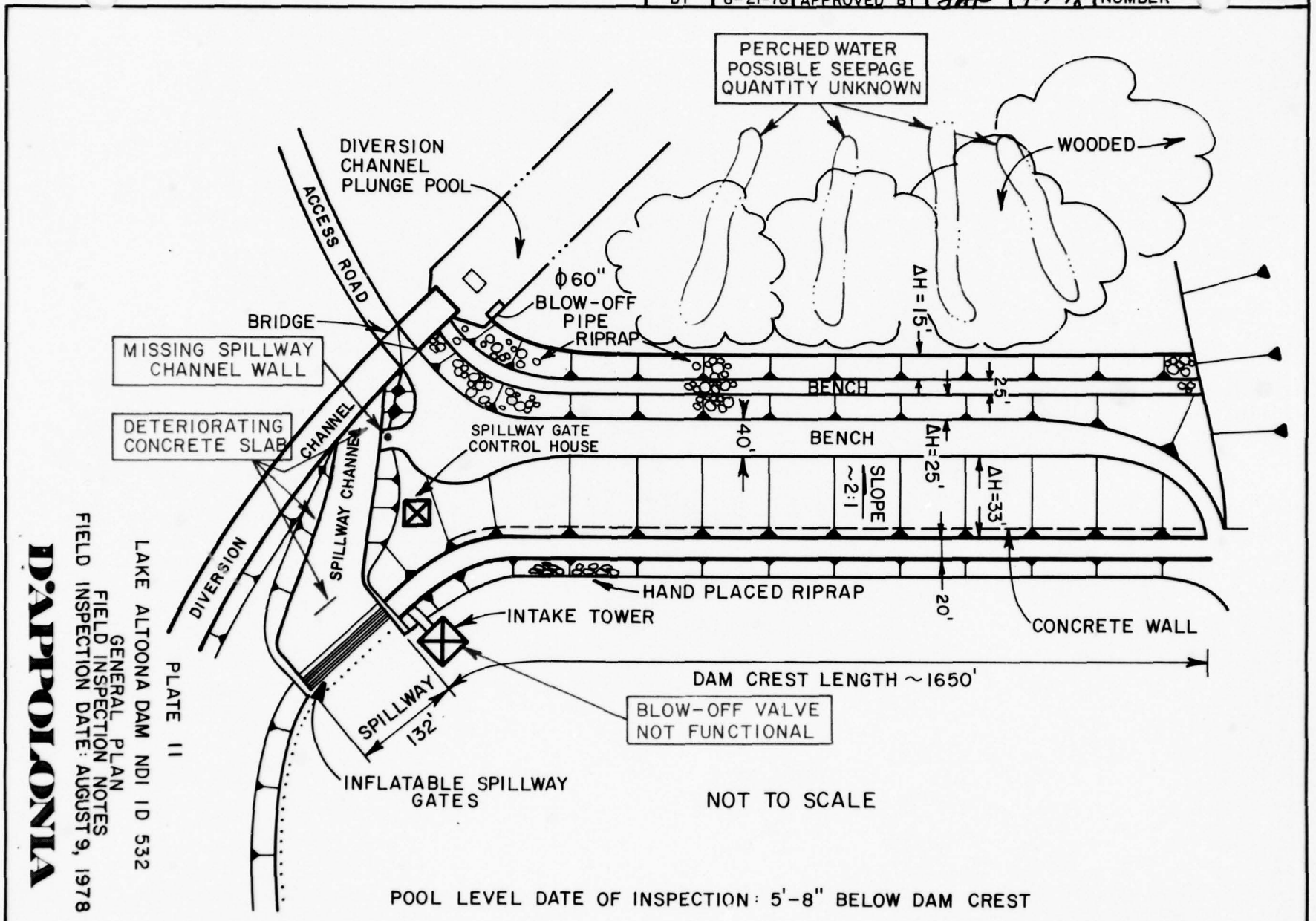


PLATE 11

LAKE ALTOONA DAM NDI ID 532

GENERAL PLAN
FIELD INSPECTION NOTES
FIELD INSPECTION DATE: AUGUST 9, 1978

DAPPOLONIA

APPENDIX A

CHECKLIST
VISUAL INSPECTION
PHASE I

CHECKLIST
VISUAL INSPECTION
PHASE 1

NAME OF DAM LAKE ALTOONA DAM COUNTY BLAIR STATE PA. ID# NDI : 532
DER : 7-8

TYPE OF DAM EARTH FILL HAZARD CATEGORY HIGH

DATE(S) INSPECTION AUGUST 9, 1978 WEATHER SUNNY TEMPERATURE 80's

POOL ELEVATION AT TIME OF INSPECTION 1358 M.S.L. TAILWATER AT TIME OF INSPECTION 1295 ± M.S.L.

