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NATIONAL DAM INSPECTION PROGRAM. SAWMILL RUN DAM (ARMCO) (NDI I--ETC(U)
SEP 78 DACW31-78-C-0049
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LEVEL II

OHIO RIVER BASIN
SAW MILL RUN , BUTLER COUNTY

PENNSYLVANIA

SAWMILL RUN DAM (ARMCO)

NDI I.D. NO: 915

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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(6) National Dam Inspection Program. Sawmill Run Dam (ARMCO) (NDI ID 915), Ohio River Basin, Saw Mill Run, Butler County, Pennsylvania. Phase I Inspection Report.

PREPARED FOR

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

BY

D'APPOLONIA CONSULTING ENGINEERS
10 DUFF ROAD
PITTSBURGH, PA. 15235
SEPTEMBER 1978

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

NAME OF DAM: Sawmill Run Dam (Armco)
STATE LOCATED: Pennsylvania
COUNTY LOCATED: Butler
STREAM: Sawmill Run, a tributary of Conoquenessing Creek
DATE OF INSPECTION: September 12 and October 3, 1978

ASSESSMENT: Based on the evaluation of the conditions as they existed on the dates of inspection and as revealed by visual observations, the condition of Sawmill Run Dam is assessed to be good.

It is recommended that brush and trees on the upstream and downstream faces of the dam be removed. It is also recommended that an upstream control be installed on the outlet pipe, consisting of either a permanent structure or temporary means of blocking the upstream end of the pipe in the event the outlet pipe must be drained.

It is further recommended that the owner develop a formal warning system to alert the downstream residents in the event of emergencies.

Based on the recommended criteria, the capacity of the spillway is classified to be adequate.

Lawrence D. Andersen
Lawrence D. Andersen, P.E.
Vice President

4 Dec 78
G. K. WITHERS
Colonel, Corps of Engineers
District Engineer

SAWMILL RUN DAM
(ARMCO)
NDI I.D. NO. 915
SEPTEMBER 12, 1978

Upstream Face

Downstream Face

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PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM
SAWMILL RUN DAM
(ARMCO)
NDI I.D. NO. 915
DER I.D. NO. 10-71

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 dam consists of an earth embankment approximately 540 feet long with a maximum height of 58 feet from the downstream toe and a crest width of 20 feet. A concrete channel located on the right abutment (looking downstream) constitutes the primary and emergency spillway of the dam. The spillway structures consist of an approach channel, a broad-crested control section, and a spillway chute which terminates at a stilling basin at the toe of the dam. The 35-foot-wide broad-crested control section is located at a level 32 feet below the dam crest. The outlet works for the dam consist of a 30-inch-diameter combined supply and outlet pipe and a valve and pump house located at the downstream toe of the dam. Flow through the outlet pipe is controlled by valves located at the pump house. The outlet pipe discharges into the stilling basin of the spillway. This pipe constitutes the emergency drawdown facility for the dam.

b. Location. Sawmill Run Dam is located on Sawmill Run about one mile upstream from its confluence with Conoquenessing Creek and three miles southwest of Butler in Butler Township, Butler County, Pennsylvania (Plate 1).

Below the dam, the remaining course of Sawmill Run is located within the Butler Works of Armco Inc. The first one-half-mile reach of the valley consists of a 2000-foot-wide slag disposal and scrap storage area. The stream follows the right valley wall. Downstream of the slag disposal area, the stream flows into a 120-foot-diameter, 1000-foot-long corrugated metal culvert which discharges into

Conoquenessing Creek. It is estimated that a failure of Sawmill Run Dam would cause significant property damage and possibly loss of life, primarily within Armco's Butler Works.

c. Size Classification. Intermediate (based on 58-foot height).

d. Hazard Classification. High.

e. Ownership. Armco Inc. (address: Mr. Robert Clouse, Armco Inc., P.O. Box 591, Butler, Pennsylvania 16001).

f. Purpose of Dam. Industrial water supply.

g. Design and Construction History. The dam was designed by General Analytics, Inc., Consulting Engineers, of Monroeville, Pennsylvania in 1966. The dam was constructed by Kaiser Engineers, Inc., of Butler, Pennsylvania. The dam was completed in 1968.

h. Normal Operating Procedure. The reservoir is normally maintained at the spillway crest level, Elevation 1041, leaving 32 feet of freeboard to the top of the dam at Elevation 1073. All inflow occurring when the reservoir is at or above the spillway elevation is discharged through the spillway. The blow-off valve for the dam is normally closed. Armco personnel reported that currently the dam is only occasionally used as a water supply source.

1.3 Pertinent Data

a. Drainage Area - 2.8 square miles

b. Discharge at Dam Site (cfs)

Maximum known flood at dam site - Unknown
Outlet conduit at maximum pool - Unknown
Gated spillway capacity at maximum pool elevation - N/A
Ungated spillway capacity at maximum pool elevation - 16,000 at Elevation 1073
Total spillway capacity at maximum pool elevation - 16,000 at Elevation 1073

c. Elevation (USGS Datum) (feet)

Top of dam - 1073
Maximum pool - 1073 (top of dam)
Normal pool - 1041 (spillway crest)
Upstream invert outlet works - N/A
Downstream invert outlet works - N/A
Streambed at center line of dam - 1002
Maximum tailwater - Unknown

d. Reservoir Length (feet)

Normal pool - 1700
Maximum pool - 4000+

e. Storage (acre-feet)

Normal pool - 144
Maximum pool - 727 (top of dam)

f. Reservoir Surface (acres)

Normal pool - 10
Maximum pool - 21+

g. Dam

Type - Earth
Length - 540 feet
Height - 58 feet
Top width - 20 feet
Side slopes - 2H:1V (downstream); 2.5H:1V (upstream)
Zoning - Yes
Impervious core - Yes
Cutoff - No
Grout curtain - No

h. Diversion and Regulating Tunnel

Type - 30-inch-diameter cast iron
Length - 310 feet
Closure - Valve (downstream end)
Access - Valves at valve house near toe of dam
Regulating facilities - Valve

i. Spillway

Type - Broad-crested overflow section with chute channel
Length of weir - 35 feet
Crest elevation - 1041
Gates - N/A
Upstream channel - Lake and approaching channel
Downstream channel - 35-foot rectangular concrete discharge channel with stilling basin

SECTION 2
ENGINEERING DATA

2.1 Design

a. Data Available

(1) Hydrology and Hydraulics. The available data are included in the engineer's report: Melt Shop Site Development, Subsurface Investigation and Design, Sawmill Run Water Supply Dam, Armco Steel Corporation, Butler, Pennsylvania, prepated by General Analytics, Inc., Consulting Engineers, Monroeville, Pennsylvania, August 1967. The report states the criteria used for the design of the spillway.

(2) Embankment. The embankment design was based on the engineer's report and technical specifications prepared by the consulting engineer. The design report includes the description of the subsurface investigation, the results of classification and compaction tests, and settlement and seepage analyses. Boring logs were included in the design drawings.

(3) Appurtenant Structures. The available information consists of design drawings.

b. Design Features

(1) Embankment

a. As designed, the dam is a zoned embankment consisting of a large impervious fill with a rock-fill section forming the downstream slope. A 10-foot-wide filter zone is located between the impervious fill and the downstream rock-fill section. The rock-fill section extends to the top of foundation rock through a trench excavated at the downstream toe of the dam. As designed, the dam was supposed to be constructed in two stages. As it exists, the dam was built to the Stage II level with its crest at Elevation 1073 (Plate 2).

b. The dam was designed to have a 2 to 1 (horizontal to vertical) slope on the downstream face and a 2-1/2 to 1 slope on the upstream face.

c. The subsurface investigation conducted for the dam consisted of 14 borings and 7 test pits. The locations of the borings are shown on Plate 3. Boring logs are illustrated in Plate 4.

The typical subsurface profile (Plate 5) consists of 5 to 15 feet of residual clayey silts on the valley sides and about 15 feet of medium dense silty sand and gravel at the valley floor. The rock beneath the site includes sandstone, claystone, siltstone, shale, and coal. The Upper and Lower Freeport coal seams were encountered at 10 and 30 feet below the Stage II crest level of the dam. In the valley bottom, top of rock was encountered at approximately Elevation 995, with the upper 3 to 15 feet being weathered and impermeable. In this zone, permeability of the rock was reported to be 10^{-3} cm/sec. Massive sandstone was found at Elevation 980, approximately 30 feet below the original ground surface.

d. The engineer's report indicates that the impervious fill section of the dam would consist of residual soils and weathered rock. The silty sand and gravels encountered at the dam site were found to be an acceptable filter material.

c. Appurtenant Structures. The appurtenant structures of the dam consist of a chute spillway on the right abutment and outlet works. The spillway is comprised of a trapezoidal, riprap-lined approach channel and a 35-foot-wide rectangular concrete channel which starts in line with the axis of the dam and terminates in a concrete stilling basin at the toe level of the dam. Plate 6 illustrates the plan and profile of the spillway. The profile of the spillway discharge channel is such that it essentially forms a broad-crested hydraulic control section. The cantilever walls of the rectangular concrete channel have a maximum height of 10 feet. The slab sections are underlain by sand and gravel and anchored to the rock. The stilling basin is a concrete box structure 20 feet long, 35 feet wide, and 20 feet deep. Flow into the basin is discharged to a side apron at a right angle to the spillway axis.

The outlet works are located at the middle of the embankment and consist of a submerged concrete intake structure at the upstream toe of the dam, a 30-inch cast-iron pipe through the embankment, and a downstream valve chamber. The outlet pipe discharges into the stilling basin of the spillway. Plate 7 illustrates the details of the outlet works. The intake structure is equipped with a trash screen. The 30-inch pipe is 310 feet long and is encased in concrete. There are seven concrete seepage collars along this length. The flow through the pipe is controlled by valves located at the valve chamber at the downstream toe of the dam. Therefore, the pipe is under pressure at all times.

d. Design Data

(1) Hydrology and Hydraulics. The 1967 engineer's report indicates that the spillway was designed for a discharge capacity of 3300 cubic feet per second (cfs) in conformance with the state requirements applicable at the time of design.

(2) Embankment. The stability calculations for the embankment are included with the design drawings (Plates 8, 9 and 10). The stability analysis of the dam included the stability of the downstream slope under steady-state seepage, the upstream slope, rapid drawdown condition, and horizontal sliding of the embankment. The minimum computed factor of safety was 1.67 for the stability of the downstream slope under steady seepage condition. The analysis was based on assumed angles of internal friction of 40 degrees for the rock fill, 35 degrees for the silty sand foundation material and filter material, and 30 degrees for compacted impervious fill with 500 pounds per square foot cohesion. The unit weights of the materials were taken as 145 pounds per cubic foot (pcf) for rock-fill foundation material and 137 pcf for impervious fill.

(3) Appurtenant Structures. There are no design calculations available for the appurtenant structures.

2.2 Construction. Construction drawings and specifications prepared by General Analytics, Inc., were available for review. To the extent that can be determined, the construction of the dam was apparently conducted in conformance with the specifications. No reference was found to indicate that any unusual problems were encountered during the construction of the dam. The dam was constructed under the supervision of the consulting engineer's representative. The earth work was monitored by field density tests, and it is reported that the results were satisfactory. The field tests also included classification, permeability, and direct shear tests. It is reported that the results showed good agreement with the corresponding soil parameters used in stability and seepage analyses.

2.3 Operation. There are no formal operating procedures for the dam. The spillway of the impoundment is uncontrolled and has no operational features. The blow-off valve for the dam is normally closed.

2.4 Other Investigations. The available information indicated no other investigations other than the reports of periodic inspections conducted by the state.

2.5 Evaluation

a. Availability. Available engineering data were provided by PennDER and GAI Consultants (formerly General Analytics, Consulting Engineers).

b. Adequacy

(1) Hydrology and Hydraulics. The available information is limited to providing the design capacity of the spillway. It is not considered to be adequate to assess the conformity of the analysis to the current spillway design criteria.

(2) Embankment. Review of the geotechnical aspects of the design indicates that although the design generally followed currently accepted practice for subsurface investigation, the stability analyses were apparently based on assumed soil strength values rather than actual strength values obtained from laboratory test results. However, it is reported that additional laboratory testing was conducted during construction of the dam, and the results of these tests showed good agreement with the corresponding soil parameters used in the stability and seepage analyses.

(3) Appurtenant Structures. Review of the design drawings indicates that, as designed, there are no significant design deficiencies that should affect the overall performance of the appurtenant structures. However, installation of an upstream control on the outlet pipe is considered to be advisable in the event it is necessary to drain the outlet pipe.

c. Operating Records. No formal operating records are available for the dam.

d. Post-Construction Changes. There are no reported post-construction changes.

e. Seismic Stability. The dam is located in Seismic Zone 1 and based on the visual observations, the static stability of the dam is considered to be adequate. Therefore, according to the recommended criteria for the 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 Sawmill Run Dam consisted of:

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

2. Visual examination of the spillway and its components and other appurtenant features.

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

4. Evaluation of downstream hazard potential.

The specific observations are illustrated in Plate 11 and in the photographs in Appendix C.

b. Embankment. The general inspection of the embankment consisted 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.

Both upstream and downstream faces of the dam were observed to be covered with brush and trees up to 10 feet high. This condition precluded close inspection of the embankment. To the extent that is visible, no signs of distress or seepage were found on the embankment or immediate area below the toe. A swampy area was observed on the left abutment approximately 200 feet downstream from the dam located between the valley wall and the ash disposal area haul road. Standing water is visible, but no flow was observed. It appeared that the probable source was surface runoff trapped due to surface grading for the slag disposal area.

c. Appurtenant Structures. The spillway structures, spillway crests, channels, and stilling basin were examined for deterioration or other signs of distress and obstructions that would limit flow.

In general, the structures were found to be in good condition. As indicated by the presence of fallen rocks in the spillway channel, the rock cut on the right side of the spillway channel poses a potential for partial blockage of the spillway in the event of a significant slide.

The blow-off valve was operated and observed to be functional.

d. Reservoir Area. While the slopes adjacent to the reservoir are covered with woodlands, most of the watershed is suburban residential area. Preston Dam, which is 17 feet high and impounds 12 acre-feet of water, is located about two miles upstream from Sawmill Run Dam.

Review of 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. The remaining course of Sawmill Run is located within the boundaries of the Butler Works of Armco Inc. The stream initially flows through an open channel, then it is confined to a 1000-foot-long, 12-foot-diameter, corrugated metal culvert which discharges into Conoquenessing Creek about 3000 feet downstream from the dam.

3.2 Evaluation. In general, the condition of the dam is considered to be good. Removal of brush from the upstream and downstream faces of the dam is required to permit closer inspection of these areas. The rock cut along the spillway channel should be observed frequently and remedial measures taken to prevent rock slides that may partially block the spillway channel.

SECTION 4
OPERATIONAL FEATURES

4.1 Procedure. Armco personnel reported that there are no formal operating procedures for the dam. Supply water is only occasionally taken from the reservoir. The only operational feature of the dam which may affect the safety is the outlet pipe valve if it is required to lower the reservoir.

Clearing of debris from the spillway as required and continued inspection of the facilities are the principal maintenance operations which would affect safety.

4.2 Maintenance of the Dam. The general maintenance condition of the dam is considered to be poor. Both upstream and downstream faces of the dam are covered with brush and trees up to 10 feet high.

4.3 Maintenance of Operating Facilities. The maintenace condition of the operating facilities is considered to be good. The blow-off valve was operated and observed to be functional.

4.4 Warning System. No formal warning system exists for the dam. The dam is maintained by Armco personnel. Communication facilities are available at the site.

4.5 Evaluation. The overall maintenance condition of the dam is considered to be fair. Brush and trees on the upstream and downstream faces of the dam should be removed to permit closer inspection of these areas. The condition of the operating facilities is considered to be good.

SECTION 5
HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features

a. Design Data. Sawmill Run Dam has a watershed area of 2.8 square miles and impounds a reservoir with a surface area of 10 acres at normal pool level. A chute spillway located on the right abutment is the only flood discharge facility for the reservoir. As previously mentioned, the dam was intended to be constructed in two phases. The present spillway was associated with Phase I construction and was designed to pass 3300 cfs with pool level at Elevation 1049.5, leaving 3.5 feet of freeboard to the Phase I crest level. However, while the embankment was completed to Phase II elevation (1073), the spillway was not modified. Therefore, as it exists, the spillway can pass the design flow of 3300 cfs with a freeboard of 23-1/2 feet.

b. Experience Data. Sawmill Run Dam is classified to be an intermediate size dam in the significant hazard category. According to the recommended criteria for evaluating emergency spillway capacity, such impoundments are required to pass one-half to full PMF.

The adequacy of the spillway was analyzed based on the simplified procedure developed by the Baltimore District, Corps of Engineers. Based on this procedure, it was determined that the PMF inflow hydrograph will have a peak flow of 5200 cfs and a total volume of approximately 3900 acre-feet (Appendix D). Further analysis according to the procedure indicated that, using the design capacity of the concrete spillway channel alone, the spillway can pass 56 percent of PMF. When flow above the spillway channel lining is considered, the spillway can pass full PMF with a freeboard of about 19 feet.

c. Visual Observations. On the dates of inspection, no conditions were observed that would indicate that the spillway of the dam could not operate satisfactorily in the event of a flood. As previously stated, the rock cut along the spillway channel is considered to pose a potential for partial blockage of the spillway in the event of a significant slide. However, with periodic observation and remedial action, this threat can be significantly reduced.

d. Overtopping Potential. The dam can pass full PMF with a freeboard of about 19 feet.

e. Spillway Adequacy. The spillway can pass the recommended design flood. Therefore, it is classified to be adequate.

