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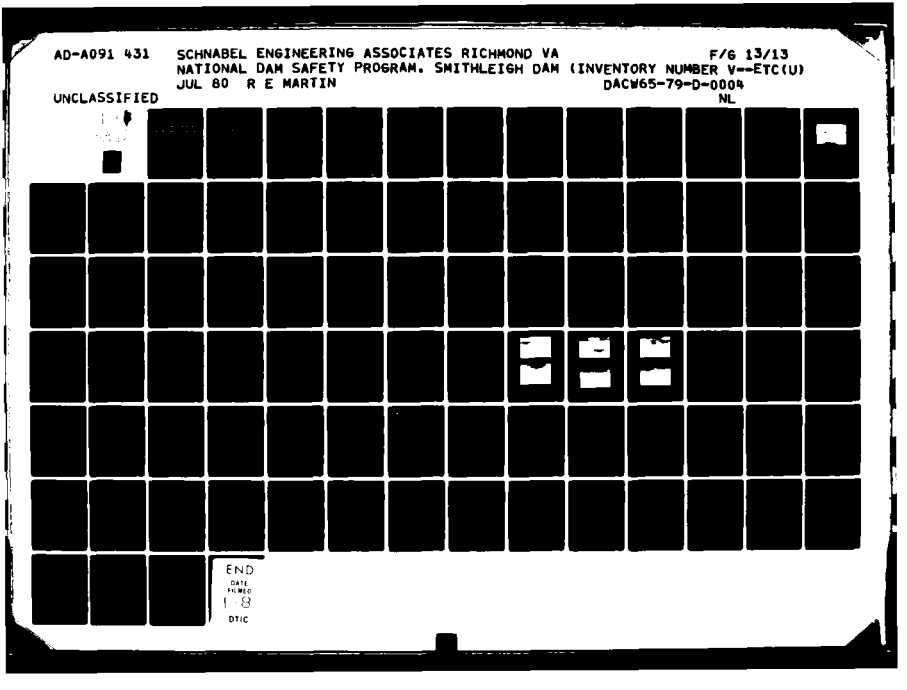

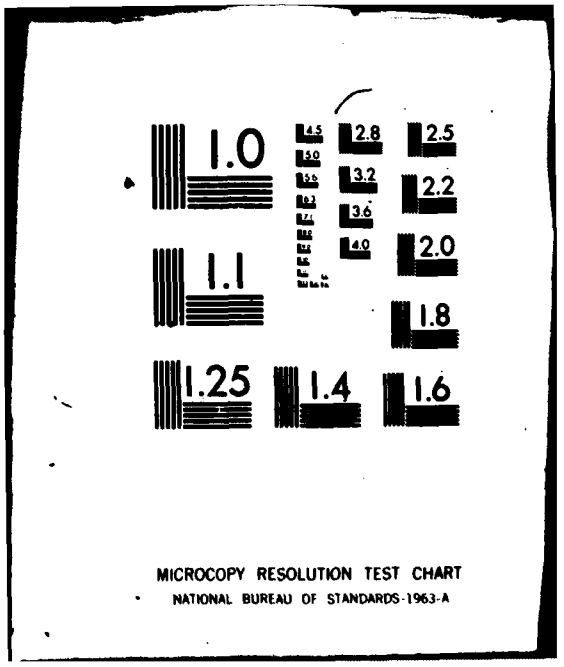
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POTOMAC RIVER BASIN

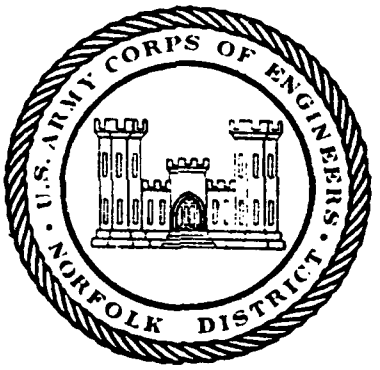
Name Of Dam: SMITHLEIGH DAM

Location: AUGUSTA COUNTY, VIRGINIA

Inventory Number: VA. NO. 01523

LEVEL II

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM



PREPARED FOR

NORFOLK DISTRICT CORPS OF ENGINEERS
803 FRONT STREET
NORFOLK, VIRGINIA 23510

BY

SCHNABEL ENGINEERING ASSOCIATES, P.C./
J. K. TIMMONS AND ASSOCIATES, INC.

JULY 1980

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20. Abstract

Pursuant to Public Law 92-367, Phase I Inspection Reports are prepared under guidance contained in the recommended guidelines for safety inspection of dams, published by the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general conditions of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

Based upon the field conditions at the time of the field inspection and all available engineering data, the Phase I report addresses the hydraulic, hydrologic, geologic, geotechnic, and structural aspects of the dam. The engineering techniques employed give a reasonably accurate assessment of the conditions of the dam. It should be realized that certain engineering aspects cannot be fully analyzed during a Phase I inspection. Assessment and remedial measures in the report include the requirements of additional indepth study when necessary.

Phase I reports include project information of the dam and appurtenances, all existing engineering data, operational procedures, hydraulic/hydrologic data of the watershed, dam stability, visual inspection report and an assessment including required remedial measures.

POTOMAC RIVER BASIN

(6) National Dam Safety Program.

NAME OF DAM: SMITHLEIGH DAM

LOCATION: AUGUSTA COUNTY, VIRGINIA

(INVENTORY NUMBER: VA. 01523)

Potomac River Basin,
Augusta County,
Virginia.

PHASE I INSPECTION REPORT.
NATIONAL DAM SAFETY PROGRAM

Ray E. Martin

(15) DACW65-84-D-0011

(Final rpt.)

(11) Jul 84

PREPARED FOR
NORFOLK DISTRICT CORPS OF ENGINEERS
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PREFACE

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

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

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

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

Name of Dam: Smithleigh Dam
State: Virginia
County: Augusta
USGS Quad Sheet: Churchville
Coordinates: Lat 38° 09.1' Long 79° 12.8'
Stream: Middle River
Date of Inspection: April 15, 1980

BRIEF ASSESSMENT OF DAM

Smithleigh Dam is a zoned earthfill structure about 510 ft long and 18 ft high. The principal spillway consists of a concrete riser and a 36 inch diameter concrete outlet pipe which extends through the structure. There are two emergency spillways; one located at the center of the dam, and another at the right abutment. The emergency spillways consist of five 44" x 72" corrugated pipe arches and a 200 ft wide grass-lined earth channel with 1.5H:1V side slopes, respectively. The structure is classified small in size and is assigned a significant hazard classification. The dam is located on the Middle River about one-half mile south of Swoope, Virginia. The lake is used for recreation and is owned and maintained by Mr. R. R. Smith.