INSPECTION PERSONNEL:

BILGIN EREL
WAH-TAK CHAN

REVIEW INSPECTION BY:
AUGUST 16, 1978

LIO D'APPOLONIA
L.D. ANDERSEN
JAMES POLLOT

BILGIN EREL RECORDER

VISUAL INSPECTION
PHASE I
EMBANKMENT

NAME OF DAM LAKE ALTOONA DAM
ID# NDI: 532 DER: 7-8

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	NONE FOUND	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	NONE FOUND	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	NONE FOUND	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	NO PERCEIVABLE MISALIGNMENT	
RIPRAP FAILURES	NONE FOUND.	

VISUAL INSPECTION
PHASE I
EMBANKMENT

NAME OF DAM LAKE ALTOONA DAM
ID# NDI: 532 DER: 7-8

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	NO VISUAL SIGNS OF DISTRESS, NO SEEPAGE.	
ANY NOTICEABLE SEEPAGE	PERCHED WATER POOLS BELOW TOE	SEE PLATE 11
STAFF GAGE AND RECORDER	NONE	
DRAINS	NONE	

VISUAL INSPECTION
PHASE I
CONCRETE/MASONRY DAMS

NAME OF DAM LAKE ALTOONA DAM
ID# NDI:532 DER:7-8

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

VISUAL INSPECTION
PHASE I
CONCRETE/MASONRY DAMS

NAME OF DAM LAKE ALTOONA DAM
ID# NDI: 532 DER: 7-8

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	EARTH FILL DAM N/A	
STRUCTURAL CRACKING	N/A	
VERTICAL AND HORIZONTAL ALIGNMENT	N/A	
MONOLITH JOINTS	N/A	
CONSTRUCTION JOINTS STAFF GAGE OF RECORDER:	N/A	

VISUAL INSPECTION
PHASE I
OUTLET WORKS

NAME OF DAM LAKE ALTOONA DAM
ID# NDI: 532 DER: 7-8

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	ϕ60-INCH CAST IRON BLOW-OFF PIPE.	
INTAKE STRUCTURE	INTAKE TOWER (WET)	
OUTLET STRUCTURE	NO OUTLET STRUCTURE. PIPE WOULD DISCHARGE DIRECTLY INTO THE DIVERSION CHANNEL PLUNGE POOL.	
OUTLET CHANNEL	NATURAL STREAM CHANNEL.	
EMERGENCY GATE	CITY PERSONNEL REPORTED THAT THE BLOW-OFF PIPE SLUICE GATE IS NOT FUNCTIONAL.	

VISUAL INSPECTION
PHASE I
UNGATED SPILLWAY

NAME OF DAM LAKE ALTOONA DAM
ID# NDI: 532 DEP: 7-8

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	SPILLWAY IS GATED. N/A.	
APPROACH CHANNEL	N/A	
DISCHARGE CHANNEL	N/A	
BRIDGE AND PIERS	N/A.	

VISUAL INSPECTION
PHASE I
GATED SPILLWAY

NAME OF DAM LAKE ALTOONA DAM
ID# NDI:532 DER:7-8

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	CONCRETE OVER-FLOW SECTION, EQUIPED WITH INFLATABLE FABRIDAMS.	
APPROACH CHANNEL	LAKE.	
DISCHARGE CHANNEL	TRAPEZOIDAL CONCRETE CHANNEL DETERIORATING CONCRETE IN DISCHARGE CHANNEL.	
BRIDGE PIERS	NO BRIDGE ACROSS THE CONTROL SECTION.	
GATES AND OPERATION EQUIPMENT	INFLATABLE FABRIDAM GATES. INFLATED BY AIR DATE OF INSPECTION GATE CAN ALSO BE INFLATED BY WATER.	

VISUAL INSPECTION
PHASE I
INSTRUMENTATION

NAME OF DAM LAKE ALTOONA DAM
ID# NDI:532 DER:7-8

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

VISUAL INSPECTION
PHASE I
RESERVOIR

NAME OF DAM LAKE ALTOONA DAM
ID# NDI: 532 DER: 7-8

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	WOODED, MILD SLOPES.	
SEDIMENTATION	UNKNOWN.	

VISUAL INSPECTION
PHASE I
DOWNSTREAM CHANNEL

NAME OF DAM LAKE ALTOONA DAM
ID# NDI:532 DER:7-8

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	ROCKY NATURAL STREAM, OBSTRUCTED BY NUMEROUS BRIDGES.	
SLOPES	N/A	
APPROXIMATE NUMBER OF HOMES AND POPULATION	MAIN IMPACT AREA OF FLOOD IN THE EVENT OF DAM FAILURE: RESIDENTIAL AREAS OF ALTOONA. ≈ 500 HOMES, POPULATION ≈ 2000.	