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 stability of the dam, and none were reported in the past.

The structural performance of the spillway structures is considered to be adequate. The structural condition of the drainpipe could not be assessed.

b. Design and Construction Data

(1) Embankment. The design engineer's report indicates that the stability of the embankment was analyzed for steady-state seepage, rapid drawdown, and horizontal sliding conditions. The minimum factor of safety was reported to be 1.67 for the steady-state seepage stability of the downstream slope. It appears that the stability analyses were based on assumed strength parameters. However, it is reported that additional direct shear tests were conducted during the construction of the dam and the results showed good agreement with the corresponding soil parameters used in the stability analyses. It is also reported that the earthwork was monitored by field density tests and the results were satisfactory.

(2) Appurtenant Structures. The review of the design drawings indicates that there are no apparent structural deficiencies that would significantly affect the performance of the appurtenant structures. However, installation of an upstream control on the outlet pipe is considered to be advisable in the event it is necessary to drain the outlet pipe.

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

d. Post-Construction Changes. There have been no reported modifications to the original design that would 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 the Sawmill Run Dam is in good condition. The field observations did not reveal any significant signs of distress at this time and none were reported in the past. A swampy area observed downstream from the dam on the left abutment was attributed to surface runoff.

The capacity of the spillway was found to be adequate.

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

c. Urgency. The recommendations listed below should be implemented as soon as practicable or on a continuing basis.

d. Necessity for Further Investigation. The condition of the dam is not considered to require further investigation at this time.

7.2 Recommendations/Remedial Measures

1. Brush and trees should be removed from the upstream and downstream faces of the dam.

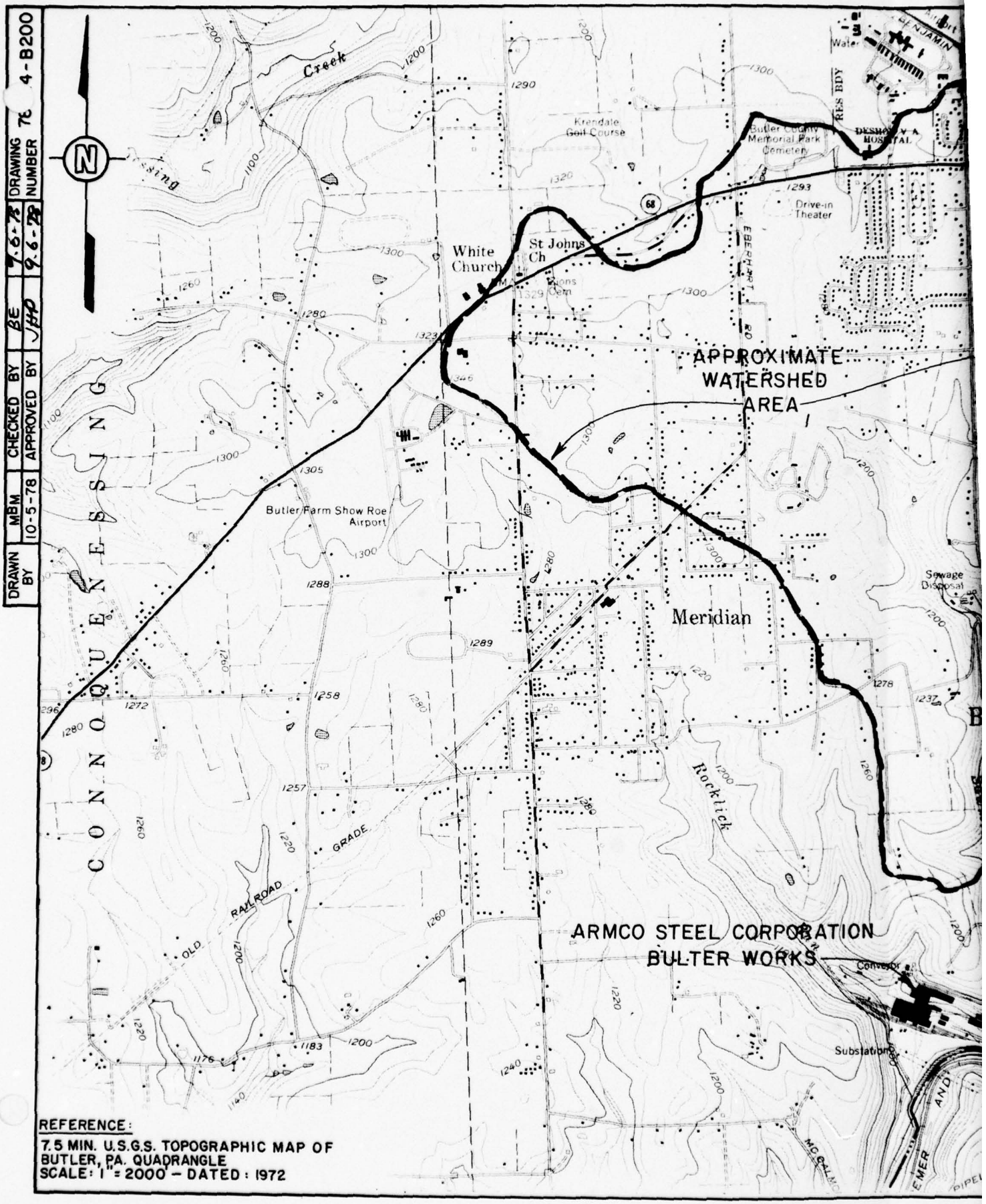
2. The steep rock cut along the spillway channel should be observed frequently and necessary remedial measures taken to prevent major rock slides that may partially block the spillway channel.

3. It is also recommended that an upstream control be installed on the outlet pipe, consisting of either a permanent structure or temporary means of blocking the upstream end of the pipe in the event it is necessary to drain the outlet pipe.

4. The owner should provide around-the-clock surveillance during periods of unusually heavy runoff and develop a formal warning system to alert the downstream residents in the event of emergencies.

5. It is recommended that the owner be advised that the dam and the appurtenant structures should be inspected regularly and be properly maintained.

PLATES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APPROVED BY JHD 9.6-78
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CONNOQUENESSING
Creek
Krendale Golf Course
Butler County Memorial Park Cemetery
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White Church
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EBERHART
APPROXIMATE WATERSHED AREA
Butler Farm Show Roe Airport
Meridian
Sewage Disposal
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RAILROAD
ARMCO STEEL CORPORATION
BULTER WORKS
Conveyor
Substation
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BUTLER, PA. QUADRANGLE
SCALE: 1" = 2000 – DATED: 1972

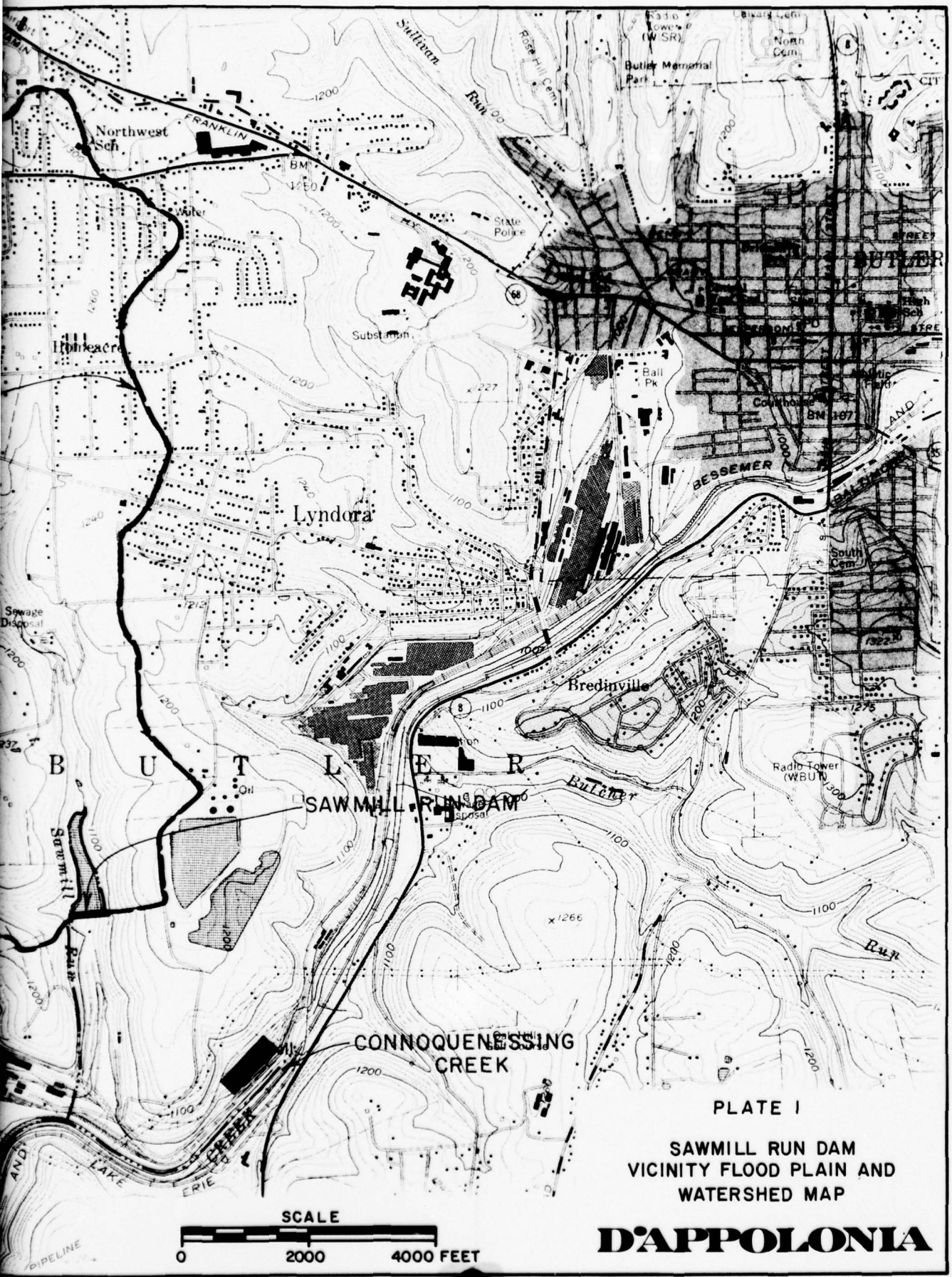

PLATE I

SAWMILL RUN DAM
VICINITY FLOOD PLAIN AND
WATERSHED MAP

D'APPOLONIA

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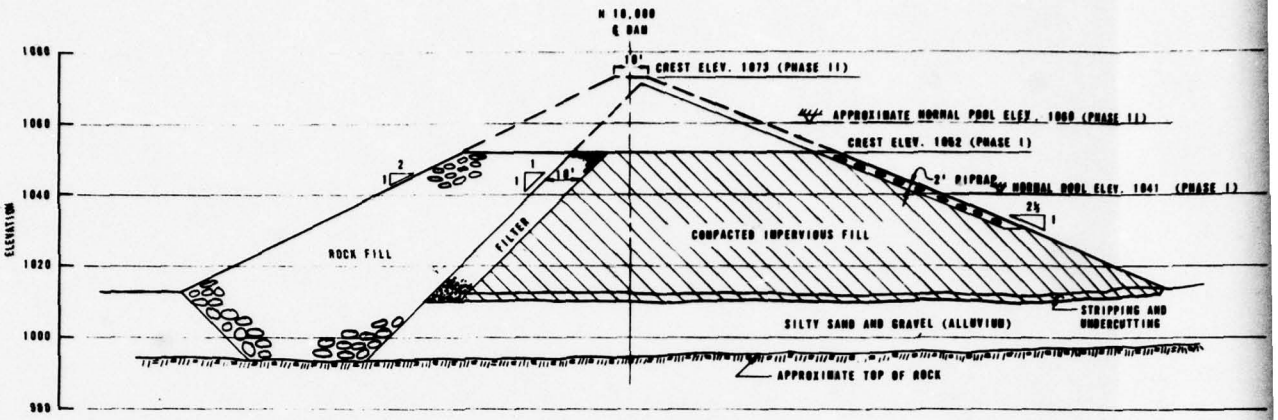

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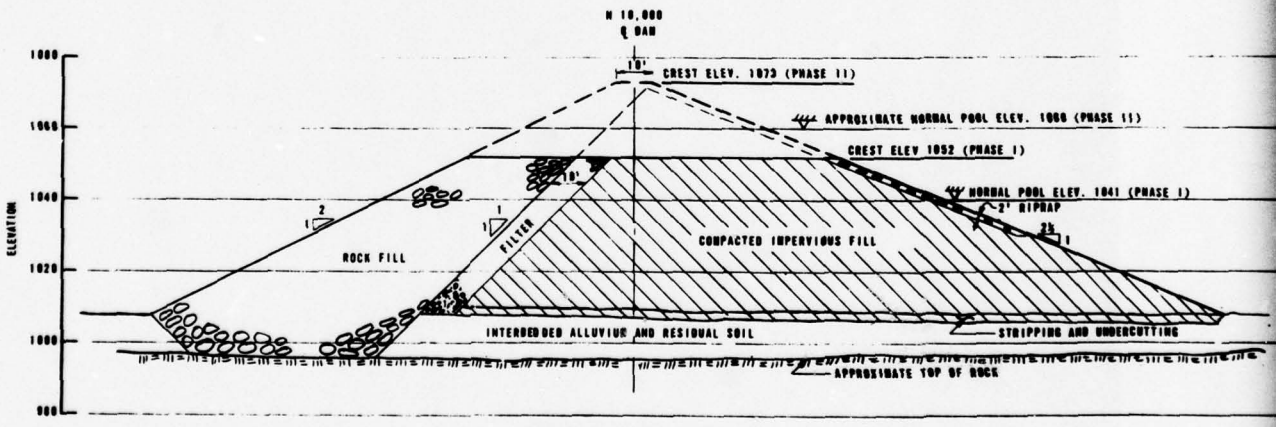

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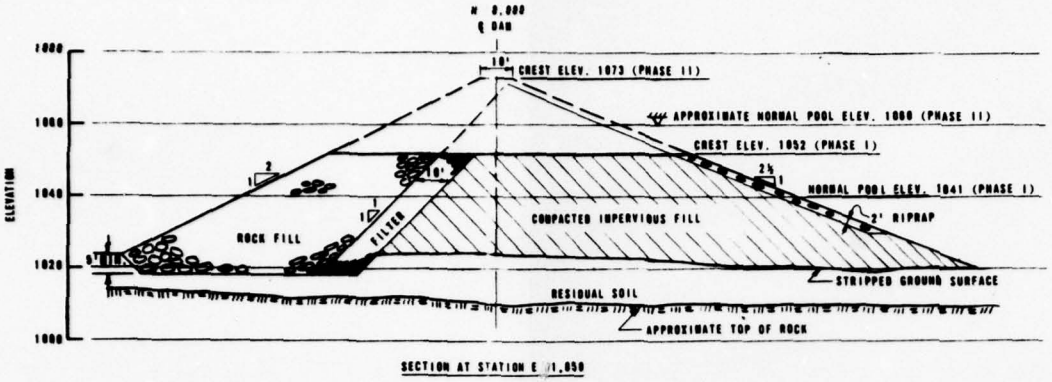

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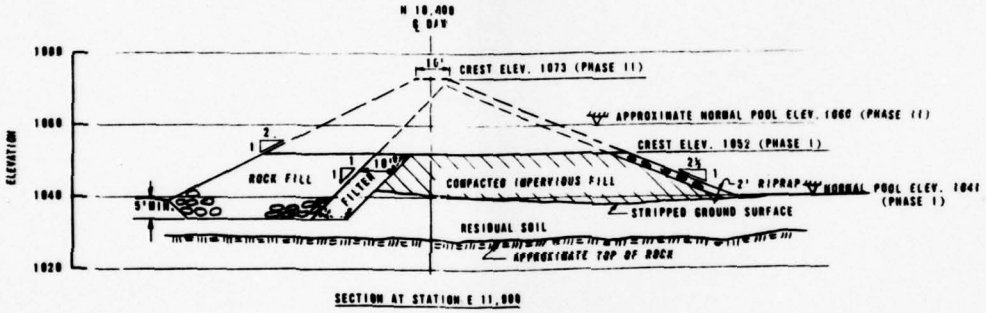

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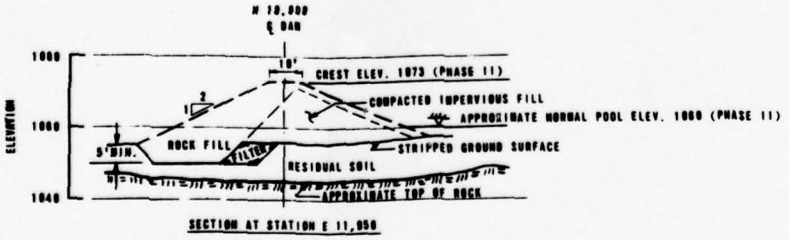