Based on criteria established by the Department of the Army, Office of the Chief of Engineers (OCE), the appropriate Spillway Design Flood (SDF) is the ½ PMF. The spillways will pass less than 10 percent of the Probable Maximum Flood (PMF) or 20 percent of the SDF. During the SDF, the dam will be overtopped to a depth of 4.8 ft maximum, at a maximum velocity of 9.4 fps, and will be overtopped for a period of 14 hours. The spillway is rated seriously inadequate.

An accurate check on stability could not be made since sufficient design data, calculations, and construction data were not available.

The embankment crest width and the downstream embankment slope meet the requirements recommended by the U. S. Bureau of Reclamation; however, the upstream slope is slightly steeper than recommended when subject to rapid drawdown. Stability is not believed to be a problem since the dam has been overtopped by 3 to 6 inches for about one hour in 1977 and also because the dam was subjected to rapid drawdown during construction of the secondary principal spillway.

Due to the inadequacy of the spillways, the dam will be subject to high, erosive stream velocities on the non-overflow section during the SDF. The potential for a dam failure exists because of the possible erosion caused by overtopping, which results in an increased hazard to loss of life for the downstream structure. Because of the potential hazard the dam is assessed "unsafe non-emergency".

The classification of "unsafe" applied to a dam because of a seriously inadequate spillway is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. It does mean, however, that based on an initial screening, and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard to loss of life downstream from the dam.

It is therefore recommended that within two months of the date of notification of the Governor of the Commonwealth of Virginia, the Owner engage the services of a professional engineering consultant to complete a detailed evaluation of the downstream floodplain and of

the Spillway Design Flood appropriate to this dam. Remedial measures to be considered include modification to the dam, spillway, floodplain, and/or any other method of eliminating the danger imposed by the dam. The erosional effects of overtopping on the embankment should also be addressed.

Within six months of the notification of the Governor, the consultant's analyses and recommendations should be completed and the Owner should have an agreement with the Commonwealth of Virginia for a reasonable time period in which all remedial measures will be complete. In the interim, an emergency operation and warning plan should be developed.

The following routine maintenance and observation functions should be initiated:

1) Repair eroded areas on the outlet channel and downstream channel and provide erosion control measures such as riprap to prevent future erosion. Areas which are undermining the outlet channel should also be backfilled and protected.

2) The presence of trees on the embankment can result in the development of deep rooted vegetation and this type growth can encourage piping within the embankment. It is recommended that the trees presently growing on the embankment be cut to the ground and be continuously controlled during normal maintenance procedures.

3) A staff gage should be installed.

On July 22, 1980 a meeting was held at the dam site to discuss the preliminary Phase I Inspection Report for the dam. Discussion included the predicted overtopping of the dam during the SDF and the resulting increase in hazard to the downstream dwelling. The Owner indicated that he would reduce the downstream hazard by providing an early warning system. A memorandum of the site meeting is included as p.9 of Appendix III.

Prepared by:

SCHNABEL ENGINEERING ASSOCIATES, P.C./
J. K. TIMMONS AND ASSOCIATES, INC.

Ray E. Martin, Ph.D., P.E.
Commonwealth of Virginia

Submitted by:

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Douglas L. Haller
Colonel, Corps of Engineers
District Engineer

Recommended by:

Original Signed by:
Ronald G. Vann

for Jack G. Starr, P.E., R.A.
Chief, Engineering Division

Date: AUG 29 1980

OVERVIEW PHOTOGRAPH

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
SMITHLEIGH DAM
VA. NO. 01523

SECTION 1 - PROJECT INFORMATION

1.1 General:

1.1.1 Authority: Public Law 92-367, 8 August 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of safety inspections of dams throughout the United States. The Norfolk District has been assigned the responsibility of supervising the inspection of dams in the Commonwealth of Virginia.

1.1.2 Purpose of Inspection: The purpose is to conduct a Phase I inspection according to the Recommended Guidelines for Safety Inspection of Dams (see Reference 1, Appendix IV). The main responsibility is to expeditiously identify those dams which may be a potential hazard to human life or property.

1.2 Project Description:

1.2.1 Dam and Appurtenances: Smithleigh Dam is a zoned earth-fill structure approximately 510 ft long and 18 ft high.* The top of the dam is 20 ft wide and is at elevation 1582 msl. Side slopes are approximately 6 horizontal to 1 vertical (6H:1V) on the downstream side and 3 horizontal to 1 vertical (3H:1V) on the upstream side to elevation 1577 msl and then grades to 2 horizontal to 1 vertical (2H:1V).

*Height is measured from the top of the dam to the downstream toe at centerline of the stream.

The dam is keyed into the foundation and an internal drainage system exists. Existing vegetation on the embankment slopes provide adequate slope protection.

The principal spillway is a reinforced concrete riser type structure 3.0 ft square with a crest elevation of 1576.5 msl. The outlet pipe is a 36 inch corrugated metal pipe (CMP) which discharges into a paved outlet channel at the toe of the dam. The inlet invert of the 36 inch CMP is 1564.9 msl. A 36 inch diameter gate located on the riser structure at elevation 1565.9 msl is used to drain the lake.

There is a secondary principal spillway which consists of five 44" x 72" CMP arches through the dam at invert elevation 1577 msl, located near the center of the dam adjacent to the riser inlet.

The original emergency spillway has been raised to within 0.5 ft of the top of the dam. The new emergency spillway is a 200 ft wide grass lined earth spillway located in a fill section at the right abutment. This spillway crosses the access road and intersects the stream below the outlet channel (See Plates No. 2 and 4, Appendix I).

1.2.2 Location: Smithleigh Dam is located on the Middle River approximately ½ mile south of Swoope, Virginia. (See Plate 1, Appendix I).