APPENDIX B

CHECKLIST
ENGINEERING DATA, DESIGN, CONSTRUCTION, OPERATION
PHASE I

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM LAKE ALTOONA DAM
ID# NDI: 532 DER: 7-8

ITEM	REMARKS
AS-BUILT DRAWINGS	LIMITED NUMBER OF DRAWINGS ARE AVAILABLE IN OWNER'S FILES.
REGIONAL VICINITY MAP	SEE PLATE 1
CONSTRUCTION HISTORY	THE DAM WAS DESIGNED BY MR. C.W KNIGHT A CONSULTING ENGINEER FROM ROME, NY IN 1906. THE DAM WAS COMPLETED IN 1913.
TYPICAL SECTIONS OF DAM	SEE PLATE 3.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS	SEE PLATES 9 & 10

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM LAKE ALTOONA DAM
ID# NDI:532 DER:7-8

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	RECORDED BY DAM TENDER AT THE DAM SITE.
DESIGN REPORTS	NOT AVAILABLE.
GEOLOGY REPORTS	NOT AVAILABLE.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	NOT AVAILABLE.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	NOT AVAILABLE.

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM LAKE ALTOONA DAM
ID# NDI:532 DER:7-8

ITEM	REMARKS
POST CONSTRUCTION SURVEYS OF DAM	NONE REPORTED.
BORROW SOURCES	UNKNOWN.
MONITORING SYSTEMS	NONE.
MODIFICATIONS	THE SPILLWAY ENLARGED IN 1929.
HIGH POOL RECORDS	NOT AVAILABLE.

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM LAKE ALTOONA DAM
ID# NDI:532 DER:7-8

ITEM	REMARKS
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	ALTOONA WATER WORKS: REPORT ON SPILLWAYS AND FLOOD CHANNEL MAY 27, 1921 BY ALLEN HAZEN A LETTER REPORT ON SPILLWAY AND FLOOD CHANNEL OCT, 4, 1921 BY ARTHER E. MORGAN.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	NONE REPORTED.
MAINTENANCE OPERATION RECORDS	NOT AVAILABLE.
SPILLWAY PLAN SECTIONS DETAILS	SEE PLATE 5 & 7
OPERATING EQUIPMENT PLANS AND DETAILS	SEE PLATE 9 & 10

NAME OF DAM LAKE ALTOONA DAM

ID# NDI: 532 DER: 7-8

CHECKLIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: WOODED, SOME STRIP MINING 13.2 SQ.MI.

ELEVATION; TOP NORMAL POOL AND STORAGE CAPACITY: 1842 AC-FT @EL 1355.5

ELEVATION; TOP FLOOD CONTROL POOL AND STORAGE CAPACITY: SAME AS ABOVE.

ELEVATION; MAXIMUM DESIGN POOL: EL 1359.5 (TOP OF FABRIDAMS)

ELEVATION; TOP DAM: EL 1364

CREST: SPILLWAY

a. Elevation 1355.5

b. Type OVERFLOW SECTION

c. Width N/A.

d. Length 133 FT

e. Location Spillover N/A.

f. Number and Type of Gates INFLATABLE FABRIDAM GATES.

OUTLET WORKS:

a. Type Φ60" BLOW-OFF PIPE

b. Location NEAR LEFT ABUTMENT.

c. Entrance Inverts UNKNOWN

d. Exit Inverts UNKNOWN

e. Emergency Draindown Facilities Φ60" BLOW-OFF PIPE

HYDROMETEOROLOGICAL GAGES:

a. Type RAIN GAGE

b. Location AT THE DAM SITE

c. Records AVAILABLE IN CITY RECORDS.