SECTION AT STATION E 11,050

NOTE:
ALL SECTIONS LOOKING WEST

PLATE 2

D'APPOLONIA

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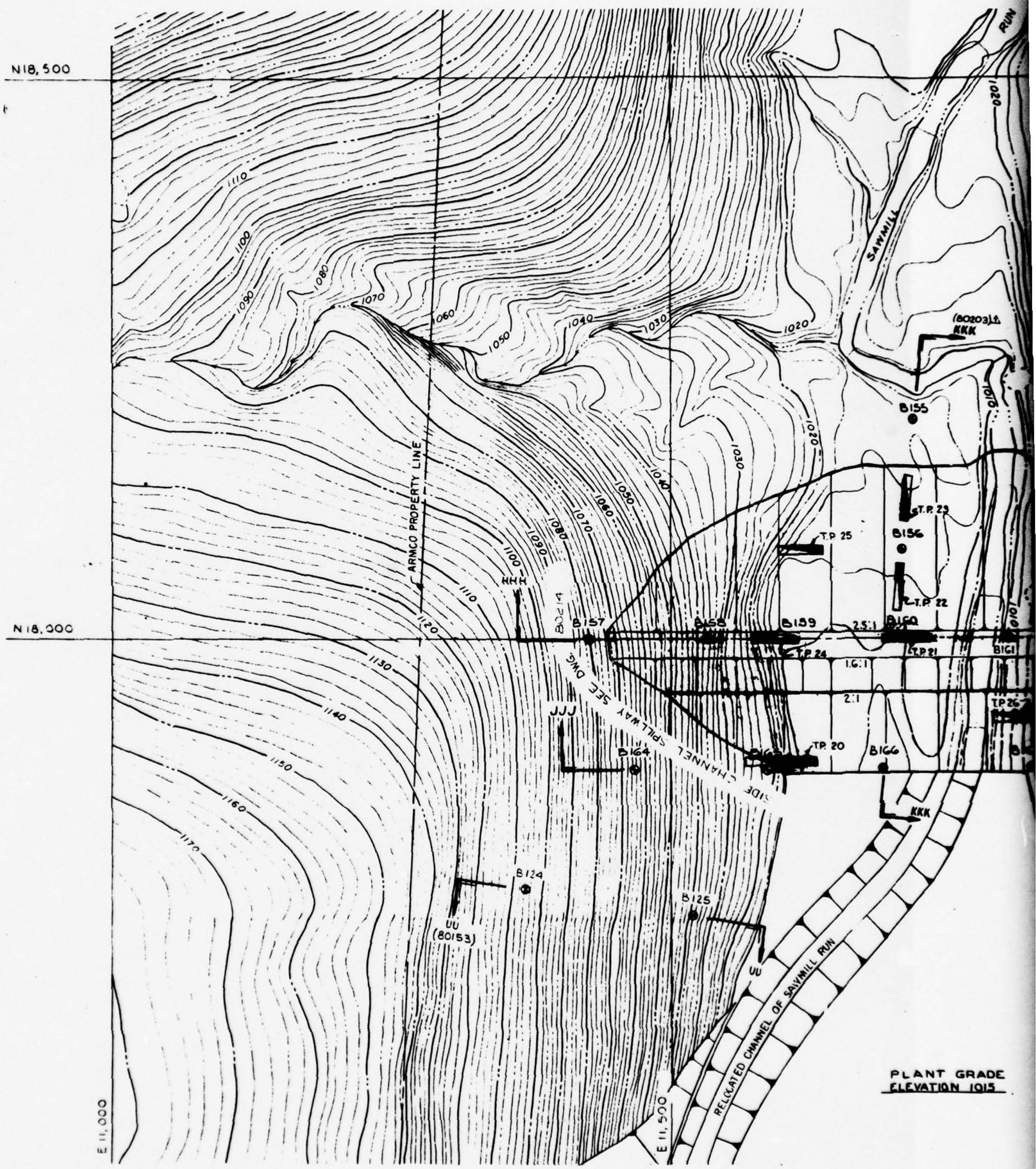
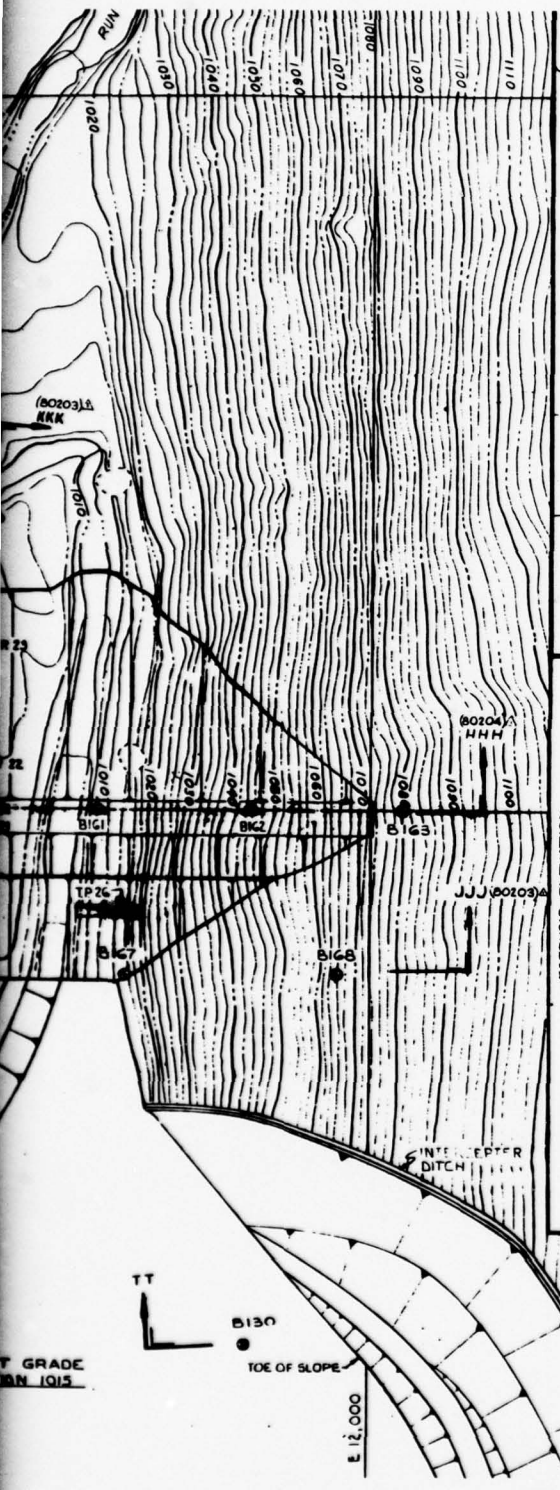
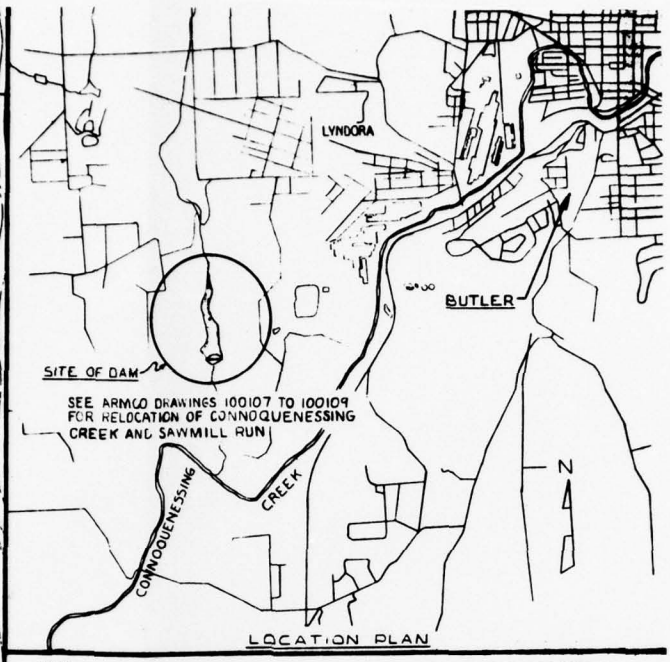
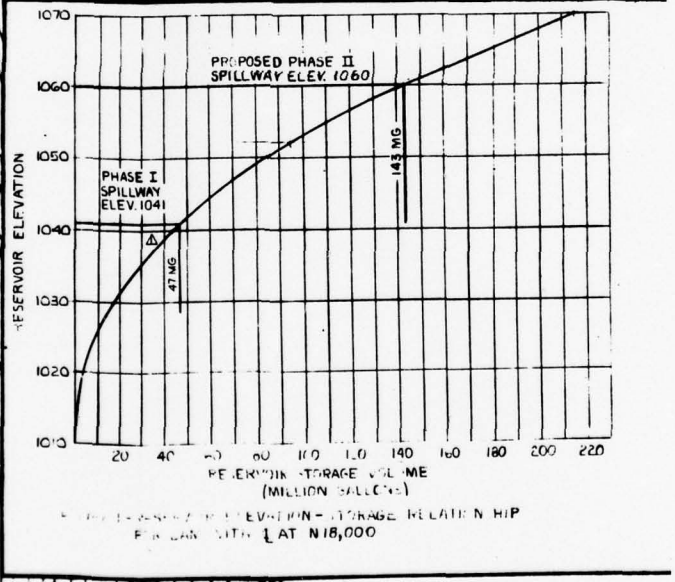






LOCATION PLAN



ELEVATION - STORAGE RELATION HIP
FOR DAM WITH ℄ AT N18,000

PLATE 3

D'APPOLONIA

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	10-5-78	APPROVED BY	JBP	9.6.78		

BORING 155

ELEV FEET	DEPTH FEET	BLOWS PER 6 INCHES * OR CORE RECOVERED PER RUN	SAMPLE TYPE	PROFILE	DESCRIPTION: SOIL DENSITY, CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: MATERIAL	WATER CONTENT-%	PERMEABILITY (CM/SEC X 10⁻⁴) *	GENERAL LABORATORY SOIL DATA
1018.3		1-1-1			LOOSE	BROWN TO BLACK SANDY SILT			
1010	10	7-9-5			MEDIUM DENSE TO DENSE	BROWN SILTY SAND AND GRAVEL			
		13-17-22							
1000	20	12-19-25							
		30-32/0.2'							
991.3	25.0	4-5 / 4-5	2 1/8" DIA CORE		MEDIUM	GRAY SILTSTONE-BROKEN		27.1	

BORING 156

ELEV FEET	DEPTH FEET	BLOWS PER 6 INCHES * OR CORE RECOVERED PER RUN	SAMPLE TYPE	PROFILE	DESCRIPTION: SOIL DENSITY, CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: MATERIAL
1013.0						
1010		1-1-3			VERY LOOSE	BROWN SILTY SAND
		11-9-9			MEDIUM DENSE	BROWN SILTY SAND AND GRAVEL
1000	10	37-29-30			VERY DENSE	BROWN SANDSTONE
		8-8-25			MEDIUM DENSE	BROWN SILTY SAND AND GRAVEL
	20	54-44/0.4'			STIFF TO VERY STIFF	BROWN TO GRAY CLAY (DECOMPOSED SHALE)
990		3-5 / 4-5	2 1/8" DIA CORE		SOFT TO MEDIUM SOFT	GRAY SILTSTONE
	30	5-5 / 5-5			MEDIUM HARD TO HARD	GRAY SILTSTONE TO SLOCKY
980		5-5 / 5-5			HARD	GRAY SANDSTONE
		5-5 / 5-5			HARD	GRAY SILTSTONE
972.5	40.5	5-5 / 5-5			HARD	GRAY SANDSTONE
					HARD	GRAY SILTY SHALE
					HARD	GRAY SANDSTONE

1-24-67

* UNDISTURBED SAMPLE
ST-1 PUSHED 1.0' RECOVERED 0.9'

BORING 158

ELEV FEET	DEPTH FEET	BLOWS PER 6 INCHES * OR CORE RECOVERED PER RUN	SAMPLE TYPE	PROFILE	DESCRIPTION: SOIL DENSITY, CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: MATERIAL	WATER CONTENT-%	PERMEABILITY (CM/SEC X 10⁻⁴) *	GENERAL LABORATORY SOIL DATA
1013.3									
1010		1-3-3			LOOSE	BROWN CLAYEY SAND AND GRAVEL (FILL)	10.4		
		4-7-9			MEDIUM STIFF	BROWN SILTY CLAY-SOME GRAVEL	15.9		
	10	5-4-7			MEDIUM STIFF TO STIFF	GRAY CLAYEY SILT-SOME SAND AND GRAVEL	23.8 / 19.6 / 17.6 / 10.6	0.16	γ_d = 116.9 PSF, q_u = 700 PSF, LL = 27.8, PL = 17.6, q_u = 1179 PSF
1000		4-38/0.2'	Δ-ST-1						
	20	4-5 / 5-6	2 1/8" DIA CORE		MEDIUM SOFT TO SOFT	GRAY INTERBEDDED SILTSTONE, SANDSTONE AND CLAYSTONE-VERY BROKEN		0	
980		5-6 / 5-6						0	
	30	4-6 / 5-6			MEDIUM HARD TO HARD	GRAY SILTSTONE-MASSIVE		0	
980		5-6 / 5-6			HARD	GRAY SILTSTONE-SOME SANDSTONE SEAMS-MASSIVE		5.7	
972.8	40.5	5-6 / 5-6						0	

1-27-67

Δ UNDISTURBED SAMPLE
ST-1 PUSHED 2.0' RECOVERED 1.8'

BORING 160

ELEV FEET	DEPTH FEET	BLOWS PER 6 INCHES * OR CORE RECOVERED PER RUN	SAMPLE TYPE	PROFILE	DESCRIPTION: SOIL DENSITY, CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: MATERIAL
1012.2						
1010		1-1-1			VERY LOOSE	BROWN SILTY SAND-GRAVEL
		6-7-15			MEDIUM DENSE TO DENSE	BROWN SILTY SAND AND GRAVEL
1000	10	14-16-17				
		17-20-20				
		19-19-27			SOFT	GRAY DECOMPOSED SHALE
	20	35/0.1'				
990		2-3 / 5-6	2 1/8" DIA CORE		SOFT TO MEDIUM SOFT	GRAY SILTSTONE
	30	2-4 / 5-6			HARD	GRAY INTERBEDDED SHALE AND SILTSTONE
980		5-6 / 5-6				
	40	5-6 / 5-6				
970		5-6 / 5-6				
	50	5-6 / 5-6				
960		5-6 / 5-6			HARD	GRAY SANDSTONE
	60	5-6 / 5-6				
950		5-6 / 5-6				
941.7	70.5	5-6 / 5-6				

1-18-67

BORING 161

ELEV FEET	DEPTH FEET	BLOWS PER 6 INCHES * OR CORE RECOVERED PER RUN	SAMPLE TYPE	PROFILE	DESCRIPTION: SOIL DENSITY, CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: MATERIAL	WATER CONTENT-%	PERMEABILITY (CM/SEC X 10⁻⁴) *	GENERAL LABORATORY SOIL DATA
1018.7		0-2-2			VERY LOOSE	BROWN SILTY SAND	29.6	0.65	
		8-8-16			SOFT	BROWN WEATHERED SANDSTONE BOULDER	11.8 / 12.9	4.0 / 0.65	
1000	10	10-8-7			MEDIUM STIFF	BROWN SANDY CLAY-SOME SILT			
		3-8-7					15.4	0.16	
		72-8.4'			MEDIUM DENSE	GRAY SILTY SAND AND GRAVEL			
990	20	1-4 / 4-4	2 1/8" DIA CORE		SOFT	GRAY DECOMPOSED SILTY SHALE		10.5	
		4-5 / 5-6			SOFT TO MEDIUM SOFT	GRAY SILTSTONE-VERY BROKEN		6.7	
980	30	5-6 / 5-6			SOFT	GRAY INTERBEDDED SILTSTONE AND SANDSTONE-VERY BROKEN		4.8	
		4-6 / 5-6			HARD	GRAY SANDSTONE-VERY BROKEN TO BROKEN		30.5	
970.7	48.0	5-6 / 5-6						1.2	

BORING 153

DESCRIPTION: MATERIAL	WATER CONTENT-%	PERMEABILITY (CM/SEC. X 10-4), *	GENERAL LABORATORY SOIL DATA
BROWN SILTY SAND	21%	0.18	γ_d = 90.5 PCF ϕ = 38° c = 250 PSF
BROWN SILTY SAND AND GRAVEL			
BROWN SANDSTONE BOULDER			
BROWN SILTY SAND-SOME GRAVEL			
BROWN TO GRAY SILTY CLAY (DECOMPOSED SHALE-SILTSTONE)			
GRAY SILTSTONE-VERY BROKEN		30.0	
GRAY SILTSTONE- BROKEN TO BLOCKY		0	
GRAY SANDSTONE- BROKEN			
GRAY SILTSTONE-BLOCKY		0	
GRAY SANDSTONE-MASSIVE		0.1	
GRAY SILTY SHALE-BROKEN			
GRAY SANDSTONE-BLOCKY			

BORING 157

ELEV. FEET	DEPTH FEET	BLOWS PER 6 INCHES * OR CORE RECOVERED PER RUN	SAMPLE TYPE	PROFILE	DESCRIPTION: SOIL DENSITY, CONSISTENCY OR ROCK HARDNESS	MATERIAL	WATER CONTENT-%	PERMEABILITY (CM/SEC. X 10-4), *	GENERAL LABORATORY SOIL DATA
1081.0									
1080		1-2-2	O		SOFT	BROWN CLAYEY SILT	18.4		
	10	28-31-31	O		STIFF	BROWN CLAYEY SILT AND SANDSTONE FRAGMENTS	9.5		
1070		18-13-12	O						
		27-78/0.2'	O						
1060	20				MEDIUM HARD TO HARD	BROWN TO GRAY COARSE SANDSTONE-BROKEN TO BLOCKY			
1050	30				MEDIUM HARD	GRAY INTERBEDDED SILTSTONE AND SANDSTONE- VERY BROKEN TO BROKEN			
1040	40				SOFT	COAL-VERY BROKEN			
					SOFT TO MEDIUM SOFT	GRAY LIMY CLAYSTONE-VERY BROKEN			
1030	50				SOFT TO MEDIUM SOFT	GRAY SILTSTONE-VERY BROKEN TO BROKEN			
1020	60								
1016.9	65.0				HARD	GRAY INTERBEDDED SANDSTONE AND SILTSTONE-BROKEN			