1.2.3 Size Classification: The dam is classified as a "small" size structure because of the dam height.

1.2.4 Hazard Classification: Smithleigh Dam is located in a rural area; however, based upon the downstream proximity of one dwelling located one-quarter mile downstream, the dam is assigned a "significant" hazard classification. The hazard classification used to categorize a dam is a function of location only and has nothing to do with its stability or probability of failure.

1.2.5 Ownership: Mr. R. R. Smith owns and operates the dam.

1.2.6 Purpose: Recreation.

1.2.7 Design and Construction History: The dam was designed and constructed under the supervision of Johnson and Williams, Consulting Engineers, for the owner. The structure was constructed by Echols Brothers Construction Company and completed in 1968. The emergency spillway was modified in 1977 from its original design by raising the crest elevation. This action was taken due to erosion caused by the magnitude and frequency of use. During the modification a new emergency spillway was constructed by Valley Paving Company consisting of five CMP pipe arches and concrete discharge chute. This structure was designed by the owner.

1.2.8 Normal Operational Procedures: The principal spillway is ungated; therefore, water rising above the crest of the riser inlet automatically is discharged downstream. Similarly, water is automatically passed through the emergency spillway in the event of an extreme flood which creates a pool elevation above that of the emergency spillway crest. Normal pool is maintained at elevation 1576.5 msl.

1.3 Pertinent Data:

1.3.1 Drainage Areas: The drainage area is 25 square miles.

1.3.2 Discharge at Dam Site: Maximum known flood at the dam site occurred in April 1977 and an estimated pool elevation of 1582.5± msl was observed. This corresponds to a peak discharge of approximately 1816 CFS.

Principal Spillway Discharges:

Pool Elevation at Crest of Dam (elev 1582)	133 CFS

Emergency Spillway Discharges:

Pool at Crest of Dam (elev 1582)	982 CFS

1.3.3 Dam and Reservoir Data: See Table 1.1 below:

TABLE 1.1 - DAM AND RESERVOIR DATA

	Reservoir				
		Storage			
	Elevation Feet msl	Area Acres	Volume Acre Feet	Watershed Inches	Length Miles
Crest of Dam	1582	40.5	306	.23	.60
Emergency Spillway	1581.5	40	286	.21	.55
Multiple CMP Arches	1577	13	95	.07	.30
Intake Riser Crest	1576.5	12	69	.05	.23
Streambed at Downstream Toe of Dam	1564	-	-	-	-

SECTION 2 - ENGINEERING DATA

2.1 Design: The dam was designed and constructed under the direction of Johnson and Williams, Consulting Engineers (Staunton, Virginia) for Mr. R. R. Smith. Design data and construction specifications are available at the office of Betz, Converse, Murdoch, Inc., 1205 North Augusta Street, P. O. Box 2277, Staunton, Virginia, 24401, the successor firm to Johnson and Williams. The hydrologic and hydraulic design report was not available and a stability analysis was not performed.

A subsurface investigation was conducted at the site by E. O. Gooch and Associates during the initial design stages. The investigation consisted of drilling 13 auger probe borings to obtain bulk samples and 7 test borings including standard penetration tests. A report of the investigation with foundation recommendations was prepared based upon geological reconnaissance, test borings, and laboratory soil testing. Boring logs are included as Appendix IV and their locations are shown on Plate No. 2 of Appendix I.

The dam is a zoned, compacted earthfill embankment (Plate No. 3, Appendix I.) The upstream slope is 3 horizontal to 1 vertical above elev 1577 and 2 horizontal to 1 vertical below elev 1577. Eighteen inches of stone riprap exists between elevations 1576 and 1579. The downstream slope is 6 horizontal to 1 vertical. Zone I was to be constructed with soils excavated from the emergency spillway, while remaining materials from the emergency spillway and soils

excavated from portions of the lake were to be included in Zone II. Laboratory test data indicate that virtually all of the on-site soils classified as silty clays (CL) in accordance with the Unified Soil Classification System and thus, from a technical viewpoint, the dam is considered homogeneous. Compaction requirements of 100 percent and 90 percent of maximum dry density were specified, however, for Zones I and II, respectively. It could not be determined from the construction specifications available whether the percent compaction was in accordance with ASTM D-1557 (modified proctor) or ASTM D-698 (standard proctor). All fill was to be placed in 6 inch layers (loose thickness) and compacted with a roller. Areas not accessible to the roller were to be placed in 4 inch layers and compacted with power tampers.

A drainage system is located under the downstream portion of the embankment to control the phreatic surface and to collect seepage. Construction specifications describe the filter material as consisting of, "well graded bankrun river bottom material about one (1) inch to two (2) inches in diameter, meeting the following consistency requirements:

Gravel - 10 to 30 percent

Sand - 25 to 40 percent

Silt - 25 to 35 percent"

A review of design drawings (Plate No. 3, Appendix I) indicates the dam is founded on overburden and includes a 10 ft wide cutoff trench which extends to bedrock. Test borings encountered limestone bedrock at depths of 4 to 5 ft below ground surface in the flood

plain and from the ground surface to 8 ft depth on the adjacent hillsides along center line of the dam.

The principal spillway consists of a concrete riser and 36 inch diameter concrete outlet pipe, which extends through the structure. Four anti-seep collars or "watertight diaphragms" were provided in design, spaced 22 ft on center (Plate No. 3, Appendix I).

An emergency spillway was originally constructed in the right abutment as shown on Plate No. 4 of Appendix I. According to the Owner this emergency spillway was subjected to continual erosion, therefore, in 1977 the spillway was raised and an additional emergency spillway constructed. The original emergency spillway is now a 210 ft wide grass-lined earth channel with 1.5:1 side slopes. The new emergency spillway which was designed by Mr. R. R. Smith, consists of five 44 inch x 72 inch corrugated pipe arches with a concrete discharge channel (Plate No. 6, Appendix I).

2.2 Construction: Construction records were not available. It is not known whether full time construction inspection was required, however, the inspection of designated areas and materials was specified in the construction specifications. The dam was originally constructed in 1968 by Echols Brothers Construction Company, Staunton, Virginia. The new emergency spillway was constructed in 1977 by Valley Paving Company, Staunton, Virginia.

2.3 Evaluation: Engineering calculations are not available and there are no records available for dam performance. Design drawings provided by Johnson and Williams appear to be generally representative of the "as built" structure. There is sufficient information to evaluate foundation conditions, but insufficient information to evaluate embankment stability.