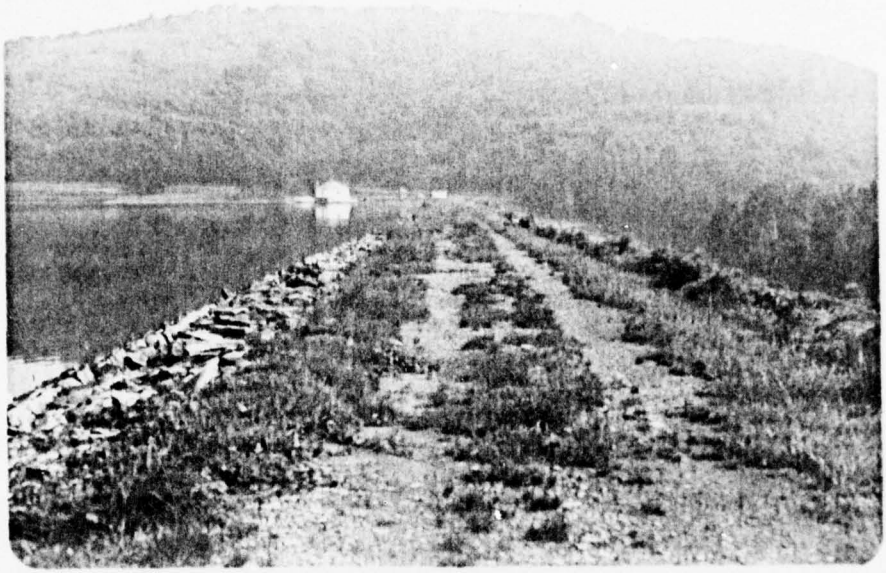
MAXIMUM NONDAMAGING DISCHARGE: _____

APPENDIX C

PHOTOGRAPHS

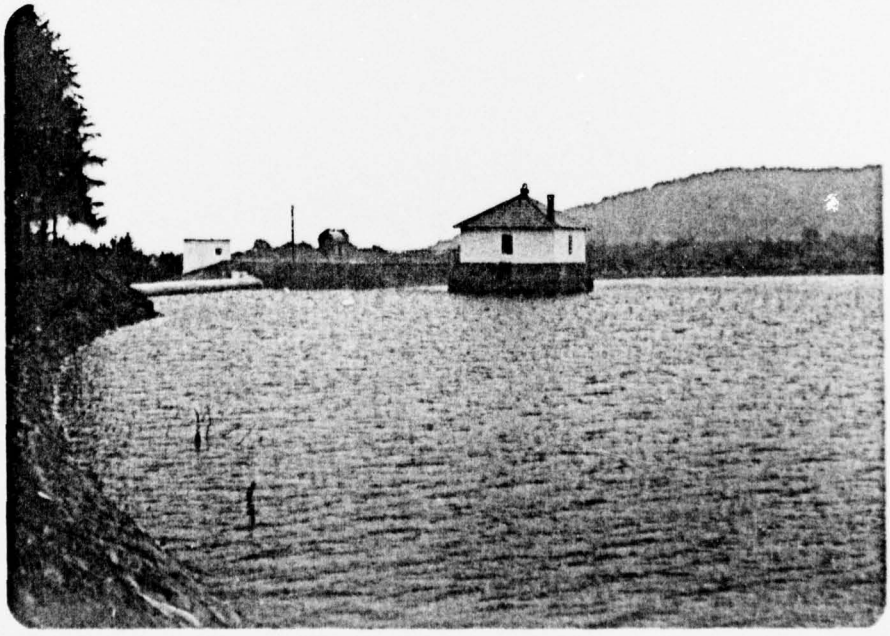
LIST OF PHOTOGRAPHS
LAKE ALTOONA DAM
NDI I.D. NO. 532
AUGUST 9, 1978

PHOTOGRAPH NO.	DESCRIPTION
1	Crest (looking north).
2	Intake tower and spillway entrance.
3	Fabridam spillway gates.
4	Spillway chute.
5	Valve controls at intake tower.
6	Blow-off pipe.
7	Perched water along the toe.
8	Typical downstream channel (through Altoona).



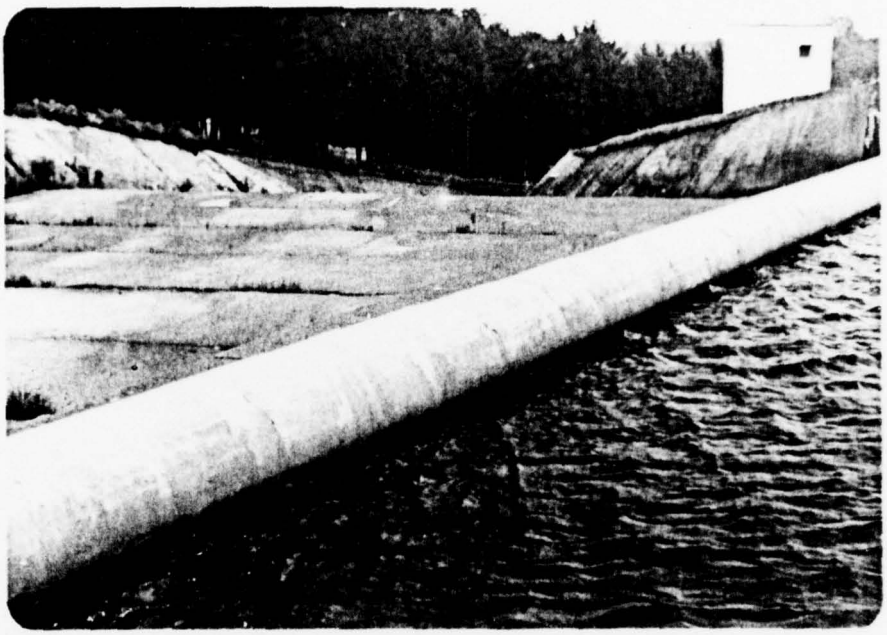
Photograph No. 1

Crest (looking north).