1-26-67

2 1/8" DIA. CORE

BORING 160

DESCRIPTION: MATERIAL	WATER CONTENT-%	PERMEABILITY (CM/SEC. X 10-4), *	GENERAL LABORATORY SOIL DATA
BROWN SILTY SAND-SOME GRAVEL	19.4	0.84	
BROWN SILTY SAND AND GRAVEL	11.7	65.0	
	12.0	0.85	
	9.0	0.85	
GRAY DECOMPOSED SILTY SHALE	12.4	9.0	
GRAY SILTSTONE-VERY BROKEN	11.1	36.0	
		92.0	
GRAY INTERBEDDED SILTY SHALE AND SILTSTONE-BLOCKY		0.1	
		0.1	
GRAY SANDSTONE-MASSIVE		0	
		0	
		0	
		0	
		0	
		0	
		0.1	

BORING 156

ELEV. FEET	DEPTH FEET	BLOWS PER 6 INCHES * OR CORE RECOVERED PER RUN	SAMPLE TYPE	PROFILE	DESCRIPTION: SOIL DENSITY, CONSISTENCY OR ROCK HARDNESS	MATERIAL	WATER CONTENT-%	PERMEABILITY (CM/SEC. X 10-4), *	GENERAL LABORATORY SOIL DATA
1088.7									
1080		13-7-8	O		STIFF TO VERY STIFF	BROWN CLAYEY SILT-SOME GRAVEL	18.0		
	10	15-17-21	O						
		22-65-75/0.1'	O						
1070		1.0			SOFT	GRAY SILTSTONE-VERY BROKEN		65.1	
1060	20				MEDIUM SOFT	GRAY INTERBEDDED SILTSTONE AND SILTY SHALE-BROKEN		9.7	
1050	30				MEDIUM SOFT	GRAY SILTY SHALE-BLOCKY		18.0	
					SOFT	COAL-VERY BROKEN		5.0	
1040	40				SOFT TO MEDIUM SOFT	GRAY CLAYSTONE-VERY BROKEN TO BLOCKY		5.0	
					HARD	GRAY SANDY SILTSTONE AND SANDSTONE-BLOCKY TO MASSIVE		27.0	
1031.7	65.0				MEDIUM HARD	GRAY SHALE AND CLAYSTONE-BROKEN		0	

2-2-67

2 1/8" DIA. CORE

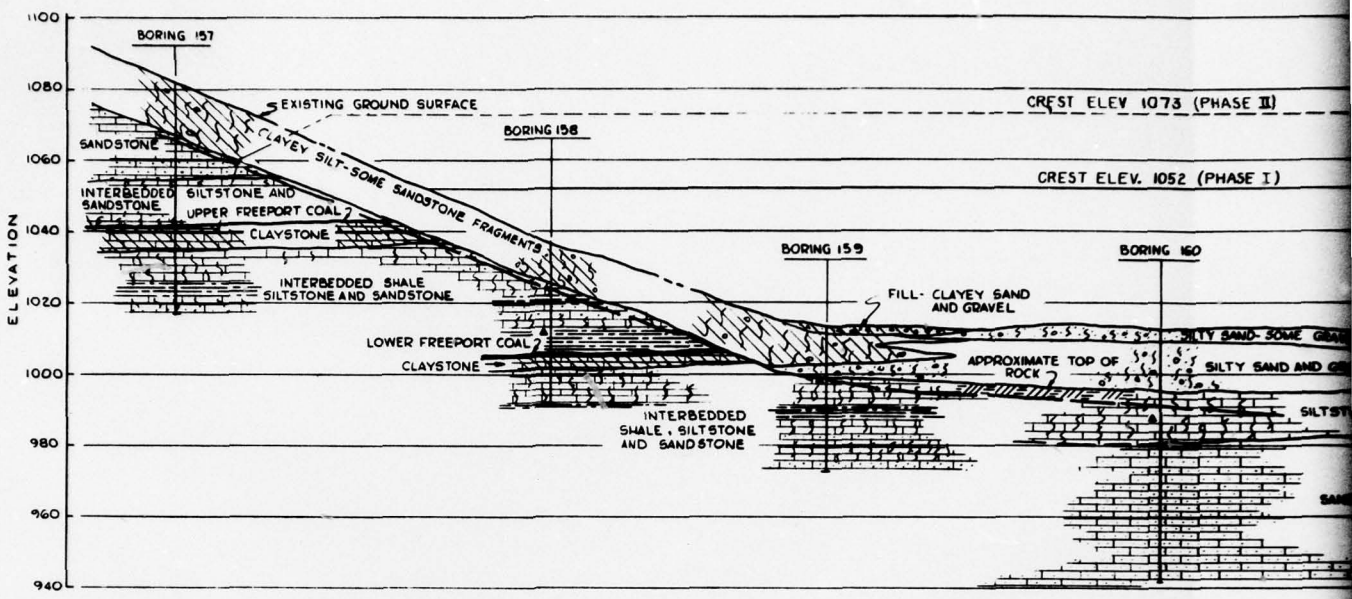
* NOTES:

1. PERMEABILITIES FOR SOIL WERE APPROXIMATED FROM THE GRAIN SIZE CURVES USING HAZEN'S FORMULA, $K=100\ d_{10}^2$. PERMEABILITIES FOR ROCK WERE DETERMINED BY FIELD PRESSURE TESTS CONDUCTED IN 5 FOOT INCREMENTS. THE PERMEABILITY VALUE IS GIVEN ON THE LOG AT THE MIDPOINT OF THE 5 FOOT INCREMENT FOR WHICH IT PERTAINS.
2. SEE REFERENCE DRAWING FOR GENERAL NOTES.

PLATE 4

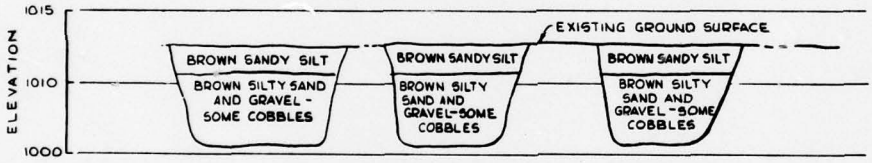
D'APPOLONIA

DRAWN BY	MBM	CHECKED BY	BE	DRAWING NUMBER	1-B203
	10-5-78	APPROVED BY	JHD		9.6.78



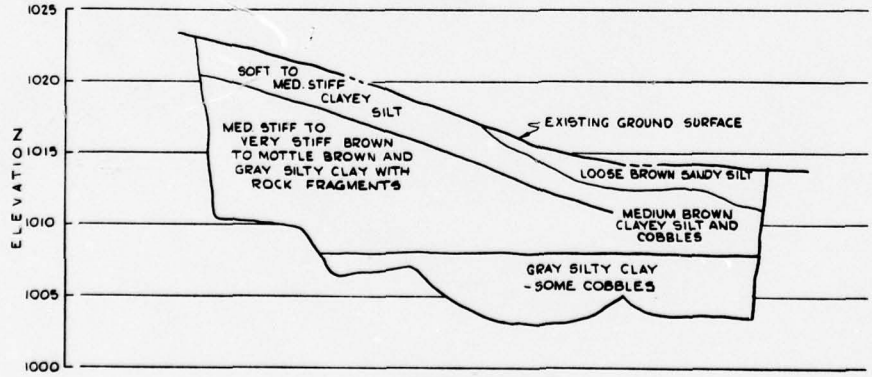
SECTION HHH-HHH

SCALE: 1"=20'



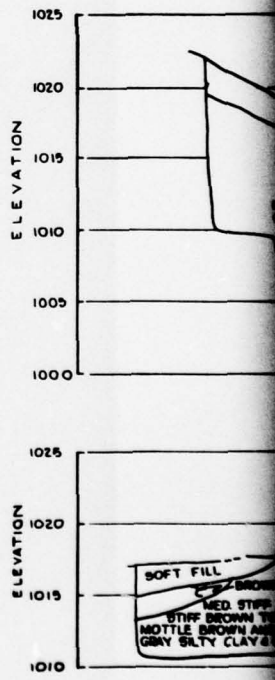
TEST PIT NO. 21

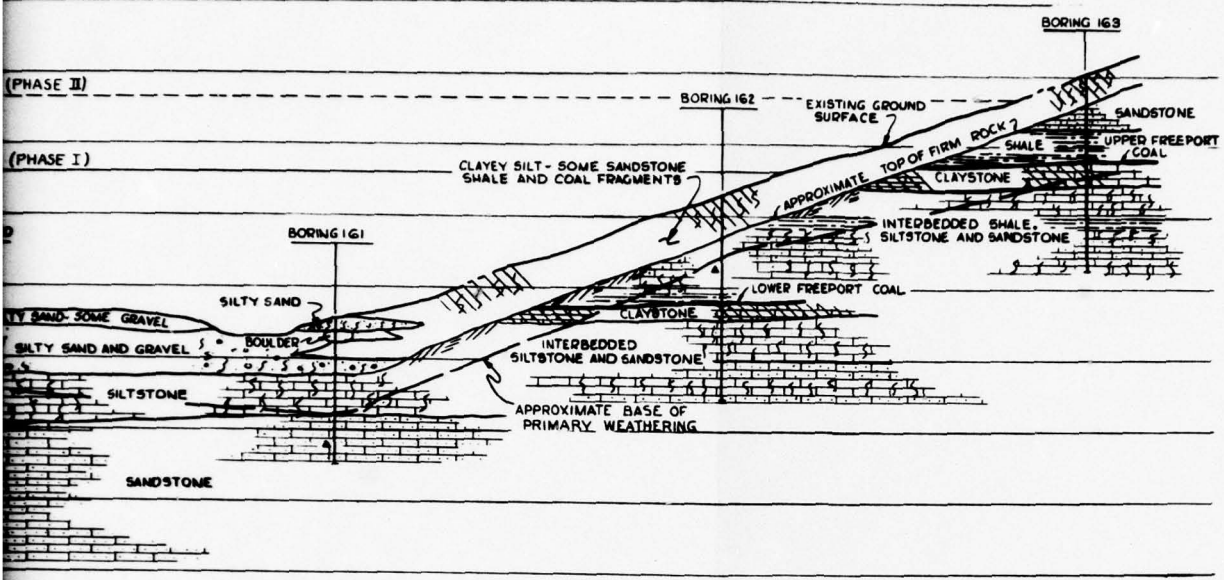
SCALE: 1"=5'



TEST PIT NO. 25

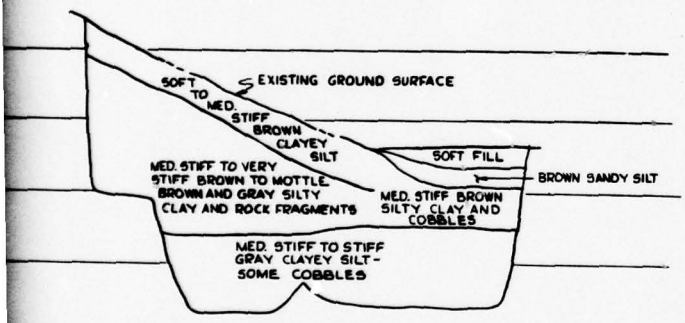
SCALE: 1"=5'





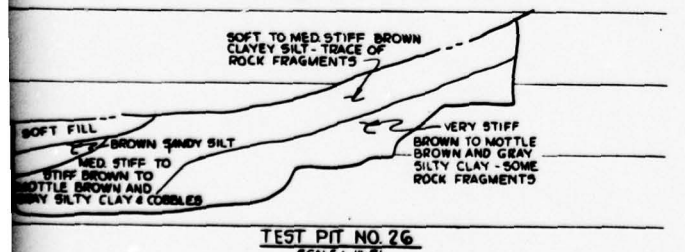
HHH-HHH

1"=20'



TEST PIT NO. 24

SCALE: 1"=5'



TEST PIT NO. 26

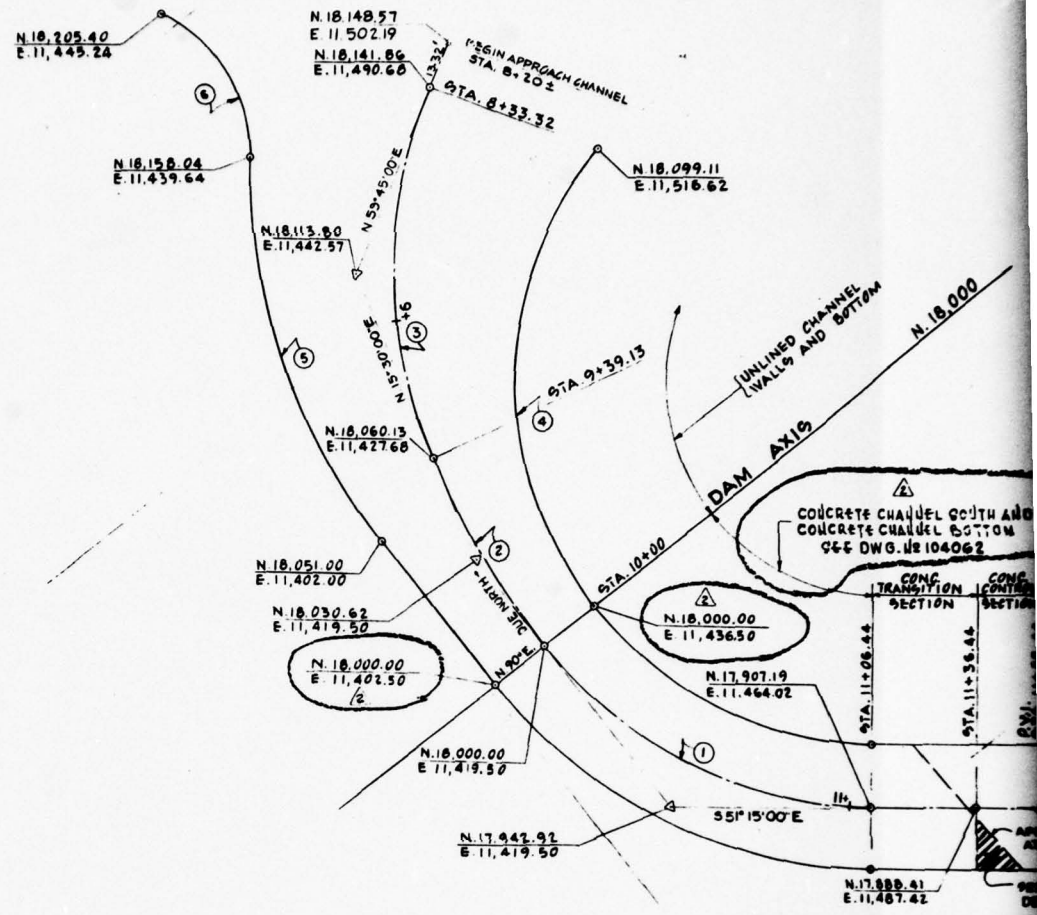
SCALE: 1"=5'

▲ INDICATES DEPTH BELOW WHICH PRESSURE TESTING SHOWED ROCK TO BE IMPERVIOUS.

PLATE 5

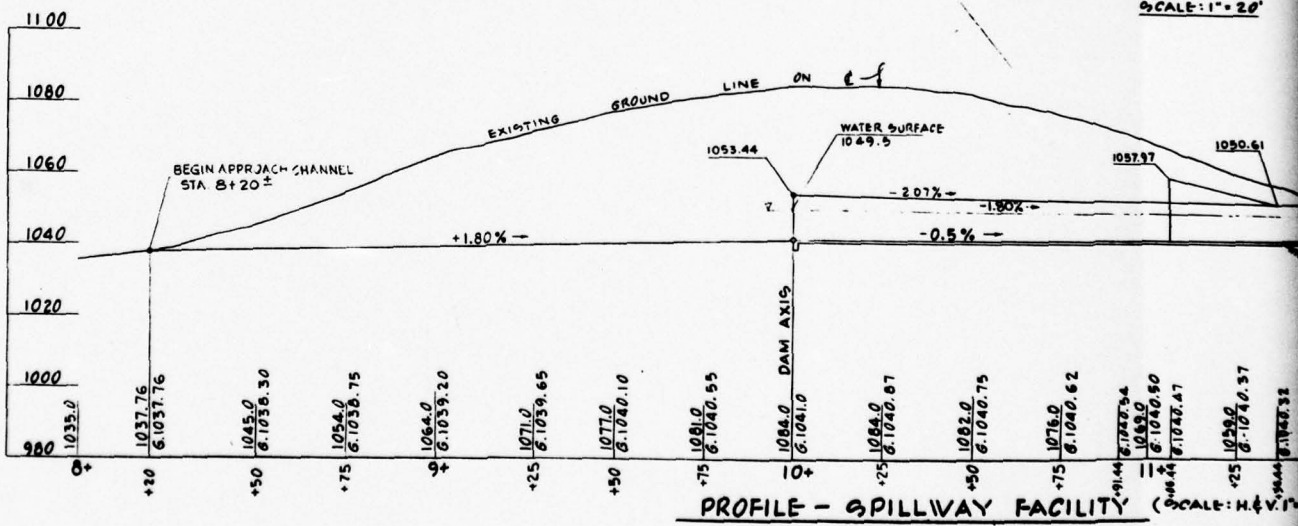
D'APPOLONIA

DRAWN BY	MBM	CHECKED BY	BE	9.6.78	DRAWING NUMBER 78[redacted]-B208
	10-5-78	APPROVED BY	JHD	9.6.78	



PLAN - SPILLWAY GE

SCALE: 1" = 20'



PROFILE - SPILLWAY FACILITY (SCALE: H & V 1"

CURVE DATA				
CV. Nº.	Δ	T	R	L
①	51°-15'	57.08'	119.00'	106.44
②	15°-30'	30.62'	225.00'	60.87'
③	44°-15'	55.70'	137.00'	105.81'
④	77°-33'	81.54'	101.50'	137.38'
⑤	38°-45'	60.14'	171.00'	115.65'
⑥	64°-00'	28.12'	45.00'	50.26'

NOTES:
1. SEE DWGS. 104070 THRU 104076 FOR GRADING WIDTHS AND EXCAVATION CROSS SECTIONS.
2. IF REQUESTED BY THE ENGINEER THE CROSS-HATCHED AREA INDICATED ON PLAN SHALL BE OVER-EXCAVATED A MINIMUM OF 3 FEET BENEATH BOTTOM OF SLAB AND BACKFILLED TO GRADE WITH COMPACTED GRANULAR MATERIAL.