SECTION 3 - VISUAL INSPECTION

3.1 Findings: At the time of inspection, the dam was in good condition. Field obsevations are outlined in Appendix III.

3.1.1 General: An inspection was made 15 April 1980 and the weather was cloudy with a temperature of 40°F. The pool and tailwater levels at the time of inspection were 1578 and 1566 msl, respectively, which corresponds to above normal levels. Ground conditions were damp at the time of the inspection. No previous inspection reports were available.

3.1.2 Dam and Spillway: The embankment and abutment slopes and the right emergency spillway are all grassed and well maintained. Numerous small trees approximately 6 ft high and 1 to 3 inches in diameter occur along the upstream slope, which is blanketed with riprap. Ponded water was observed in two areas; first, along the downstream toe several hundred ft left of the concrete outlet channel and second, in a 60 ft x 25 ft± area about 75 ft below and to the left edge of the concrete channel. No iron staining was observed and both areas are believed to represent ponded runoff from earlier rainfalls. Just to the right of the second area, water was flowing through a small opening in the concrete channel at a rate of 5 to 10 gpm±. This water is believed to represent water flowing beneath and along the side of the channel. Water was also flowing from beneath the concrete channel at a rate of 25 to 30 gpm±. See Sheet 1, Appendix III. No foundation drains were observed; however, Mr. Cox recalled seeing several when there was no flow in the concrete outlet channel.

The abutments are grassed and no bedrock was exposed. No faults were observed in the field during this inspection and geologic maps of the area do not show the presence of faults in the immediate vicinity.

The intake structure showed no signs of deterioration, but was partially submerged and observation was hindered. The drain valve was reportedly in operational condition. The outlet pipe is a 36 inch diameter concrete pipe and was submerged. There was no staff gage located at the site.

The emergency spillway consists of a ground overflow section approximately 200 ft wide with a control section six inches (elev 1581.5) below the crest of the dam, and five 72" x 44" corrugated metal pipe arches through the dam embankment adjacent to the intake structure with an invert elevation of 1577± msl. The 72" x 44" pipe arches were flowing approximately one foot deep at the time of inspection.

The concrete discharge channel below the principal spillway outlet is severely eroded behind the concrete sidewalls. This erosion reportedly occurred primarily during the storm of April, 1977.

3.1.3 Reservoir Area: The reservoir area was free of debris and the perimeter is pasture. The reservoir is located in a broad valley streambed with side slopes at approximately 4H:1V. Sediment buildup was indicated near the upstream reaches by the farm manager.

3.1.4 Downstream Area: The downstream channel consists of a 20 ft wide by 2 ft deep channel located in a valley. The valley side slopes are approximately 4H:1V and consist of open pasture. For a distance of approximately 100 ft downstream of the outlet channel,

the stream banks are severely eroded. Approximately one-quarter mile downstream there is one home about 15 ft above the streambed. During the April 1977 storm, the stream level rose to within several feet of the dwelling and encroached within the yard area. The dam was overtopped during this storm by 3 to 6 inches for approximately one hour.

3.1.5 Instrumentation: No instrumentation (monuments, observation wells, piezometers, etc.) was encountered for the structure.

3.2 Evaluation: Overall, the dam was in good condition at the time of inspection. The embankment and abutment slopes are well maintained. A number of small trees exist on the upstream slope. Uncontrolled growth promotes the development of deep rooted vegetation and this type growth can encourage piping within the embankment. Small trees presently growing on the embankment should be cut to the ground.

Described wet areas on the downstream slope are believed to represent ponded runoff from earlier rainfalls and not seepage.

The intake and outlet structures are thought to be in good condition, although observation was hindered by high water.

The concrete outlet channel is in need of erosion protection. The downstream channel below the outlet channel is also in need of erosion control. The erosion on the outlet channel and downstream channel is severe enough to cause damage to the outlet channel if left unchecked. This could ultimately be detrimental to the dam performance.

A staff gage should be installed.

3.2.2 Downstream Area: The dwelling located immediately downstream of the dam could be jeopardized by a dam breach during periods of intense flooding.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures: Smithleigh Lake is used for recreational purposes only. The normal pool elevation (1577 msl) is maintained by the crest of a riser-type inlet acting as the principal spillway. Water automatically passes through the riser inlet as the water level rises above the crest of the riser inlet. Water will automatically pass through the multiple arch pipe spillway when the water level rises above the pipe invert. Large increases in flows which cannot be absorbed by storage and the riser-inlet and arch pipe spillway are automatically passed through the emergency spillway when the pool rises above elevation 1581.5 msl.

4.2 Maintenance of Dam and Appurtenances: Maintenance is the responsibility of the Owner. A regular maintenance program consisting of inspection, debris removal, mowing of the vegetative cover, and repair is routinely performed. The operating appurtenances are reportedly in working order.

4.3 Warning System: No warning system exists.

4.4 Evaluation: The dam and appurtenances are in good operating condition and maintenance of the dam is adequate. Complete records of maintenance and inspections should be maintained for future reference. An emergency operation and warning plan should be developed. It is recommended that a formal emergency procedure be prepared and furnished to all operating personnel. This should include:

a) How to operate the dam during an emergency.

b) Who to notify, including public officials, in case evacuation from the downstream area is necessary.

SECTION 5 - HYDRAULICS/HYDROLOGIC DATA

5.1 Design: No hydraulic/hydrologic data is available.

5.2 Hydrologic Records: There are no records available.

5.3 Flood Experience: An estimated maximum pool elevation of 1582.5± msl occurred in April 1977, which corresponds to 1816 CFS.

5.4 Flood Potential: In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" (flood discharges that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region) or fractions thereof. The Probable Maximum Flood (PMF), ½ PMF and 100 year hydrographs were developed by the SCS method. (Reference 4, Appendix IV). Precipitation amounts for the flood hydrographs of the PMF and 100 year flood are taken from the U. S. Weather Bureau Information (References 5 & 6, Appendix V). Appropriate adjustments for basin size and shape were accounted for. These hydrographs were routed through the reservoir to determine maximum pool elevations.