Photograph No. 2

Intake tower and spillway entrance.

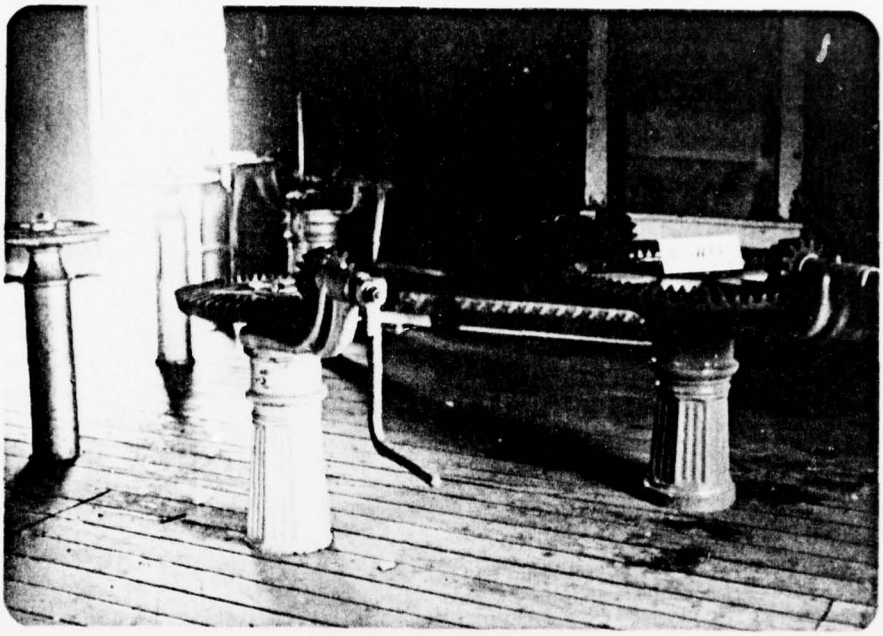


Photograph No. 3

Fabridam spillway gates.

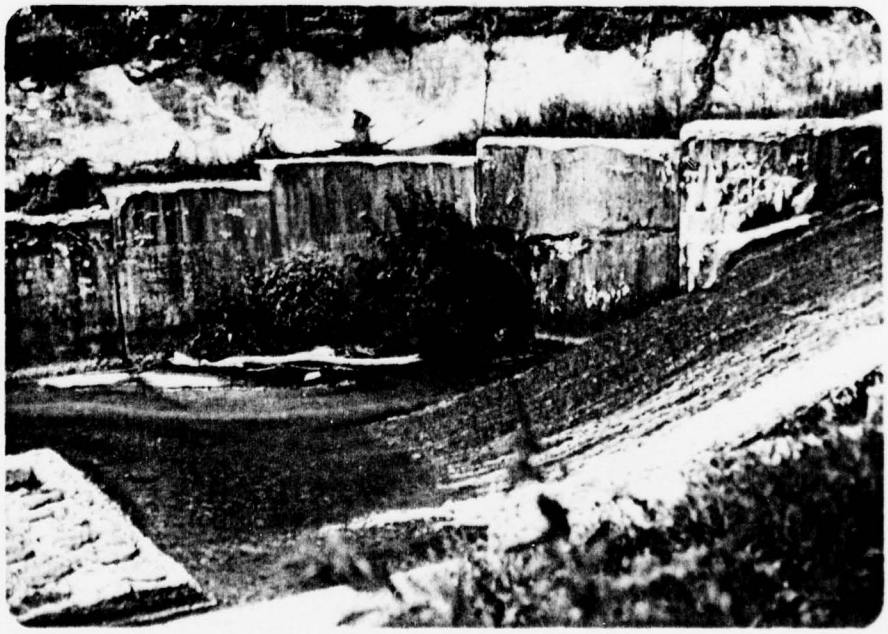
Photograph No. 4

Spillway chute.



Photograph No. 5

Valve controls at intake tower.