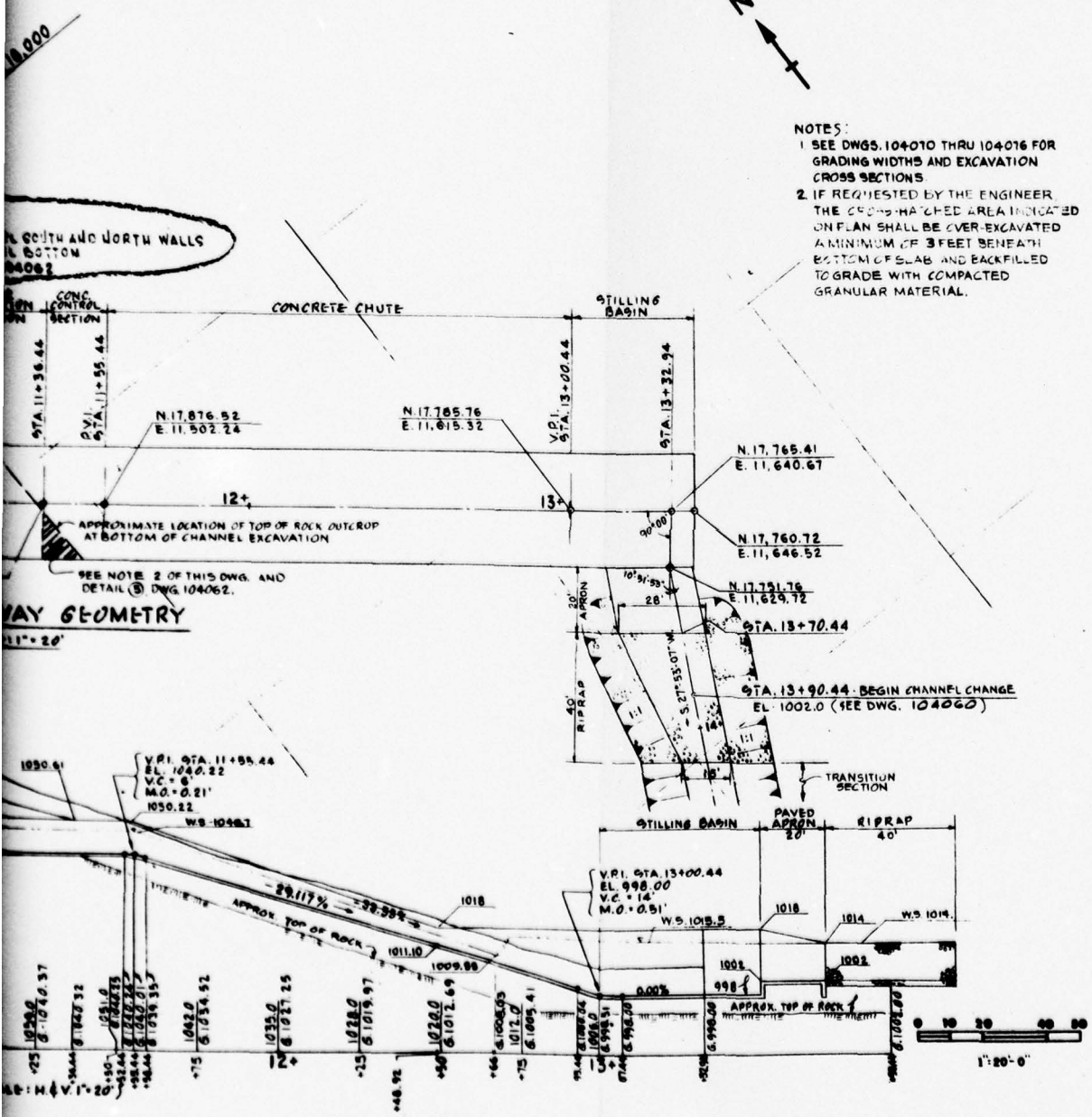
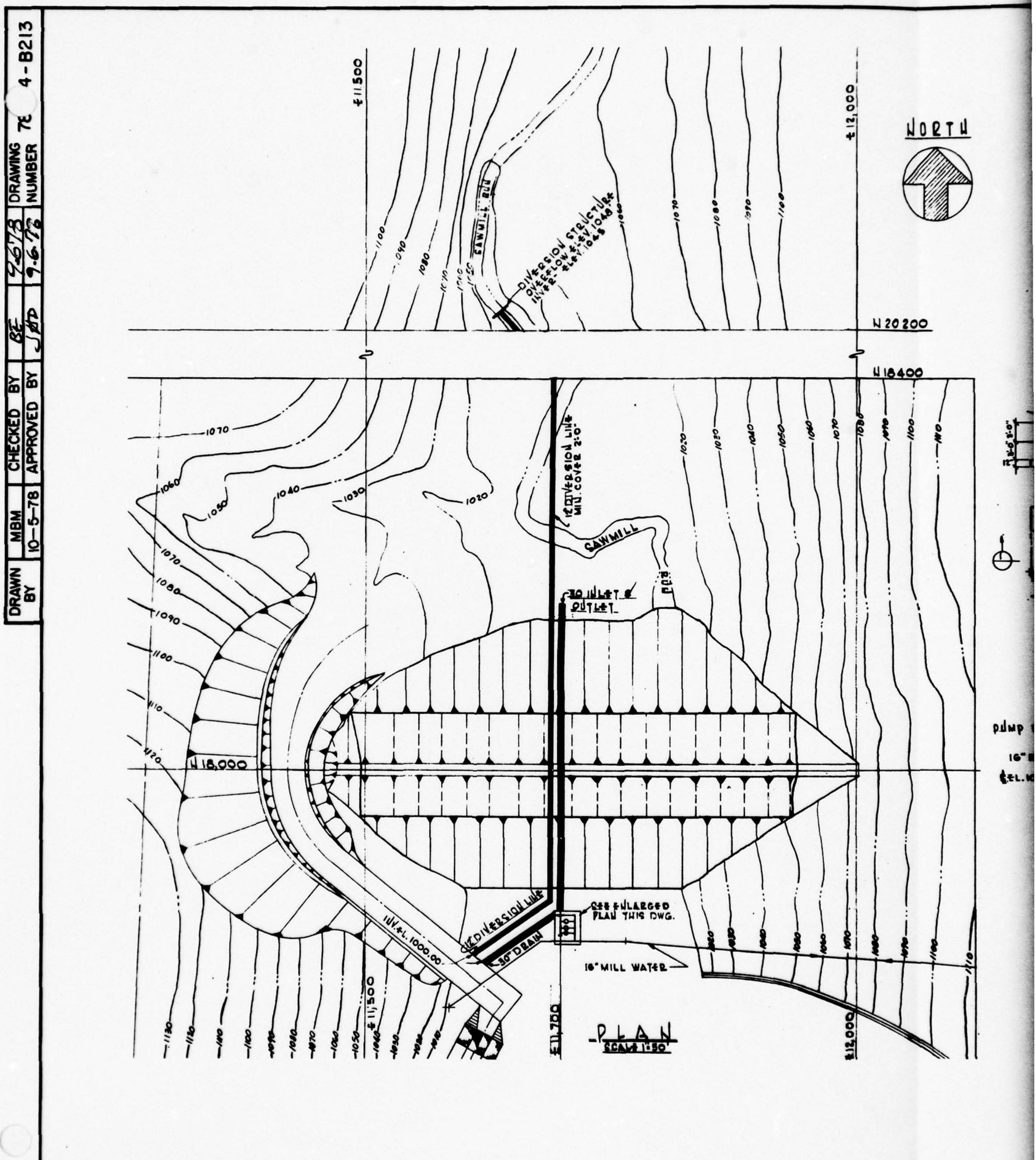
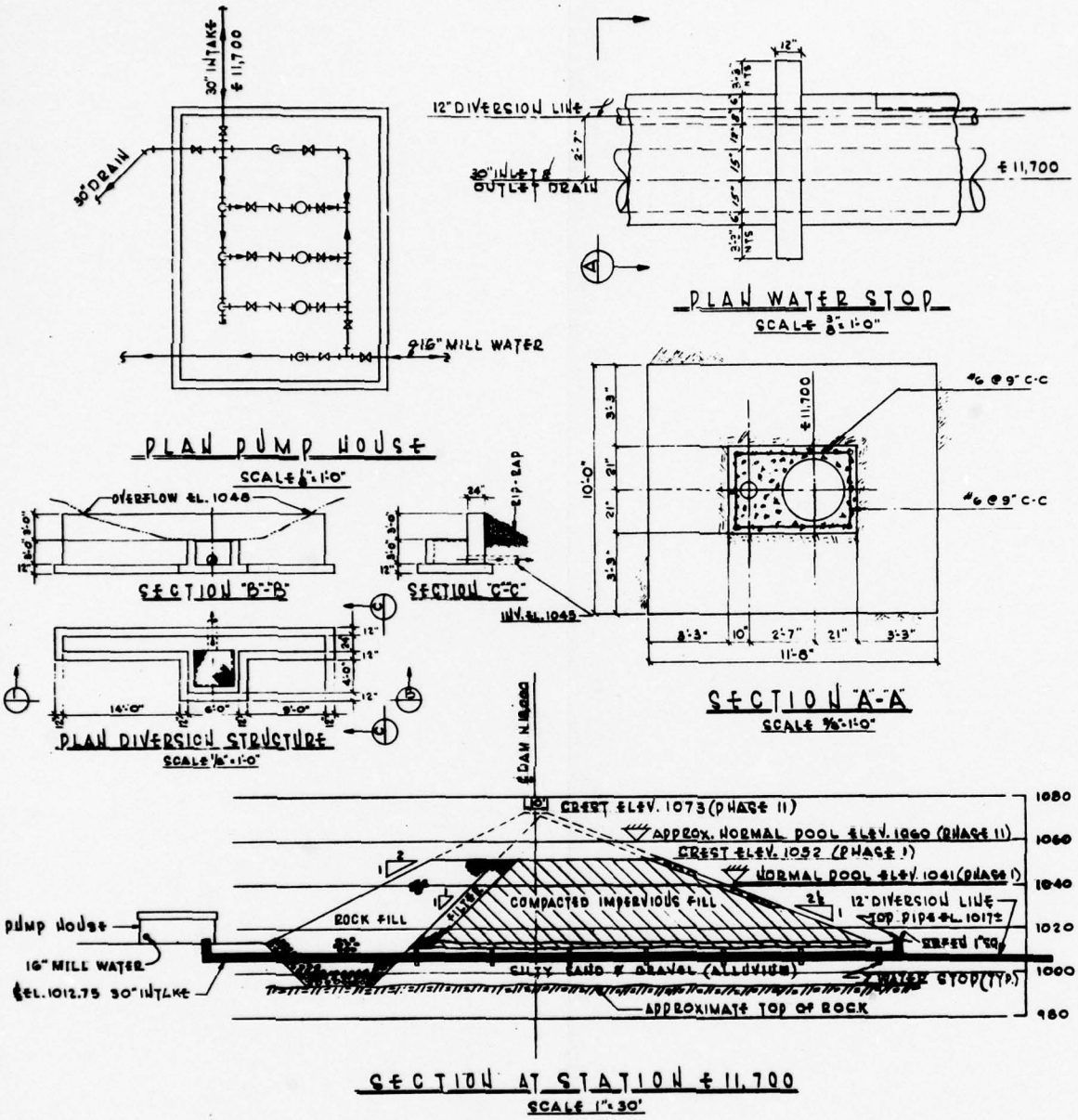


PLATE 6

D'APPOLONIA


DRAWN BY MBM 10-5-78
CHECKED BY BE 9-6-78
APPROVED BY JPD 9-6-78
DRAWING NUMBER 7E 4-B213
NORTH
N 20200
N 18400
N 18,000
E 11500
E 12,000
E 11,700
DIVERSION STRUCTURE
SAWMILL RUN
SAWMILL
DIVERSION LINE MIN. COVER 2'0"
30 INLET & OUTLET
DIVERSION LINE
30" DRAIN
INV. EL. 1000.00
SEE ENLARGED PLAN THIS DWG.
16" MILL WATER
PLAN
SCALE 1:50'