5.5 Reservoir Regulation: For routing purposes, the pool at the beginning of flood was assumed to be at elevation 1576 msl. Reservoir stage-storage data and stage-discharge data were determined from the available plans, field measurement and USGS quadrangle sheets. Floods were routed through the reservoir using the principal and emergency spillways discharge up to a pool storage elevation of 1582 msl and a combined spillway and non-overflow section discharge of pool elevations above 1582 msl.

5.6 Overtopping Potential: The predicted rise of the reservoir pool and other pertinent data were determined by routing the flood hydrographs through the reservoir as previously described. The results for the flood conditions (PMF, ½ PMF and 100 year) are shown in the following Table 5.1.

TABLE 5.1 - RESERVOIR PERFORMANCE

		Hydrograph		
	Normal Flow	100 Year	½ PMF	PMF
Peak Flow, CFS				
Inflow	25	6418	22,843	45,686
Outflow	25	6336	22,182	44,570
Maximum Pool Elevation ft, msl	-	1583.6	1586.8	1589.9
Non-Overflow Section (Elev 1582 msl)				
Depth of Flow, ft	-	1.6	4.8	6.9
Duration, Hours	-	11.2	14.4	19.0
Velocity, fps (a)	-	5.4	9.4	12.0
Tailwater Elevation ft msl	1565	1577	1584	1589.9

(a) Critical velocity at control section

5.7 Reservoir Emptying Potential: A 36-inch diameter gate at elevation 1565.7 msl is capable of draining the reservoir through the 36-inch diameter outlet pipe. Assuming that the lake is at normal pool elevation (1577 msl) and there is 25 cfs inflow, it would take approximately 1 day to lower the reservoir to elevation 1566 msl or at a rate of 11 ft per day.

5.8 Evaluation: Department of the Army, Corps of Engineers guidelines indicate the appropriate Spillway Design Flood (SDF) for a small size significant hazard dam is the 100 year flood to the ½ PMF. Because of the risk involved, the ½ PMF has been selected as the SDF. The spillway will pass 10 percent of the PMF (20% of the SDF). The SDF will overtop the dam a maximum of 4.1 ft, and remain above the dam for 14 hours with a maximum critical velocity of 9.4 fps.

Hydrologic data used in the evaluation pertains to present day conditions with no consideration given to future development.

SECTION 6 - DAM STABILITY

6.1 Foundation and Abutments: The dam is located in the Valley and Ridge Physiographic Province of Virginia. The structure and the eastern portion of the impoundment are underlain by the Edinburg Formation of upper Ordovician Age. The Edinburg consists basically of dark gray to black shaley limestone, shale, and coarse-grained, fossiliferous limestone. The western portion of the impoundment is underlain by slightly younger shales of the Martinsburg Formation. The geologic report by E. O. Gooch and Associates described the exposure of thin to medium-bedded limestone beds in the stream channel several hundred feet west of the dam site. Bedrock strikes to the north and dips of about 60 degrees to the east were reported. No bedrock or faults were observed at the site during the inspection.

A cutoff trench was provided in design. The trench was to extend through the overburden soils to the top of rock, having a bottom width of 10 ft and side slopes of 1 horizontal to 1 vertical. The horizontal extent of the cutoff was not shown on the drawings provided. The cutoff was to be backfilled with silty clay materials from the emergency spillway excavation.

The design geologic report indicates the presence of limestone bedrock at shallow depths below the preconstruction ground surface. Bedrock was encountered at depths of 4 to 5 ft in the flood plain and from the ground surface to depths of 8 ft in the adjacent hillsides along centerline of the dam. Although solution channels were observed by Gooch in limestone beds exposed 400 ft east of the dam site, no

such channels were reported at the dam site proper. Boring logs are included as Appendix IV. Overburden soils are apparently of residual and alluvial origin, consisting basically of silty clays (CL) and clays (CH) with assorted combinations of sand and rock fragments.

Laboratory test data indicates the overburden soils possess low to very low compacted permeabilities. Higher permeabilities would be expected in those soils which contained increased amounts of sand and rock fragments. A very high water table (3 ft below ground surface) was encountered in the flood plain during the subsurface investigation.

Based upon the design geologic data and performance history of the dam to date, a stable foundation is assumed. Gradual consolidation of underlying soils would be expected during application of fill materials. The underlying soils had probably essentially consolidated under the applied load not long after completion of construction.

6.2 Embankment:

6.2.1 Materials: The dam was constructed in 1968 as a zoned structure; however, basically the same quality silty clay (CL) and clay (CH) soils were used in both Zone I and Zone II, (see Plate No. 3, Appendix I). The distinction in zones was basically only related to the higher compaction requirements specified for Zone I. Therefore, the dam is considered a modified homogeneous dam with respect to stability. It could not be determined from the construction specifications whether compaction was in accordance with ASTM Standard D-1557 (modified proctor) or ASTM Standard D-698 (standard proctor).

However, compaction to 100% of maximum dry density was specified for Zone I and 90% for Zone 2.

6.2.2 Subdrains and Seepage: Design drawings (Plate No. 3, Appendix I) indicate the presence of a drainage system under the downstream portion of the embankment. Filter material consists of well graded bankrun sand, silt, and gravel. The drainage system is apparently functioning properly, as no seepage was encountered during the inspection. No foundation drains were observed during the inspection; however, Mr. Cox recalled seeing several when there was no flow in the concrete outlet channel.

6.2.3 Stability: There are no available stability calculations. The dam is 18 ft high and has a bottom width of approximately 120 ft and crest width of 20 ft along the principal spillway section of the dam. The upstream slope is 3H:1V above elevation 1577 msl and 2H:1V below. The downstream slope is 6H:1V. The dam is subject to rapid drawdown, as the lake can be lowered to the principal spillway invert, elevation 1565.7 msl in one day. This is at a rate of about 11 ft per day as compared to the accepted standard (Bureau of Reclamation) of 0.5 ft per day. For stability purposes, the structure was assumed to be homogeneous and constructed with CL to CH soils. According to the guidelines present in Design of Small Dams, U. S. Department of the Interior Bureau of Reclamation, for small homogeneous dams with a stable foundation subjected to drawdown and composed of CL to CH materials, the recommended slopes range from 2.5H:1V to 3.5H:1V for the downstream and upstream slopes respectively. The downstream slope is considered adequate, but the upstream slope is considered inadequate.

The recommended crest width is 13.6 ft, therefore, the existing crest width is considered to be adequate.