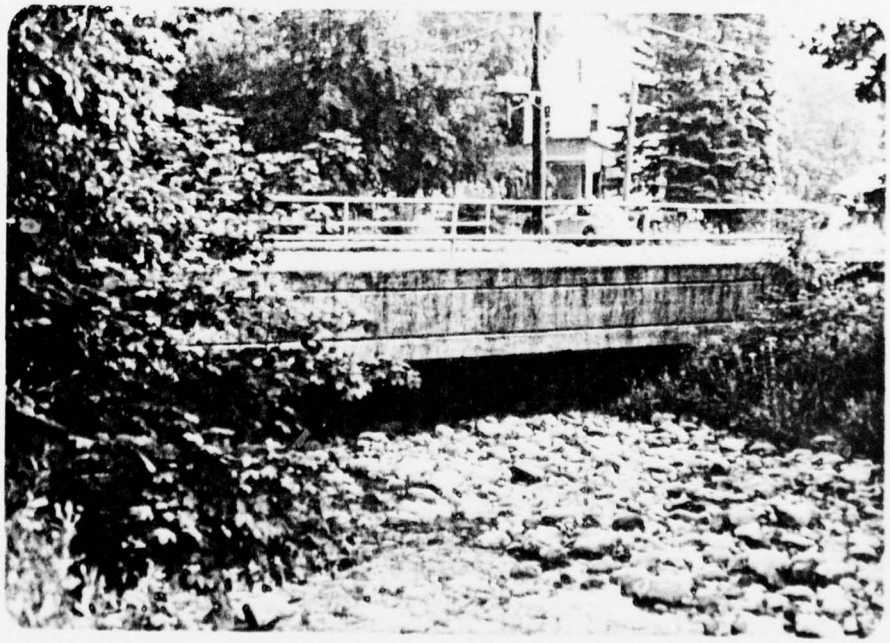


Photograph No. 6

Blow-off pipe.

Photograph No. 7

Perched water along the toe.



Photograph No. 8

Typical downstream channel (through Altoona).

APPENDIX D
CALCULATIONS

DiPIPOLONIA
CONSULTING ENGINEERS, INC

By WTC Date 8-21-78 Subject LAKE ALTOONA Sheet No 1 of 1
Chkd. By MS Date 8/23/78 WATERSHED & LAKE AREA Proj No 78-114-21

REF: USGS ALTOONA, HOLLIDAYSBURG, CRESSON, and ASHVILLE QUADRANGLE, 7.5 min. SERIES

A) WATERSHED AREA FOR LAKE

$= 11.8\ IN^2 \times \left(\frac{2000}{5280}\ MILE/IN\right)^2$

$= 1.69$ SQ MILE

WATERSHED AREA FOR DIVERSION CHANNEL

$= (200 - 122.3)\ IN^2$

$= 77.7\ IN^2 \left(\frac{2000}{5280}\right)^2$

$= 11.15$ SQ MILE

FOR FLOOD EXCEED DIVERSION CHANNEL CAPACITY. THE WATERSHED FOR DAM WILL BE

$1.69 + 11.15 = 12.84$ SQ MILE

say 12.8 SQ MILE

B) LAKE AREA (1355.5) Dam EL 1364.4

LAKE AREA (1355.5)	= 0.92 IN²	= 84.48 ACRES		say 85 ac
@ EL 1360	= 1.12	= 102.85	"	say 100 ac
@ EL 1380	= 1.40	= 128.56	"	say 130 ac

C) VOLUME

ELEV.	ΔH ft	AREA, ac	ΔV, ac·ft	ΣV, ac·ft
1355.5	4.5	85	416	0
1360	20	100	2294	416
1380		130		2710

INTERPOLATING BETWEEN 1360 & 1380 ⇒ Vol @ 1364.4 = 920 ac·ft.

DIAPPOLONIA
CONSULTING ENGINEERS, INC

By WTC Date 8-29-78 Subject LAKE ALTOONA DAM Sheet No. 1 of 5
Chkd. By RC Date 9/8/-8 HYDROLOGY & HYDRAULIC Proj. No. 78-114-24

DAM: LAKE ALTOONA DAM

WATERSHED AREA A_1 = 1.7 SQ MILE FOR LAKES

Where 0.4 SQ MILES FROM UPPER LAKE
1.3 SQ MILES FROM ITS OWN

A_2 = 11.1 SQ MILE FOR CHANNEL
(INCLUDING 1.3 SQ MILE OF SCOTCH RUN)

TOTAL AREA = 12.8 SQ. MILES

ACCORDING TO THE CHARTS PROVIDED BY COE BALTIMORE DIST FOR SUSQUEHANNA (REGION 1) BASIN

AMF Max Peak inflow = 2200 cfs/SQ MILE
= 28160 cfs

Say 28000 cfs

TOTAL 26" RUNOFF WATER VOLUME

$V_1 = \frac{26}{12} \times 12.8 \times 640$

= 17749 AC-FT

Say 17800 ac-ft

SURCHARGE STORAGE VOLUME ABOVE NORMAL POOL EL 1355.5 AND DAM CREST EL 1364.4

Vol = 920 ac-ft (See Vol calc.)

WITH FABRIC DAM

Vol = $\frac{4.9}{8.9} \times 920 = 505$ ac-ft

Say
920 ac ft w/o FAB.
510 ac ft w/ FAB.