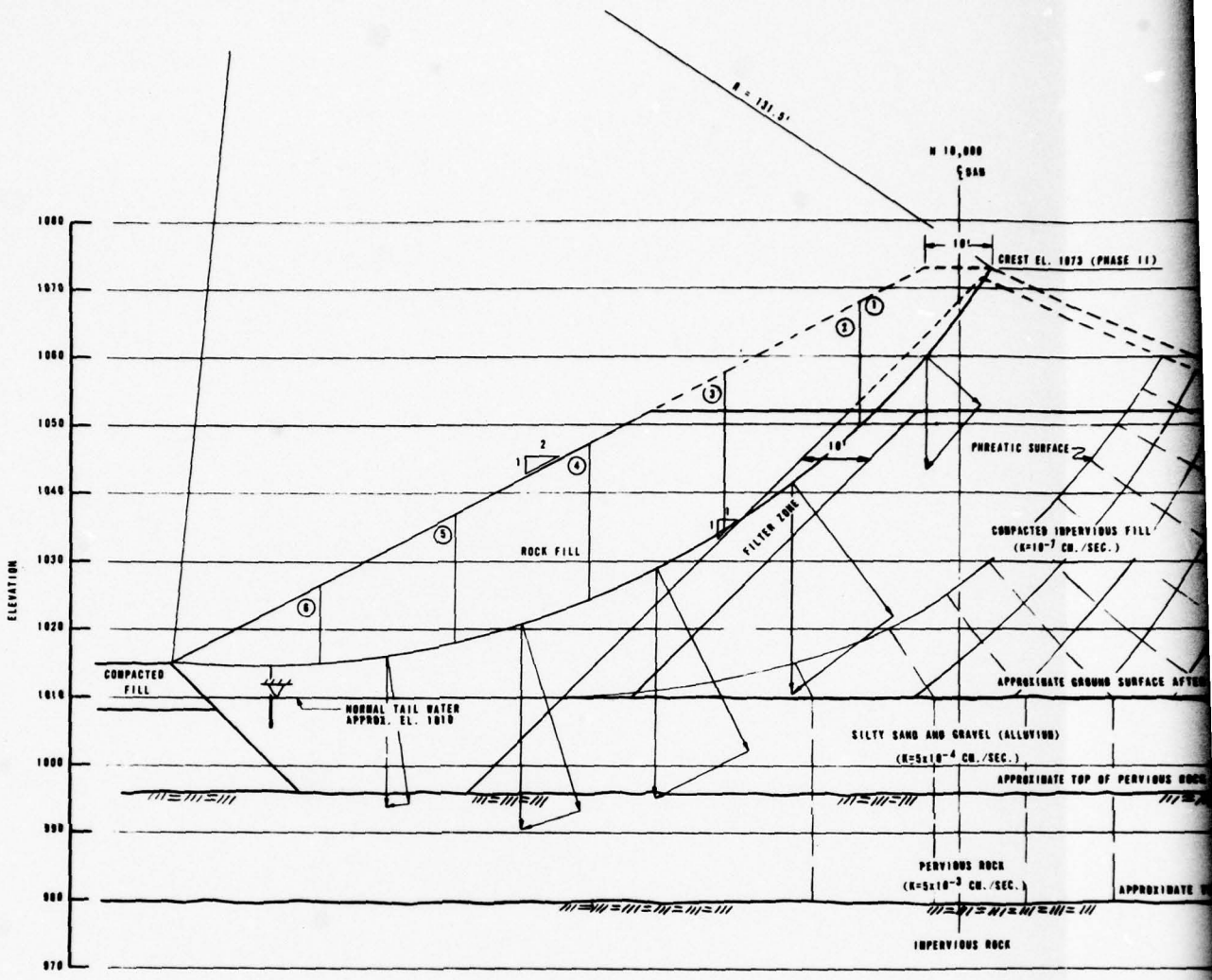


NOTE:
DIVERSION PIPE TO BE CEMENT LINED
CAST IRON CLASS No 22
INLET - OUTLET PIPE TO BE CEMENT LINED
STEEL PIPE

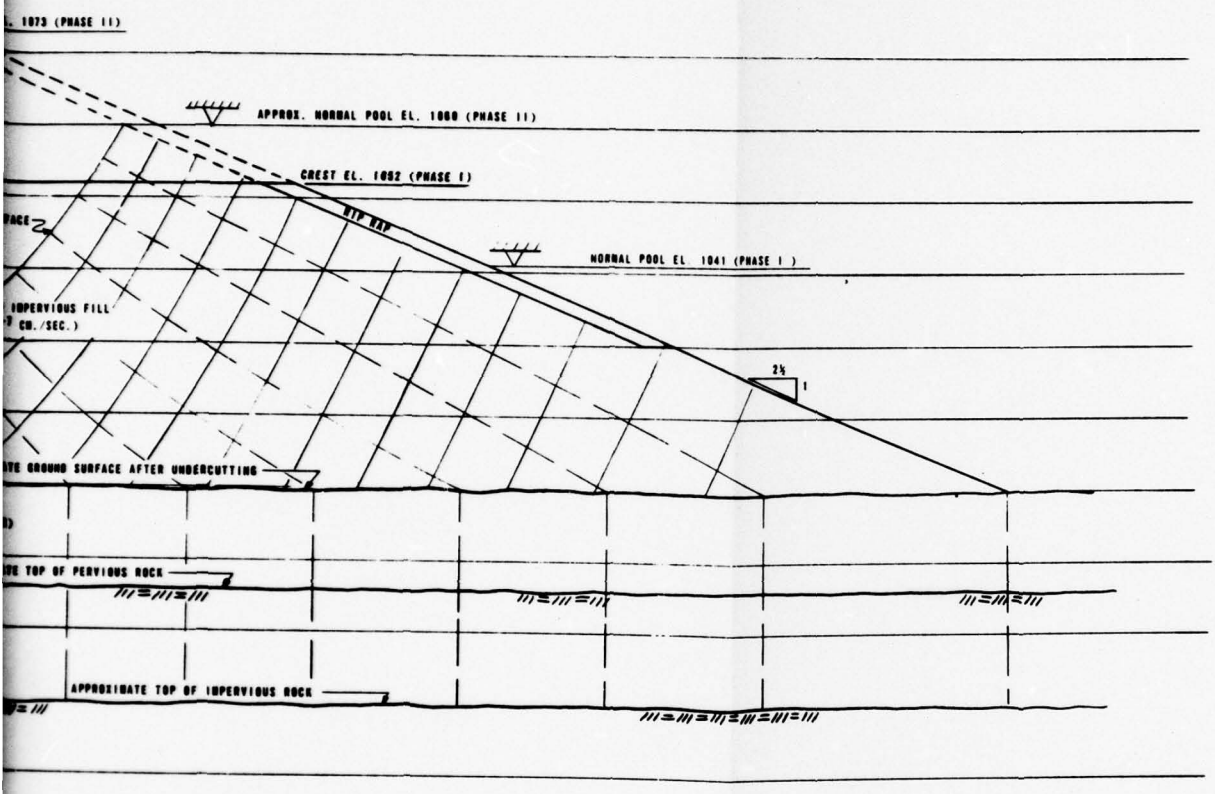
PLATE 7

D'APPOLONIA

DRAWN BY	MBM	CHECKED BY	BE	9.6.78	DRAWING NUMBER	4-8210
	10-5-78	APPROVED BY	JMP	9.6.78		



SLICE	IMPERVIOUS FILL				ROCK FILL				NATURAL SOIL				WATER		TOTAL WEIGHT	HYDROSTATIC UPLIFT			FRICTIONAL RESISTANCE			COHESIVE RESISTANCE		
	DRAINED		SATURATED		DRAINED		SATURATED		DRAINED		SATURATED					BASE LENGTH	MEAN HEAD	NORMAL UPLIFT FORCE U	NORMAL EFFECTIVE FORCE N-U	ANGLE OF FRICTION ϕ	RESISTING FORCE N tan ϕ	ARC OF LENGTH L	RESISTING FORCE LC
	VOL.	WT.	VOL.	WT.	VOL.	WT.	VOL.	WT.	VOL.	WT.	VOL.	WT.	VOL.	WT.	W									
	C.FT.	KIPS	C.FT.	KIPS	C. FT.	KIPS	C.FT.	KIPS	C.FT.	KIPS	C.FT.	KIPS	C.FT.	KIPS	KIPS.	FT.	FT.	KIPS	KIPS	DEGREES	KIPS	FT.	KIPS
1					227	32.0									32.0				21.0	35	15.1		
2					420	60.9									60.9				48.3	35	34.5		
3					488	67.6									67.6				60.2	40	50.5		
4					420	60.9									60.9				57.0	40	48.0		
5					308	44.4									44.4				44.1	40	37.0		
6					126.5	18.3									18.3				18.3	40	15.9		



	COHESIVE RESISTANCE		TANGENTIAL WEIGHT COMPONENTS	
	ARC OF LENGTH L	RESISTING FORCE LC	DRIVING +T	RESISTING -T
	FT.	KIPS	KIPS	KIPS
			25.5	
			37.0	
			31.0	
			10.0	
			0.0	
			0.0	

BASIC DATA				
MATERIAL	UNIT WEIGHTS		FRICTION ANGLE ϕ	COHESION C
	DRAINED	SATURATED		
	P.C.F.	P.C.F.	DEGREES	K.S.F.
ROCK FILL	145	-	40	0
COMPACTED IMPERVIOUS FILL	137	140	30	0.500
FILTER MATERIAL	145	147	35	0
SILTY SAND AND GRAVEL	-	135	35	0

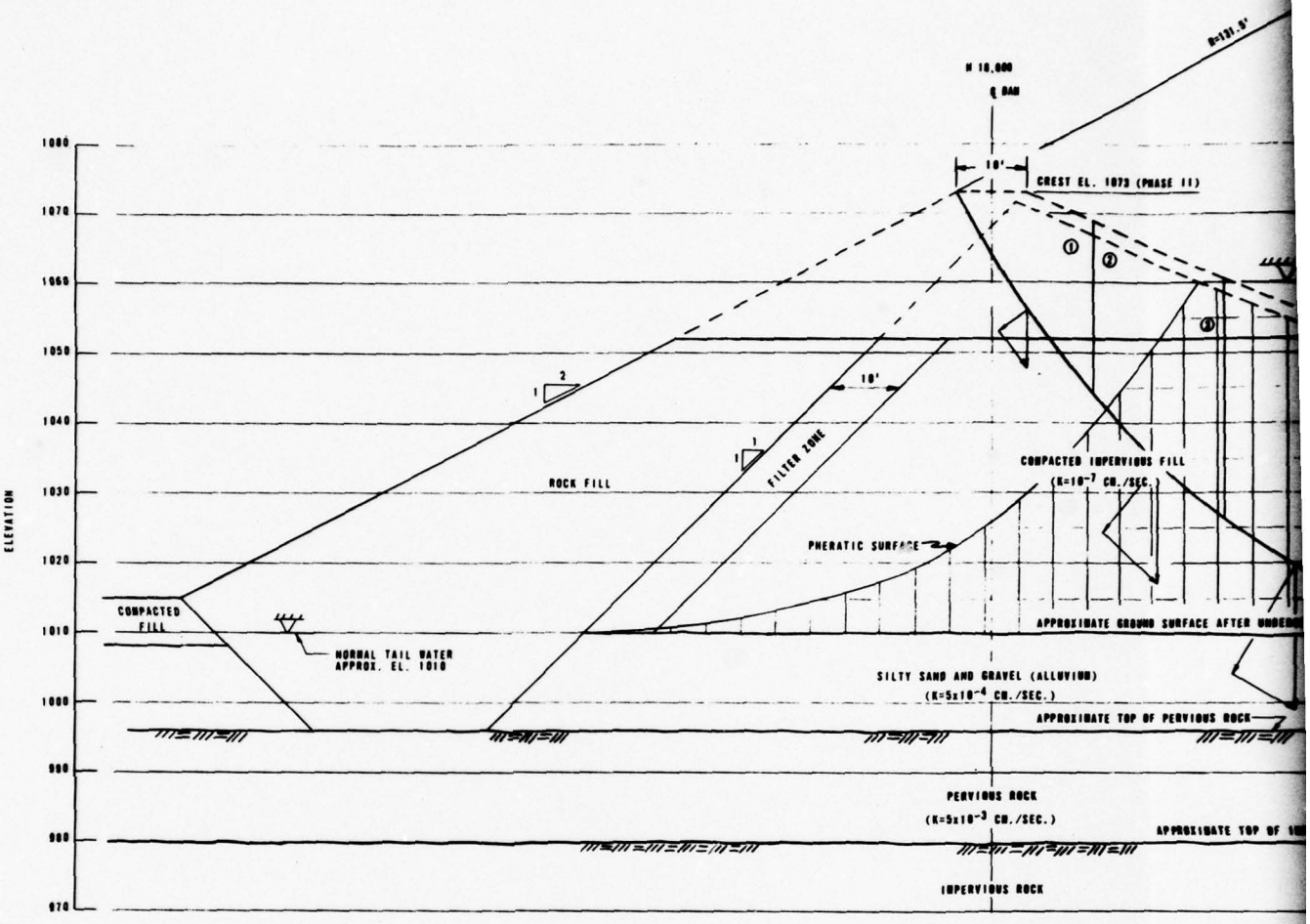
RESULTS			
FORCES			FACTOR OF SAFETY
RESISTING		DRIVING	$\frac{\sum N \tan\phi + \sum LC}{\sum T}$
$\sum N \tan\phi$	$\sum LC$	$\sum T$	
201.1	—	120.3	1.67

NOTES:
K = COEFFICIENT OF PERMEABILITY
FORCE SCALE 1" = 20 KIPS

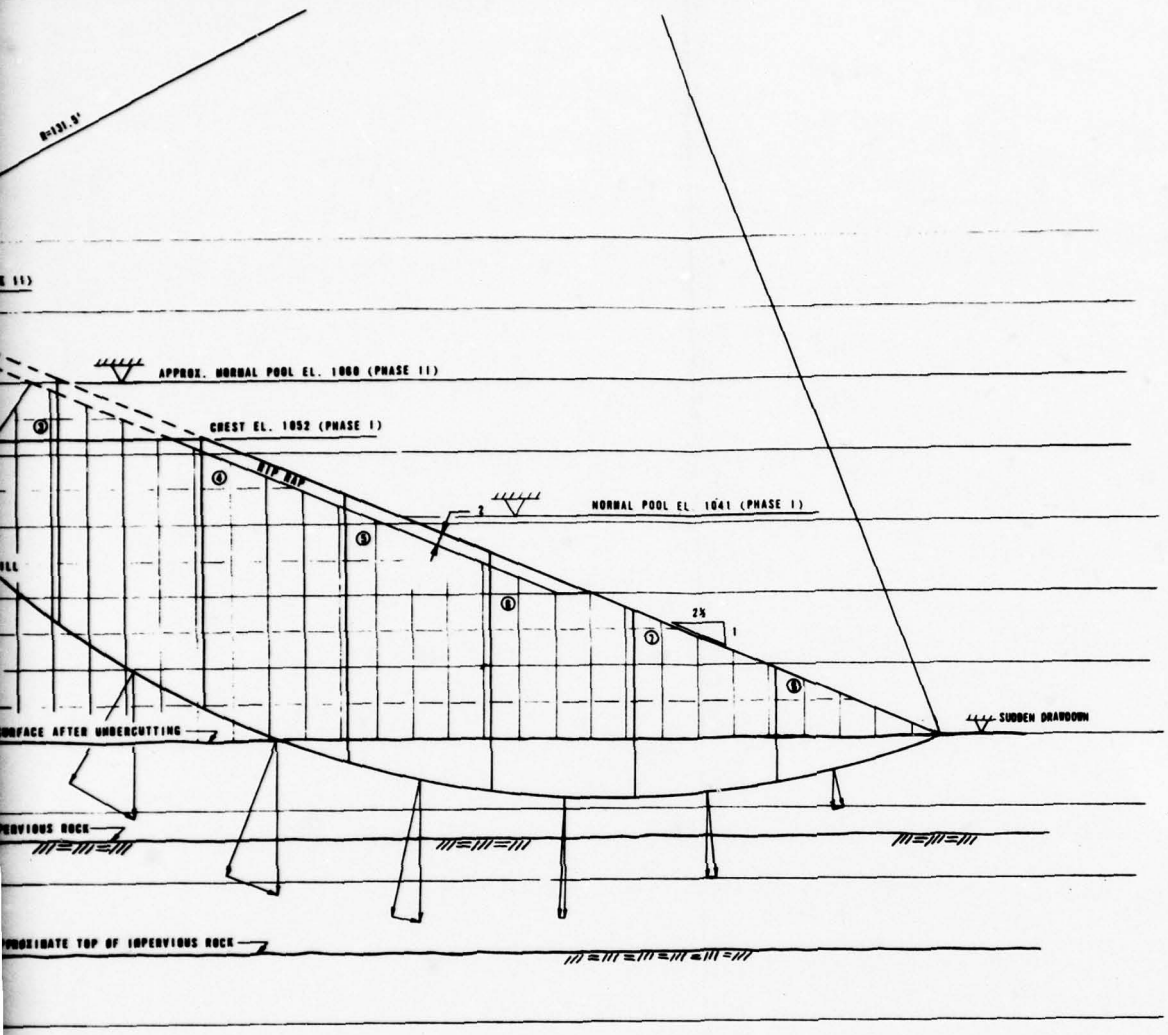
PLATE 8

D'APPOLONIA

DRAWN BY	MBM	10-5-78
CHECKED BY	BE	9.6.78
APPROVED BY	JHP	9.6.78
DRAWING NUMBER	7E	4-B202



SLICE	IMPERVIOUS FILL				ROCK FILL				NATURAL SOIL				WATER		TOTAL WEIGHT	HYDROSTATIC UPLIFT			FRICTIONAL RESISTANCE			COHESIVE RESISTANCE		TANGENTIAL WEIGHT COMP
	DRAINED		SATURATED		DRAINED		SATURATED		DRAINED		SATURATED													
	VOL.	WT.	VOL.	WT.	VOL.	WT.	VOL.	WT.	VOL.	WT.	VOL.	WT.	VOL.	WT.		BASE LENGTH	MEAN HEAD	NORMAL UPLIFT FORCE	NORMAL EFFECTIVE FORCE	ANGLE OF FRICTION	RESISTING FORCE	ARC LENGTH	RESISTING FORCE	DRIVING
	C.FT.	KIPS	C.FT.	KIPS	C.FT.	KIPS	C.FT.	KIPS	C.FT.	KIPS	C.FT.	KIPS	C.FT.	KIPS	U KIPS	FT.	FT.		N-U KIPS	DEGREES	N tan φ KIPS	L FT.	LC KIPS	+T KIPS
1			170	25.1	110	17.3									42.4				25.5	30	14.8	20.5	10.3	34.0
2			810	85.4											85.4				85.0	30	37.7	20.0	13.4	98.5
3			730	103.3											103.3				89.5	30	51.0	23.3	11.7	82.0
4			763	108.0							17.0	2.3			108.1	10.0	2.1	1.3	108.2	33	85.2	11.0	5.5	30.5
5			810	85.4							180	14.8			100.0	20.5	5.7	7.3	99.2	35	83.2			20.0
6			440	62.4							160	21.6			84.0	20.0	7.7	9.8	73.0	35	51.7			4.0
7			282	39.5							151	20.4			59.9	20.0	7.2	9.0	51.0	35	35.7			
8			115	19.1							80	10.8			29.9	24.2	3.1	4.7	22.3	35	15.8			



ESIVE NCE	TANGENTIAL WEIGHT COMPONENTS	
RESIST-ING FORCE LC	DRIVING +T	RESIST-ING -T
KIPS	KIPS	KIPS
10.3	34.0	
13.4	98.5	
11.7	52.0	
9.5	30.5	
	20.0	
	4.9	
		6.5
		7.0

BASIC DATA				
MATERIAL	UNIT WEIGHTS		FRICTION ANGLE ϕ	COHESION C
	DRAINED	SATURATED		
	P.C.F.	P.C.F.	DEGREES	K.S.F.
ROCK FILL	145	-	40	0
COMPACTED IMPERVIOUS FILL	137	140	30	*0.500
FILTER MATERIAL	145	147	35	0
SILTY SAND AND GRAVEL	-	135	35	0

RESULTS			
FORCES			FACTOR OF SAFETY
RESISTING		DRIVING	$\frac{\sum N \tan \phi + \sum LC}{\sum T}$
$\sum N \tan \phi$	$\sum LC$	$\sum T$	
335.0	40.0	181.5	1.06