6.2.4 Seismic Stability: The dam is located in Seismic Zone 2. Therefore, according to the Recommended Guidelines for Safety Inspection of Dams, the dam is considered to have no hazard from earthquakes provided static stability conditions are satisfactory and conventional safety margins exist.

6.3 Evaluation: An accurate check on the stability of this structure cannot be made since stability analyses were not performed for design, and construction records are not available. The embankment crest width and the downstream embankment slope meet the requirements recommended by the U. S. Bureau of Reclamation; however, the upstream slope is slightly steeper than recommended when subject to rapid drawdown. Stability is not believed to be a problem since the dam has been overtopped by 3 to 6 inches for about one hour in 1977 and also because the dam was subjected to rapid drawdown during construction of the secondary principal spillway. Overtopping is considered a problem because of the depth and duration of flood and also the velocity of 9.4 fps is greater than 6 fps, the effective eroding velocity for a vegetated earth embankment. Some erosion is anticipated on the downstream slope during overtopping; however, tailwater conditions will absorb the additional flow. The crest of the dam is occupied by a paved hard surface road which provides erosional protection for the crest during overtopping. Since no undue settlement, cracking, or seepage was noted at the time of inspection, it appears that the

embankment is adequate for maximum control storage with water at elevation 1577 msl. Based upon design data, construction methods and the performance history of the dam, no further studies are believed necessary.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment: The Smithleigh Dam at the time of inspection appeared to be in good condition. The appropriate SDF for this dam is the ½ PMF. The spillway will pass 10 percent of the PMF (20 percent of the SDF) without overtopping, and the dam will be overtopped by 4.8 ft during the SDF. The spillways are judged seriously inadequate.

The actual embankment structure appears to be similar to the design drawings with the exception of the addition of the emergency spillway pipe arches. The downstream embankment slope meets the requirement recommended by the U. S. Bureau of Reclamation, (Reference 2, Appendix VI); however, the upstream slope is slightly steeper than recommended when subject to rapid drawdown.

Due to the inadequacy of the spillways, the dam will be subject to high, erosive stream velocities on the non-overflow section during the SDF. The potential for a dam failure exists because of the possible erosion caused by overtopping, which results in an increased hazard to loss of life for the downstream structure. Because of the potential hazard the dam is assessed "unsafe, non-emergency".

The classification of "unsafe" applied to a dam because of a seriously inadequate spillway is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. It does mean, however, that based on an initial screening, and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard to loss of life downstream from the dam.

Maintenance of the structure is good. The dam appears to have been constructed generally in accordance with design drawings, except for the modifications to the emergency spillway.

7.2 Recommended Remedial Measures: It is recommended that within two months of the date of notification of the Governor of the Commonwealth of Virginia, that the Owner engage the services of a professional engineering consultant to complete a detailed evaluation of the downstream floodplain and of the Spillway Design Flood appropriate to this dam. Remedial measures to be considered include modification to the dam, spillway, floodplain, and/or any other method of eliminating the danger imposed by the dam. The erosional effects of overtopping on the embankment should also be addressed.

Within six months of the notification of the Governor, the consultant's report of appropriate remedial mitigating measures should have been completed and the Owner should have an agreement with the Commonwealth of Virginia for a reasonable time frame in which all remedial measures will be complete.

Until corrective measures are completed, the dam should be checked during periods of heavy runoff. If dam overtopping is imminent, warning should be issued to the downstream inhabitants.

In the interim, an emergency operation and warning plan should be promptly developed. It is recommended that a formal emergency procedure be prepared, prominently displayed, and furnished to all operating personnel. This should include:

1) How to operate the dam during an emergency.

2) Who to notify, including public officials, in case evacuation from the downstream area is necessary.

7.3 Required Maintenance and Observation:

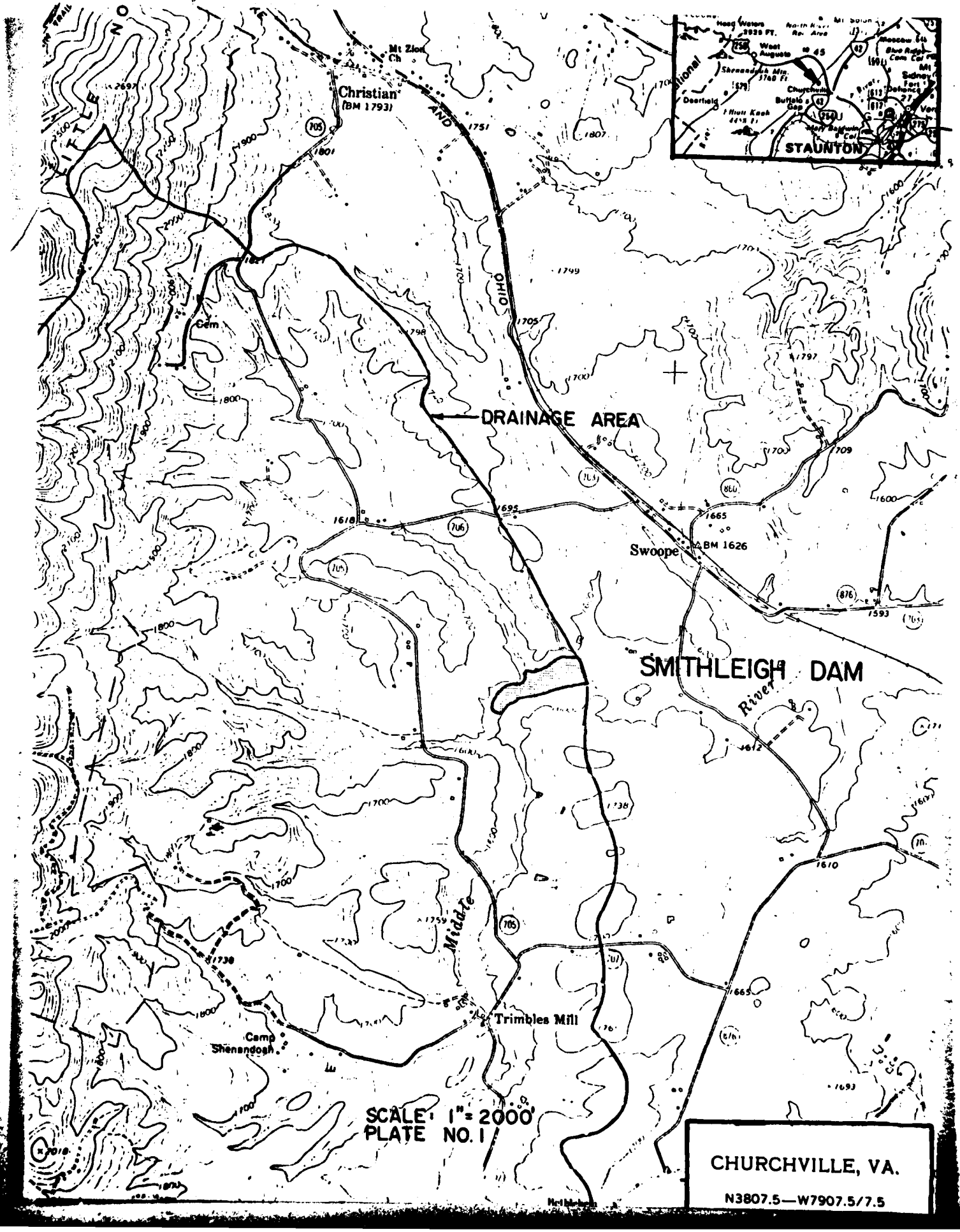
7.3.1 Repair eroded areas on the outlet channel and downstream channel, and provide erosion control measures such as riprap to prevent future erosion. Areas which are undermining the outlet channel should also be backfilled and protected.