DAPPOLONIA
CONSULTING ENGINEERS, INC

By WTC Date 8-29-78 Subject LAKE ALTOONA DAM Sheet No. 2 of 5
Chkd. By [illegible] Date 9/8/78 HYDROLOGY & HYDRAULIC Proj. No. 78-117-21

SPILLWAY DISCHARGE CAPACITY

TYPE BROAD CRESTED CONCRETE OVERFLOW WEIR W/ 4' FABIC DAM
LENGTH = 132 FT (FIELD MEASURED)

$Q_{13} = Q_S$ (FABRIC DAM DEFLATED)

$= (2.65)(132)(1364.4 - 1355)^{1.5}$ (2.9)

$= 9288$ cfs

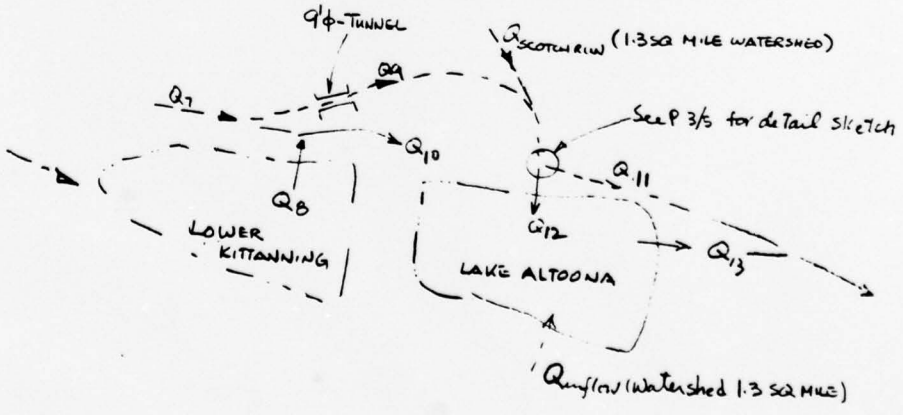
Say 9300 cfs

$Q_{13} = Q_S$ (FABRIC DAM INFLATED)

$= (3.6)(132)(8.9 - 4)^{1.5}$ (APPROXIMATE FABRIC DAM HEIGHT)

$= 5154$ cfs

Say 5200 cfs



DIAMOND NA
CONSULTING ENGINEERS, INC

By WTC Date 9-2-78 Subject LAKE ALTOONA DAM Sheet No. 3 of 5
Chkd. By [illegible] Date 9/11/78 HYDROLOGY & HYDRAULIC Proj. No. 78-114-21

DISCHARGE CAPACITY OF Q_{11} & Q_{12} (SCOTCH RUN BRIDGE)

a) Q_{11} (DIVERSION CHANNEL)
INV EL 1397 (BOTTOM)

B (WIDTH) = 16'-6"

MAX HEAD BEFORE OVERFLOW TO LAKE ALTOONA (FROM SCOTCH RUN & TUNNEL) = 1402 - 1397 = 5 FT

CRITICAL DEPTH OCCUR @ D/S SIDE OF BRIDGE (CONTROL)

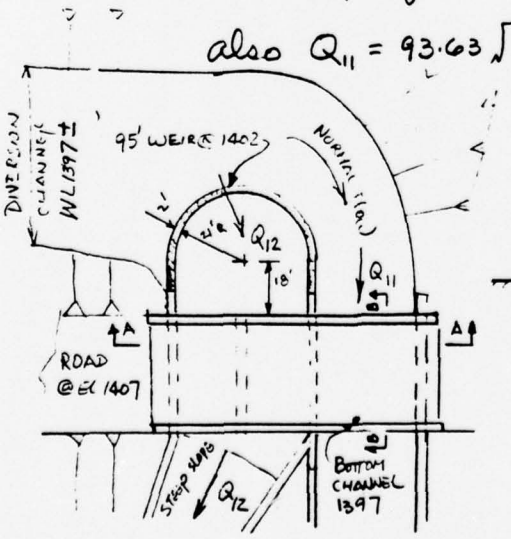
$$\frac{Q^2}{g} = \frac{a^3}{T} = \frac{(T \times h)^3}{T}$$