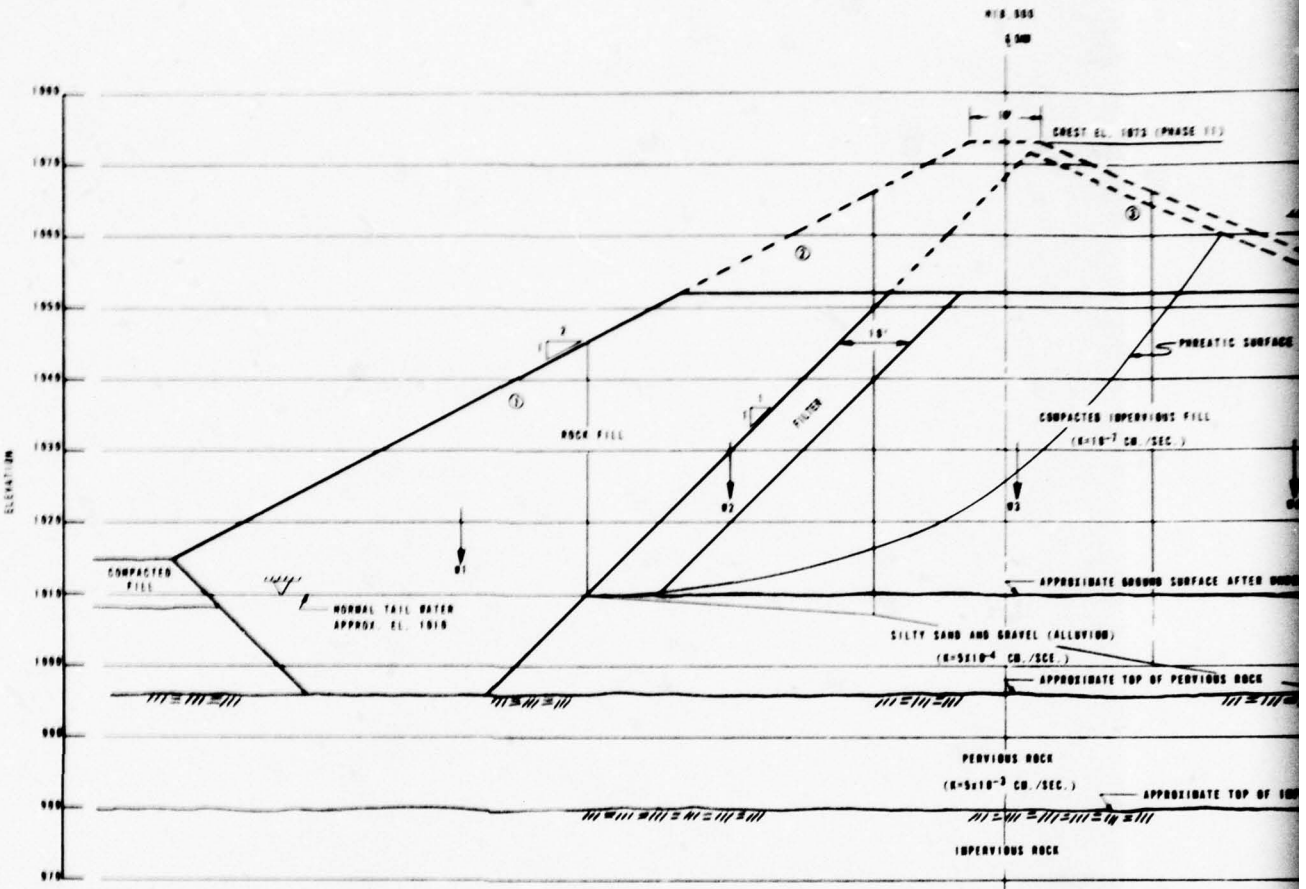
NOTES:
K = COEFFICIENT OF PERMEABILITY

FORCE SCALE 1" = 50' KIPS

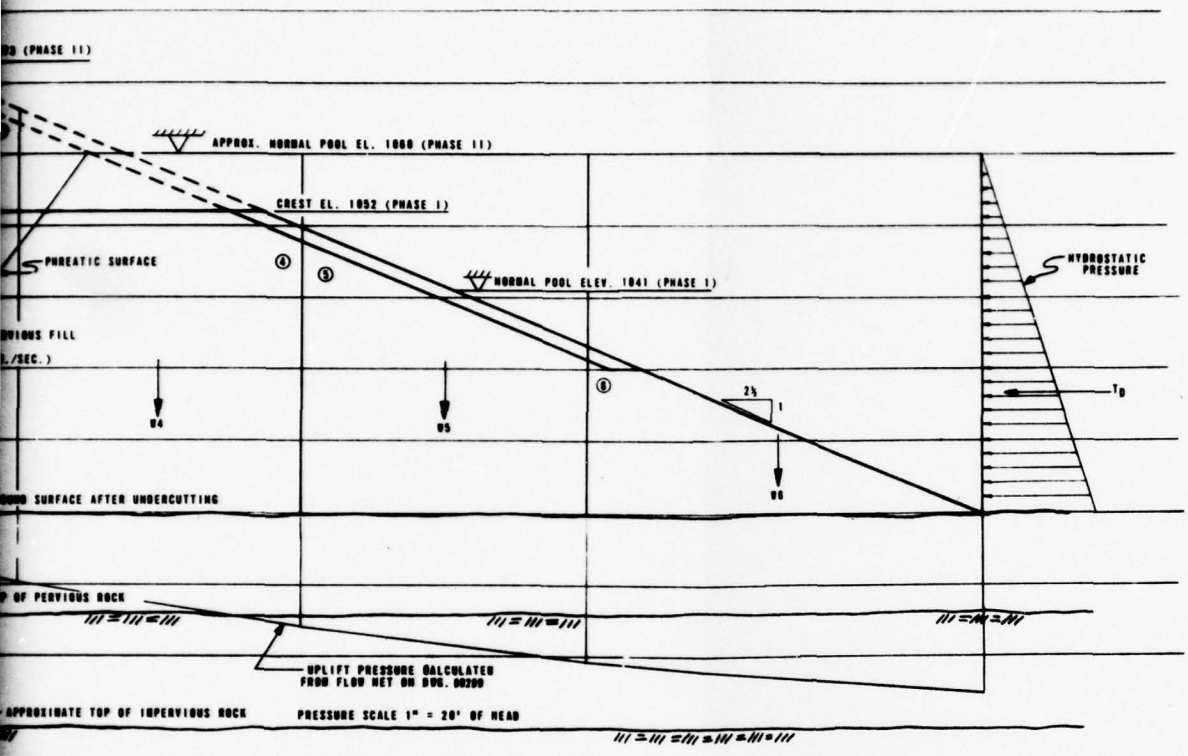
PLATE 9

D'APPOLONIA

DRAWN BY	MEM	CHECKED BY	JE	DRAWING NUMBER	4-B201
	10-5-78	APPROVED BY	JHP		



SLICE	IMPERVIOUS FILL				ROCK FILL				NATURAL SOIL				WATER		TOTAL WEIGHT	HYDROSTATIC UPLIFT			FRICTIONAL RESISTANCE			COHESIVE RESISTANCE		
	DRAINED		SATURATED		DRAINED		SATURATED		DRAINED		SATURATED					BASE LENGTH	MEAN HEAD	NORMAL UPLIFT FORCE U	NORMAL EFFECTIVE FORCE N-U	ANGLE OF FRICTION φ	RESISTING FORCE N tan φ	ARC LENGTH L	RESISTING FORCE LC	
	VOL.	WT.	VOL.	WT.	VOL.	WT.	VOL.	WT.	VOL.	WT.	VOL.	WT.	VOL.	WT.	W									
	C.FT.	KIPS	C.FT.	KIPS	C.FT.	KIPS	C.FT.	KIPS	C.FT.	KIPS	C.FT.	KIPS	C.FT.	KIPS	KIPS	FT.	FT.	KIPS	KIPS	DEGREES	KIPS	FT.	KIPS	
1					1180	188.2									188.2		0	0	188.2	40	141.1			
2			450	83.8	1370	186.7									261.7	40.0	2.8	7.8	254.7	35	178.3			
3			1980	283.2	513	74.4									337.8	40.0	14	34.9	302.7	35	212.0			
4			1875	282.5									125	7.8	270.3	40.0	20.5	83.3	207.0	35	144.8			
5			1270	177.8									730	45.8	223.4	40.0	30	80.0	133.5	35	93.5			
6			680	92.4									2150	134.2	226.2	98.5	45.5	188.4	85.8	35	40.1			



	COHESIVE RESISTANCE		DRIVING FORCE
	ARC LENGTH L	RESISTING FORCE LC	T_D
	FT.	KIPS	KIPS
			$T_D = 1/2 \times 0.0026 \times (80)^2 = 70$ KIPS

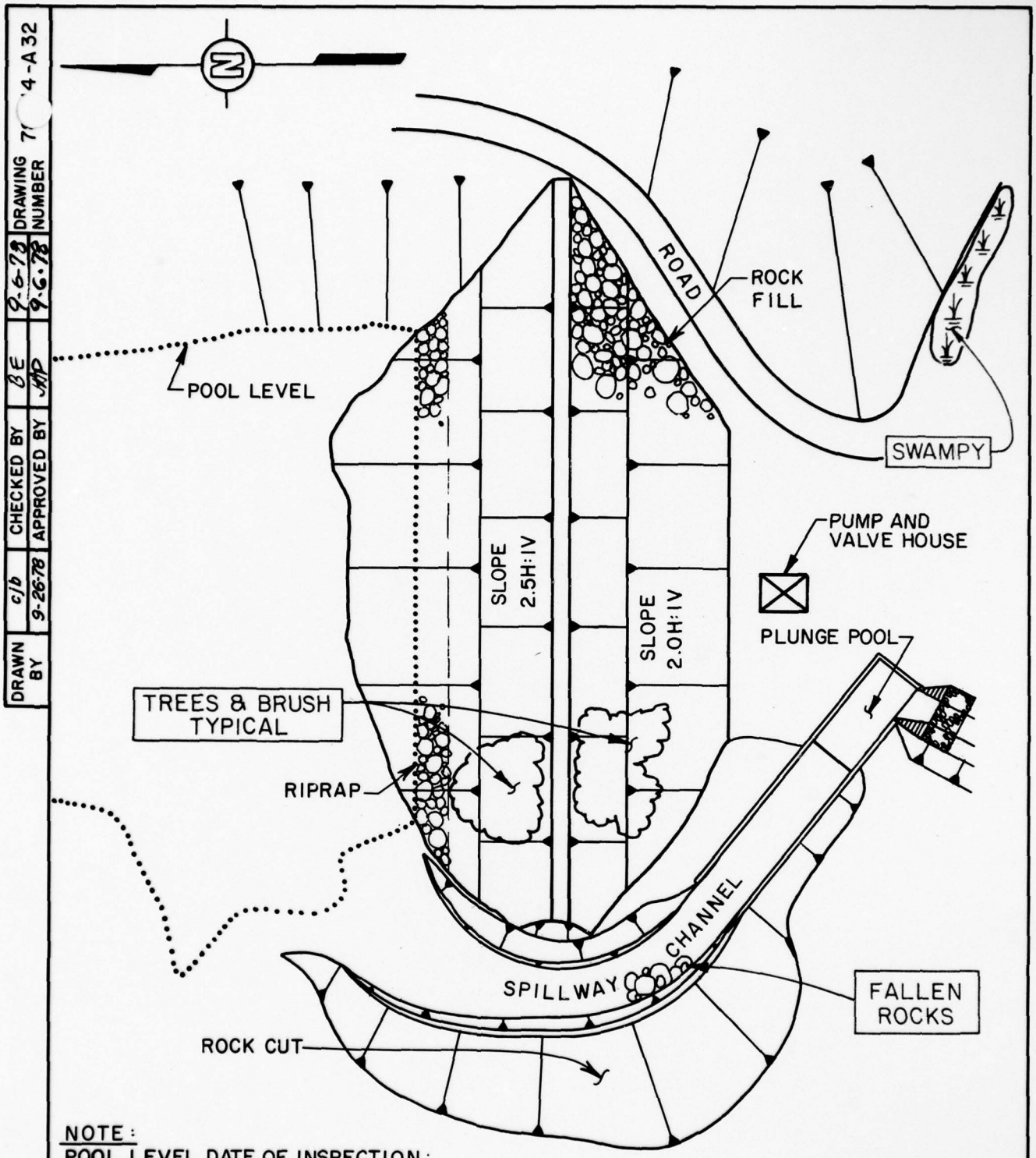
BASIC DATA				
MATERIAL	UNIT WEIGHTS		FRICTION ANGLE ϕ	COHESION C
	OBAINED	SATURATED		
	P.C.F.	P.C.F.	DEGREES	K.S.F.
ROCK FILL	145	-	40	0
COMPACTED IMPERVIOUS FILL	137	140	30	0.500
FILTER MATERIAL	146	147	35	0
SILTY SAND AND GRAVEL	-	135	35	0

RESULTS			
FORCES			FACTOR OF SAFETY
RESISTING		DRIVING	$\frac{\sum N \tan \phi + \sum LC}{\sum T_D}$
$\sum N \tan \phi$	$\sum LC$	$\sum T$	
815.0	0	78	10.5

NOTES:
K = COEFFICIENT OF PERMEABILITY

PLATE 10

D'APPOLONIA



DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
c/b 9-26-78	BE 9-6-78	MP 9-6-78	7[illegible]4-A32

NOTE:
POOL LEVEL DATE OF INSPECTION:
3.5 FT. BELOW SPILLWAY CREST
(EL. 1037.5)

SCALE
0 100 200 FEET

PLATE II

SAWMILL RUN DAM

GENERAL PLAN
FIELD INSPECTION NOTES
FIELD INSPECTION DATE: SEPT. 12, 1978

D'APPOLONIA

APPENDIX A

CHECKLIST
VISUAL INSPECTION
PHASE I

CHECKLIST
VISUAL INSPECTION
PHASE 1

NAME OF DAM Sawmill Run Dam COUNTY Butler STATE Pennsylvania ID# NDI 915 / DER 10-71

TYPE OF DAM Earthfill HAZARD CATEGORY Significant

DATE(S) INSPECTION September 12, 1978 WEATHER Rainy TEMPERATURE 70's

POOL ELEVATION AT TIME OF INSPECTION 1037.5 M.S.L. TAILWATER AT TIME OF INSPECTION 1002+ M.S.L.

INSPECTION PERSONNEL:

Bilgin Erel	Review Inspection by:	Elio D'Appolonia
Wah-Tak Chan	(October 3, 1978)	L. D. Andersen
		J. H. Poellot

Bilgin Erel RECORDER

VISUAL INSPECTION
PHASE I
EMBANKMENT

NAME OF DAM Sawmill Run

ID# NDI 915, DER 10-71

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 Sawmill Run

ID# NDI 915, DER 10-71

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	A swampy area on the left abutment approximately 200 feet downstream from the dam.	Probable source of water - surface runoff
STAFF GAGE AND RECORDER	None	
DRAINS	None	

VISUAL INSPECTION
PHASE I
CONCRETE/MASONRY DAMS

NAME OF DAM Sawmill Run

ID# NDI 915, DER 10-71

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 Sawmill Run

ID# NDI 915, DER 10-71

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	N/A	
STAFF GAGE OF RECORDER:		

VISUAL INSPECTION
PHASE I
OUTLET WORKS

NAME OF DAM Sawmill Run
ID# NDI 915, DER 10-71

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	30-inch cast-iron pipe. Only downstream end is visible.	
INTAKE STRUCTURE	Submerged, not visible	
OUTLET STRUCTURE	Outlet pipe directly discharges into the stilling basin of the spillway.	
OUTLET CHANNEL	N/A	
EMERGENCY GATE	Located at the valve house. Operated and observed to be functional.	

VISUAL INSPECTION
PHASE I
UNGATED SPILLWAY

NAME OF DAM Sawmill Run

ID# NDI 915, DER 10-71

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Concrete broad-crested weir. In good condition.	Rock cut along the channel poses a potential for partial blockage of the spillway channel in the event of a significant rock slide.
APPROACH CHANNEL	Riprapped earth channel. No debris, no operating constraints.	
DISCHARGE CHANNEL	Rectangular concrete channel in good condition. Some rocks have fallen into the channel from the adjacent rock cut.	Rock cut should be periodically observed. Debris should be cleared.
BRIDGE AND PIERS	None	

VISUAL INSPECTION
PHASE I
GATED SPILLWAY

NAME OF DAM Sawmill Run

ID# NDI 915, DER 10-71

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	N/A (No gated spillway)	
APPROACH CHANNEL	N/A	
DISCHARGE CHANNEL	N/A	
BRIDGE PIERS	N/A	
GATES AND OPERATION EQUIPMENT	N/A	

VISUAL INSPECTION
PHASE I
INSTRUMENTATION

NAME OF DAM Sawmill Run

ID# NDI 915, DER 10-71

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 Sawmill Run

ID# NDI 915, DER 10-71

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Wooded and steep. No signs of instability.	
SEDIMENTATION	Unknown	

VISUAL INSPECTION
PHASE I
DOWNSTREAM CHANNEL

NAME OF DAM Sawmill Run
ID# NDI 915, DER 10-71

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Approximately 2000 feet downstream from the dam, the stream flows through a 1000-foot-long, 12-foot-diameter corrugated metal pipe.	
SLOPES	No apparent erosion	
APPROXIMATE NUMBER OF HOMES AND POPULATION	Armco's Butler Works between the dam and the Conoquenessing Creek.	

APPENDIX B

CHECKLIST
ENGINEERING DATA, DESIGN,
CONSTRUCTTION, OPERATION
PHASE I

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Sawmill Run
ID# NDI 915, DER 10-71

ITEM	REMARKS
AS-BUILT DRAWINGS	Complete set of construction drawings is available in state files.
REGIONAL VICINITY MAP	See Plate 1
CONSTRUCTION HISTORY	The dam was designed by General Analytics, Inc., Consulting Engineers, of Monroeville, Pennsylvania in 1966. The dam was constructed by Kaiser Engineers, Inc., of Butler, Pennsylvania. The dam was completed in 1968.
TYPICAL SECTIONS OF DAM	See Plate 2
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS	See Plate 7

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Sawmill Run

ID# NDI 915, DER 10-71

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	Not recorded
DESIGN REPORTS	"Melt Shop Site Development, Subusrface Investigation and Design, Sawmill Run Water Supply Dam, Armco Steel Corporation, Butler, Pennsylvania," by General Analytics, Inc., Consulting Engineers, August 1967.
GEOLOGY REPORTS	Included in the above-referenced report
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Hydrology and hydraulic calculations are presented in the engineer's report. The results of stability and seepage analyses are included in the design drawings.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Available in engineer's report and design drawings.