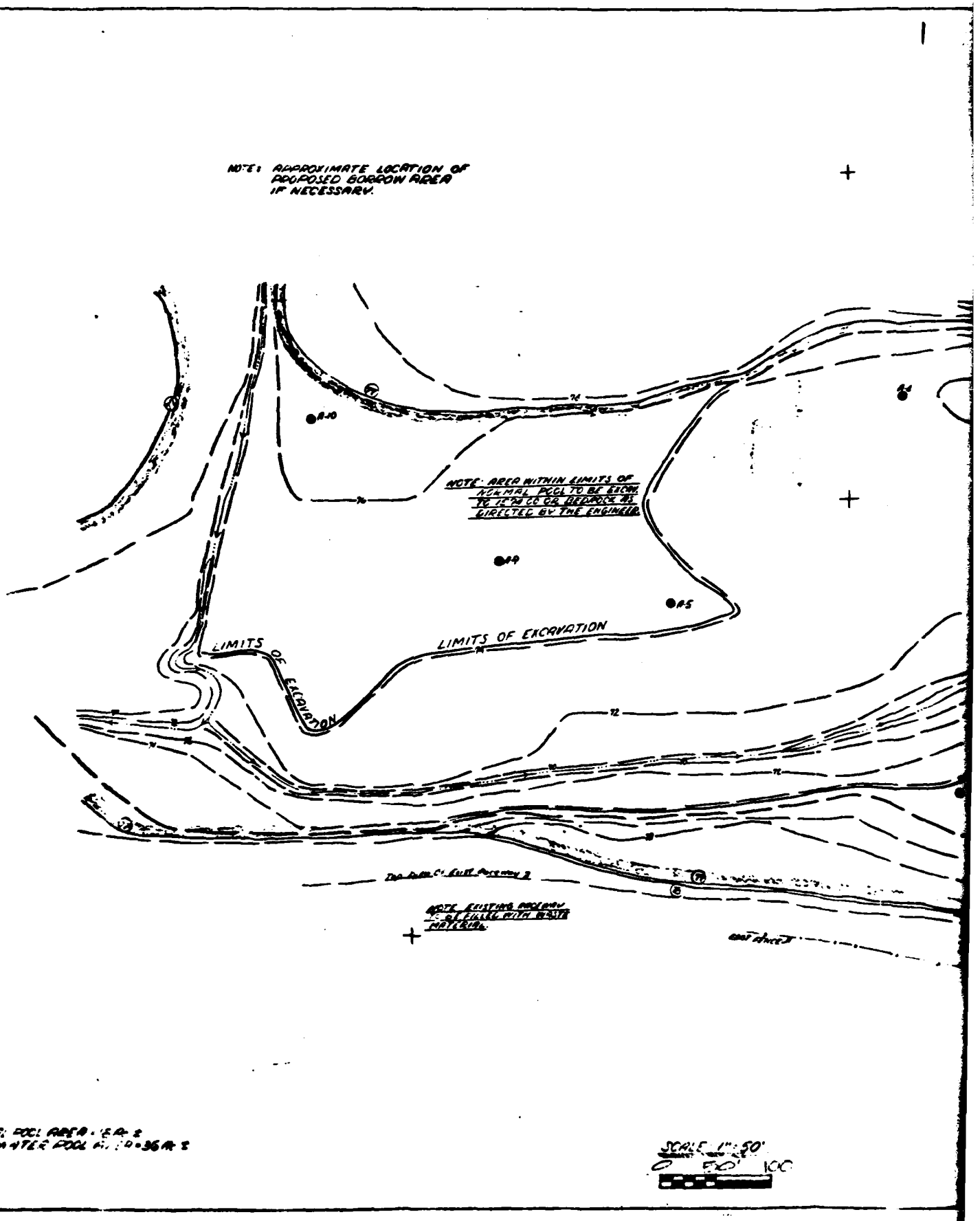
7.3.2 The presence of trees on the embankment can result in the development of deep rooted vegetation and this type growth can encourage piping within the embankment. It is recommended that the trees presently growing on the embankment be cut to the ground and be continuously controlled during normal maintenance procedures.