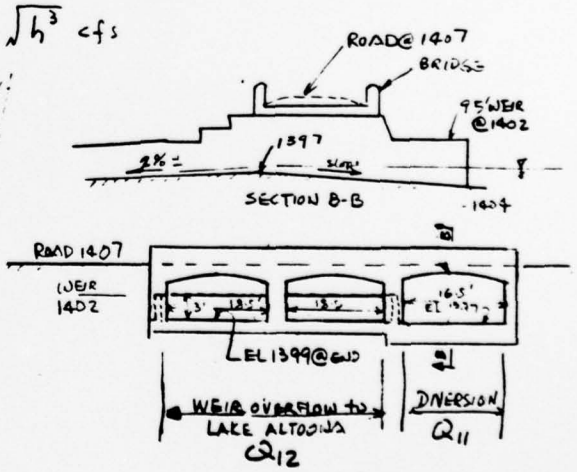
$$\left(\frac{Q}{T}\right)^2 = h^3 \times g$$

$$q = \sqrt{g h^3} \quad cfs/FT = \sqrt{(32.2)(5)^3} = 63.4 \ cfs/FT$$

$$Q_{11} = q \cdot T = 63.4 \times 16.5 = 1047 \ cfs \quad \boxed{\text{Say } 1050 \ cfs}$$

also $Q_{11} = 93.63 \sqrt{h^3}$ cfs





SECTION A-A

b) Q_{12} (WEIR OVERFLOW to LAKE ALTOONA)

$L = 95'$

$Q_{12} = c\,L\,H^{1.5}$ (SHARP CREST WEIR) (See P 3 SKETCH)

$= (3.2)(95)(H)^{1.5}$

$= 304\,H^{1.5}$ cfs $\quad (h = H + 5)$

EL	DIVERSION h	DIVERSION Q_{11}, cfs	WEIR OVERFLOW to LAKE H	WEIR OVERFLOW to LAKE Q_{12} cfs	TOTAL INFLOW $Q_{11}+Q_{12}$ cfs
1397	0	0	—	—	0
1402	5	1047	0	0	1047
1403	6	1376	1	304	1680
1404*	7	1734	2	860	2594
1405*	8*	2119*	3	1580	3698
1406*	9*	2528*	4	2432	4960
1407*	10*	2961*	5	3399	6360

* BOTTOM OF BRIDGE EL 1404 ($\Delta h = 7$ ft) ASSUME INLET CONTROL (OR CRITICAL DEPTH CONTROL)

THE MAX INFLOW AT THIS POINT IS

TUNNEL FLOW = 1200 cfs (see P 1/5, SCOTCH GAP RUN WATERSHED)

WATERSHED INFLOW = 1.3 SQ. MILE × 2400 cfs/SQ MILE

= 3120 cfs

$Q_{MAX} = 4320$ cfs < 6361 cfs OK — say 4300 cfs

BACK FIGURE h H and ELEV. FOR Q = 4300 cfs

@ ELEV 1405.5 $h = 8.50$ $Q_{11} = 2320$ cfs

$H = 3.50$ $Q_{12} = 1991$ cfs

$\Sigma Q = Q_{11} + Q_{12} = 4311 \approx 4300$ OK

DAPPOLONIA
CONSULTING ENGINEERS, INC

By JSTC Date 9-2-78 Subject LAKE ALTOONA DAM Sheet No 5 of 5
Chkd. By [illegible] Date 9/11/78 HYDROLOGY & HYDRAULIC Proj No 78-114-21

D/S CHANNEL CAN CARRY MORE THAN 4300 cfs

AND THE SPILLWAY CAPACITY IS LIMITED TO

9300 cfs FABRIC DEFLATED

5200 cfs FABRIC INFLATED

ESTIMATE THE PERCENT* OF PMF W/O OVERTOPPING

$$\%PMF = \left(\frac{9300 + 1200 + (\%PMF)(3100)}{28000} + \frac{920}{17800} \right) \text{(See NOTE 1)}$$

%PMF = 48.0% (WITHOUT FABRIC DAM)

Say 48% PMF W/O FABRIC

OR $\left(\frac{5200^{cfs} + 1200 + (\%)3100}{28000} + \frac{510}{17800} \right) 100\%$

= 28.9% (WITH FABRIC DAM)

Say 29% PMF W/ FABRIC

NOTE(1) SINCE THE SURCHARGE STORAGE CAPACITY OF TWO U/S DAM (70 + 250 + 320 ac-ft) IS RELATIVELY SMALLER THAN THE VOLUME OF PMF (28000 ac-ft), THE AFFECT OF TWO U/S DAM IN REDUCING THE PEAK OF PMF IS NEGLECTED

* FLOW IN DIVERSION CHANNEL

APPENDIX E
REGIONAL GEOLOGY

APPENDIX E
REGIONAL GEOLOGY

Lake Altoona Dam and its reservoir are situated on strata of the Upper Devonian Age Catskill Red Beds and Upper Devonian Age Chemung Shales. The red beds consist of reddish-brown highly fractured shale and claystone. The Chemung Shale is a thin-bedded greenish-gray shale with some thin interbedded sandstone layers. The rock strikes northeast and dips approximately 15 to 20 degrees to the northwest. The shale is less resistant to weathering than the overlying red beds and forms more gentle slopes. The south slope of the valley is hummocky and may have experienced landslides in the past. However, no evidence was found indicating recent movement.