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Sawmill Run
ID# NDI 915, DER 10-71

ITEM	REMARKS
POST CONSTRUCTION SURVEYS OF DAM	None reported
BORROW SOURCES	Described in engineer's report
MONITORING SYSTEMS	None
MODIFICATIONS	None reported
HIGH POOL RECORDS	Pool levels are not recorded

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Sawmill Run
ID# NDI 915, DER 10-71

ITEM	REMARKS
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None reported
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None reported
MAINTENANCE OPERATION RECORDS	Not available
SPILLWAY PLAN SECTIONS DETAILS	See Plate 6
OPERATING EQUIPMENT PLANS AND DETAILS	See Plate 7

NAME OF DAM Sawmill Run

ID# NDI 915, DER 10-71

CHECKLIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Wooded and residential. 2.8 square miles

ELEVATION; TOP NORMAL POOL AND STORAGE CAPACITY: 144 acre-feet at El. 1041

ELEVATION; TOP FLOOD CONTROL POOL AND STORAGE CAPACITY: Same as above

ELEVATION; MAXIMUM DESIGN POOL: El. 1073 (top of dam)

ELEVATION; TOP DAM: El. 1073

CREST: (Spillway)

a. Elevation 1041

b. Type Broad-crested weir

c. Width 35 feet

d. Length 150± feet

e. Location Spillover Between embankment and spillway channel

f. Number and Type of Gates None

OUTLET WORKS:

a. Type 30-inch cast-iron pipe

b. Location Middle of dam

c. Entrance Inverts El. 1017±

d. Exit Inverts El. 1013±

e. Emergency Draindown Facilities 30-inch drainpipe

HYDROMETEOROLOGICAL GAGES:

a. Type None

b. Location None

c. Records None

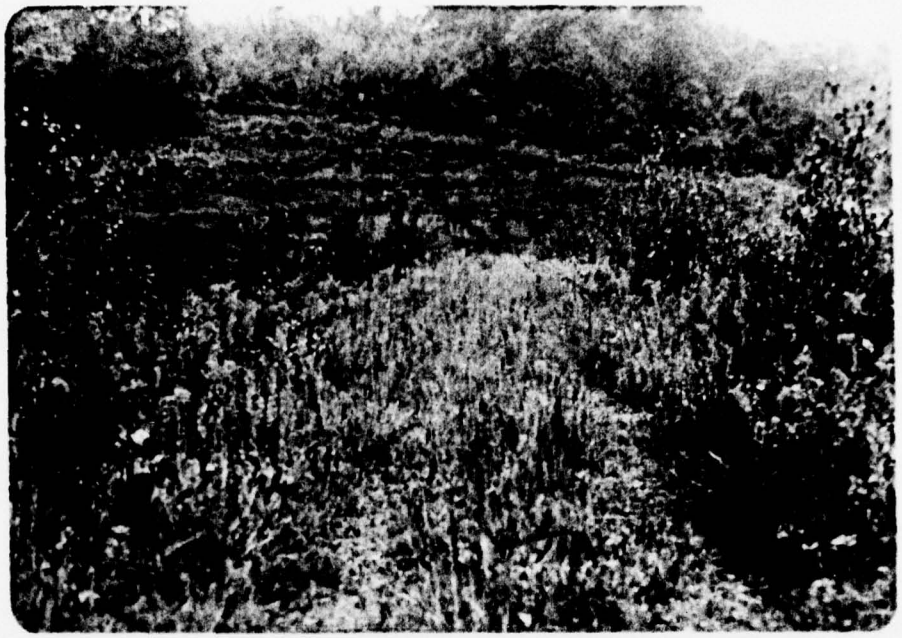
MAXIMUM NONDAMAGING DISCHARGE: 3300 cfs (design spillway capacity)

APPENDIX C

PHOTOGRAPHS

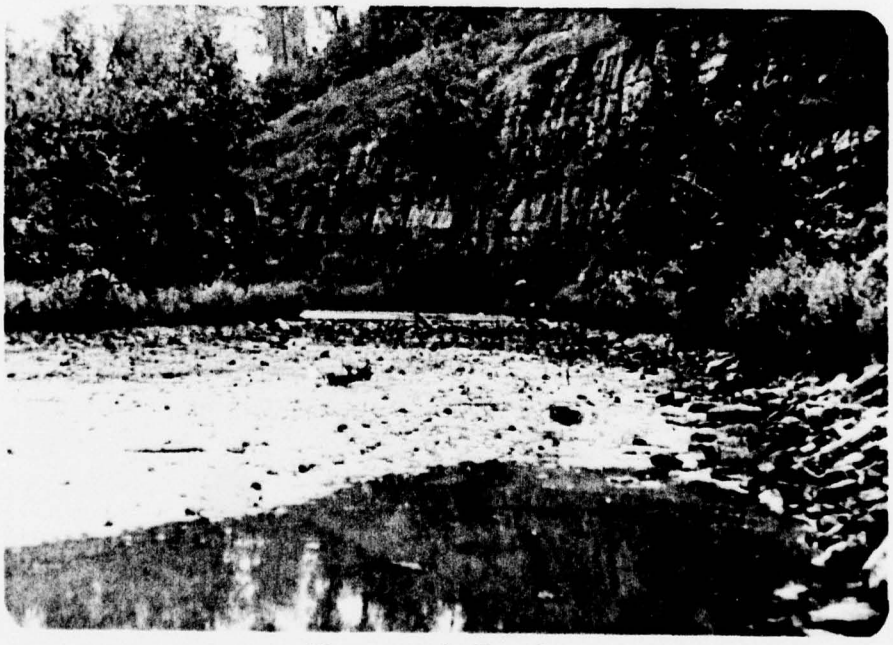
LIST OF PHOTOGRAPHS
SAWMILL RUN DAM
NDI I.D. NO. 915
SEPTEMBER 12, 1978

PHOTOGRAPH NO.	DESCRIPTION
1	Crest (looking west).
2	Spillway approach channel.
3	Spillway side channel.
4	Spillway chute.
5	Stilling basin.
6	Valve and pump house at the toe of the dam.
7	Blow-off valve control.
8	Blow-off pipe discharging.



Photograph No. 1

Crest (looking west).



Photograph No. 2

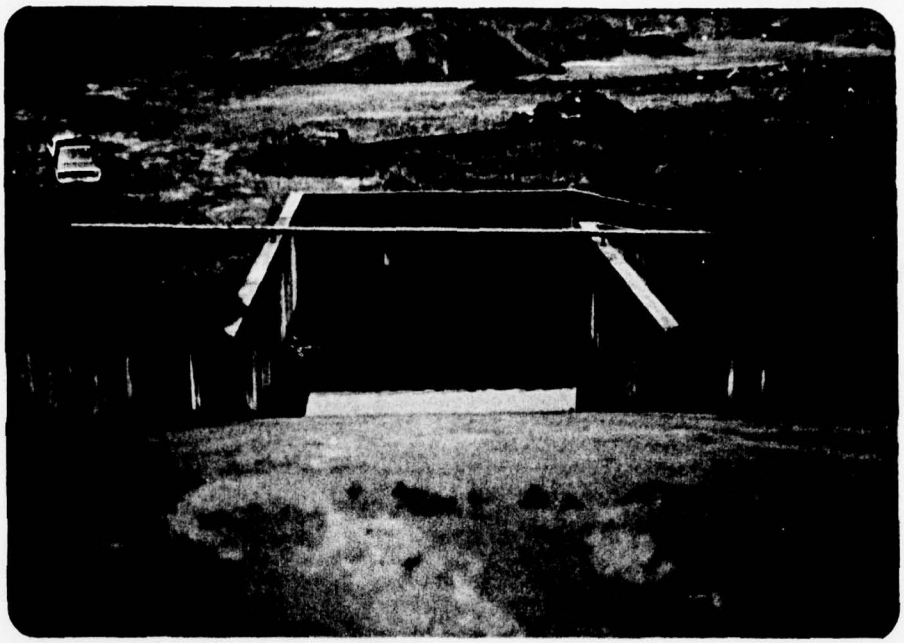
Spillway approach channel.

Photograph No. 3

Spillway side channel.

Photograph No. 4

Spillway chute.

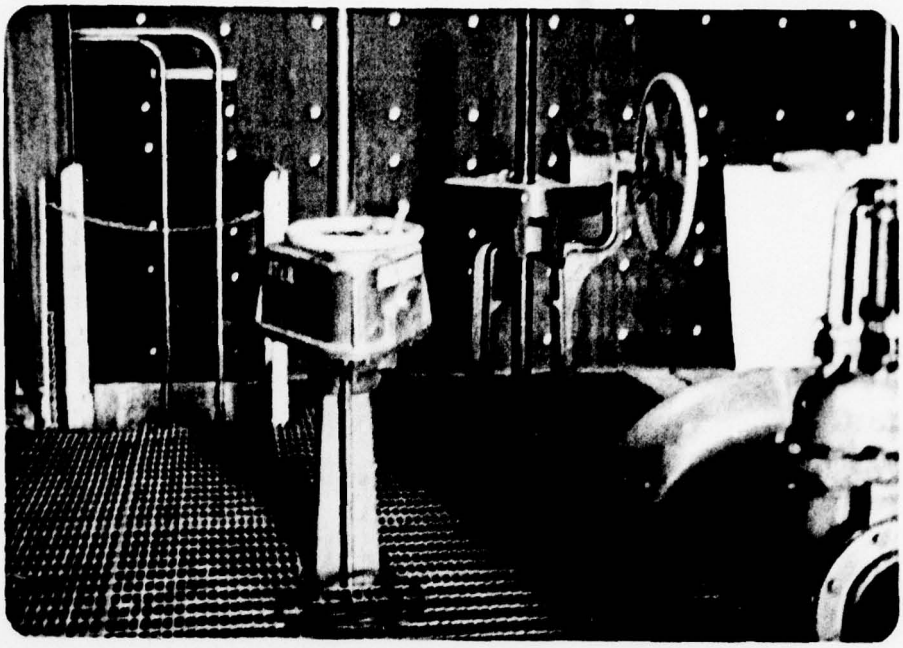


Photograph No. 5

Stilling basin.

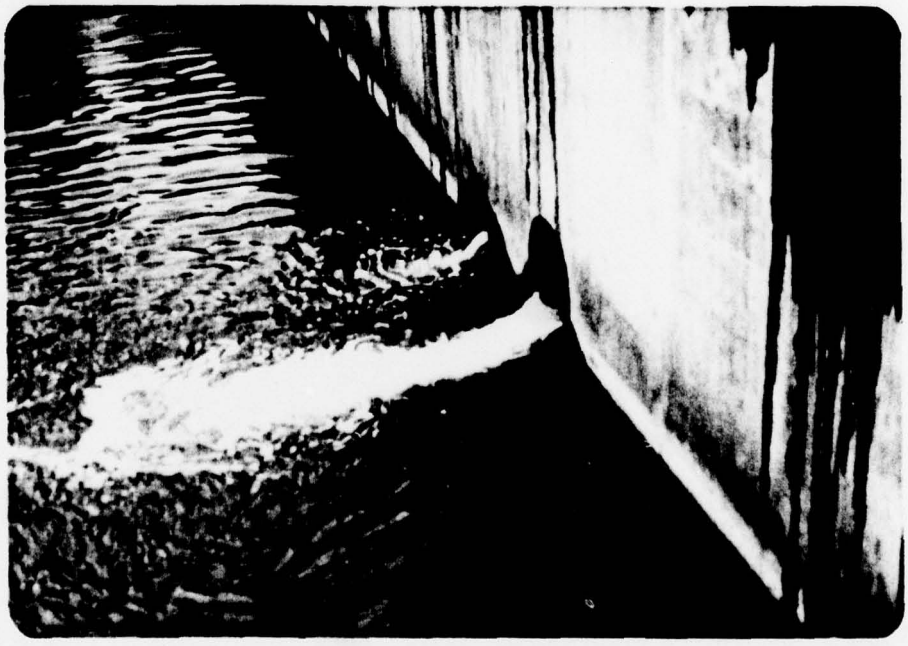
Photograph No. 6

Valve and pump house at the toe of the dam.



Photograph No. 7

Blow-off valve control.



Photograph No. 8

Blow-off pipe discharging.

APPENDIX D
CALCULATIONS

DiAPPOLONIA
CONSULTING ENGINEERS, INC

By WTC Date 9-19-78 Subject SAWMILL RUN DAM Sheet No. 1 of 1
Chkd. By CMG Date 9/22/78 Proj. No. 78-114-31

WATERSHED AREA

REF. U.S.G.S. BUTLER QUADRANGLE, PA 7.5' min

a) WATERSHED AREA = $19.4\ IN^2$
$= 19.4 \times \left(\frac{2000}{5280}\right)^2$
$= 2.78$ SQ MILE

Say 2.8 SQ. MILE

b) LAKE AREA (ELEV. 1041)

$A_L = 0.11\ IN^2$
$= 0.11 \times \left(\frac{2000}{5280}\right)^2 \times 640$
$= 10.1$ acre

say 10 acre lake

c) @ ELEV 1060 and Top of Dam (1052, Phase I / 1073 Phase II)

$A_{1060} = 0.18\ IN^2$
$= 0.18 \times \left(\frac{2000}{5280}\right)^2 \times 640 = 165$ acres @ EL1060

BY INTERPOLATION
Top of Dam. $A_{1052} \cong 14$ acre
$A_{1073} \cong 21$ acres

Say 21 acre dam)

DAM: SAW MILL RUN DAM — ARMCO DAM IN BUTLER, PA

BASIN: OHIO RIVER BASIN, SAW MILL RUN

WATERSHED AREA $A = 2.8$ SQ. MILE

ACCORDING TO CHARTS PROVIDED BY COE BALTIMORE DIST.

THE MAX INFLOW FOR PMF $q = 1850$ cfs/SQ MILE

$Q = 5180$ cfs Say 5200 cfs

26" RUNOFF, WATER VOLUME $= \frac{26}{12} \times 2.8 \times 640$

$V_i = 3883$ ac-ft

Say 3900 ac-ft

Spillway capacity

Type CONCRETE BOARD CREST OVERFLOW WEIR

LENGTH $L = 35$ FT

$\Delta H = 32$ FT (NORMAL POOL 1041, Dam crest 1073)

$Q_s = (2.6)(35)(32)^{1.5}$

$= 16472$ cfs Say 16000 cfs

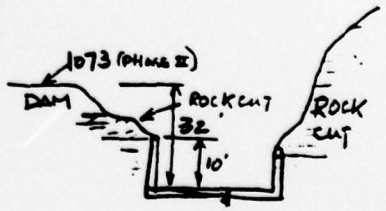
FOR FLOW WITHIN CONCRETE CHANNEL

$\Delta H = 10$ FT (Field measured)

$Q_s = (2.6)(35)(10)^{1.5}$

$= 2878$

Say 2900 cfs



CREST EL 1040.2 @ SPILLWAY END
NORMAL POOL EL 1041 @ LAKE

REF ARMCO DWG 80214 "SPILLWAY FACILITY-PLAN, SECTIONS AND HYDRAULIC Profile" 8-25-67
@ LAKE LEVEL 1051.5 Design FLOW = 3300 cfs

SURCHARGE Vol

REF ARMCO Dwg 80200, GAI Dwg CC-214-E1

EL	Vol MG	Vol ac-ft
1041	47	144
1050	84	258
1051	89	273
1052	94	288
1060	143	439
1070	215	660
1073	237 (projected)	727

MAX SURCHARGE = 727 - 144 = 583 ac-ft

PERCENT OF PMF (ASSUMING WATER FLOW WITHIN SPILLWAY OR LAKE LEVEL @ 1051)

$$= \left(\frac{2900}{5200} + \frac{273-144}{3900}\right)100\%$$

$$= (0.56 + 0.03)100\%$$

$$= 59.1\% \text{ PMF}$$

DETERMINE HEIGHT OF WATER FOR 100% PMF

$$\frac{(2.6)(35)(H)^{1.5}}{5200} + \frac{(273-144) + \frac{439+273}{2}(H-11)}{3900} = 1$$

H = 14.39 FT or EL 1055.35

or 17.7' free board

Say 100% PMP

CHECK WATER Depth @ SPILLWAY CHUTE BEGINNING (CRITICAL DEPTH)

Q_s = 4947 cfs

$$d_c = \sqrt[3]{\frac{(4947)^2}{(35)^2 \cdot 32.2}} = 8.5' < 10'$$ ok.

APPENDIX E

REGIONAL GEOLOGY

APPENDIX E
REGIONAL GEOLOGY

The Sawmill Run Dam near Butler is located on the boundary of strata of the Allegheny Group and the overlying strata of the Conemaugh Group. The dam is located west of the Bradys Bend Syncline and is near the crest of the Millerstown-Brush Creek Syncline, although the strata are near horizontal in the region and the syncline is difficult to define. In the vicinity of the dam, the rock strata dip gently to the west-northwest.

A two-foot-thick coal seam, probably the Upper Freeport seam, crops near the base of the valley slopes. The rock below the coal seam and the dam consist of hard massive gray sandstone interbedded with thin seams of shale and claystone. The strata in the slopes above the dam and reservoir consist of interbedded relatively thin seams of shale, claystone, sandstone and several thin coal seams. The slopes are relatively steep and rock falls and small slides may be expected considering the low resistance to weathering of the strata around the existing slopes

The dam and reservoir have not been undermined. The coal seams that exist are not minable under present conditions due to their thickness and high impurity content.