7.3.3 A staff gage should be installed.

APPENDIX I

MAPS AND DRAWINGS


Christian
(BM 1793)
Mt Zion Ch
Cem
DRAINAGE AREA
Swoope
BM 1626
SMITHLEIGH DAM
Middle River
Trimbles Mill
Camp Shenandoah
STAUNTON
SCALE 1"= 2000'
PLATE NO. 1
CHURCHVILLE, VA.
N3807.5—W7907.5/7.5


NOTE: APPROXIMATE LOCATION OF PROPOSED BORROW AREA IF NECESSARY.
B-10
NOTE: AREA WITHIN LIMITS OF NORMAL POOL TO BE ELEV. 70 TO 72 IN CO CR. BEDROCK AS DIRECTED BY THE ENGINEER.
B-9
B-5
LIMITS OF EXCAVATION
LIMITS OF EXCAVATION
NOTE: EXISTING ROADWAY TO BE FILLED WITH WASTE MATERIAL
SCALE 1" = 50'
0 50' 100

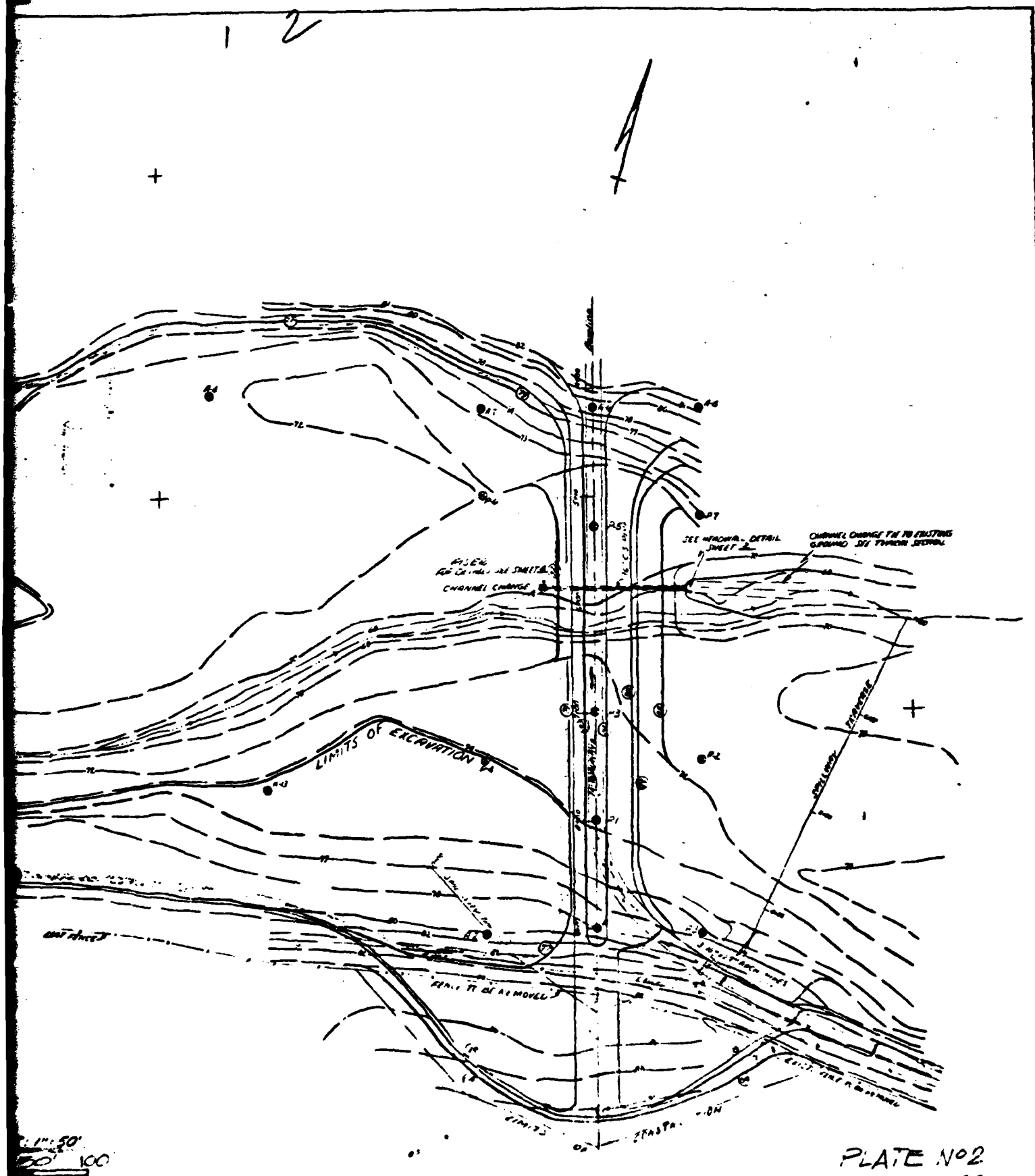
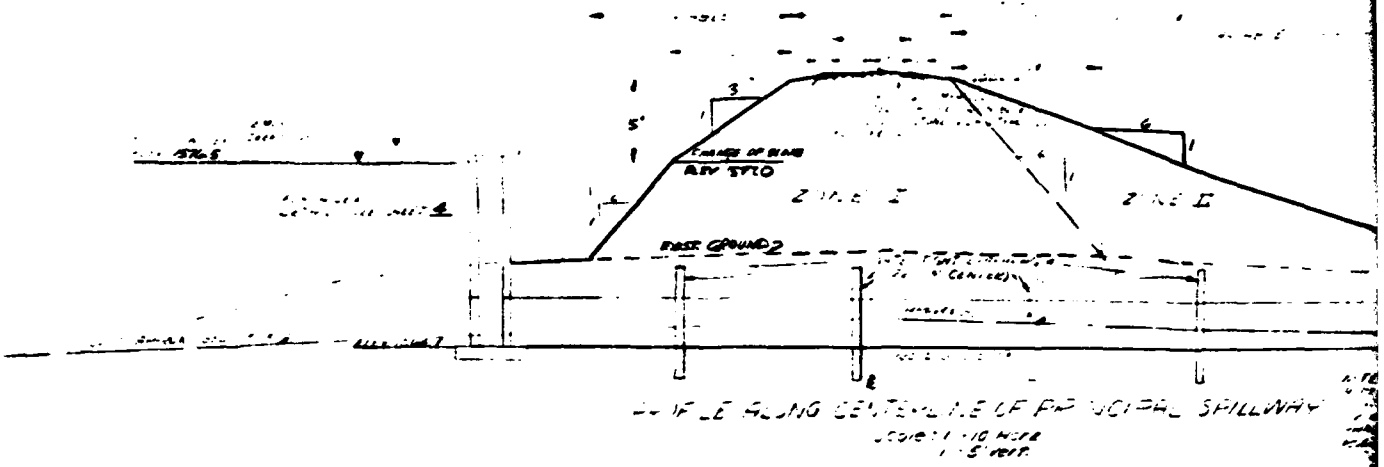
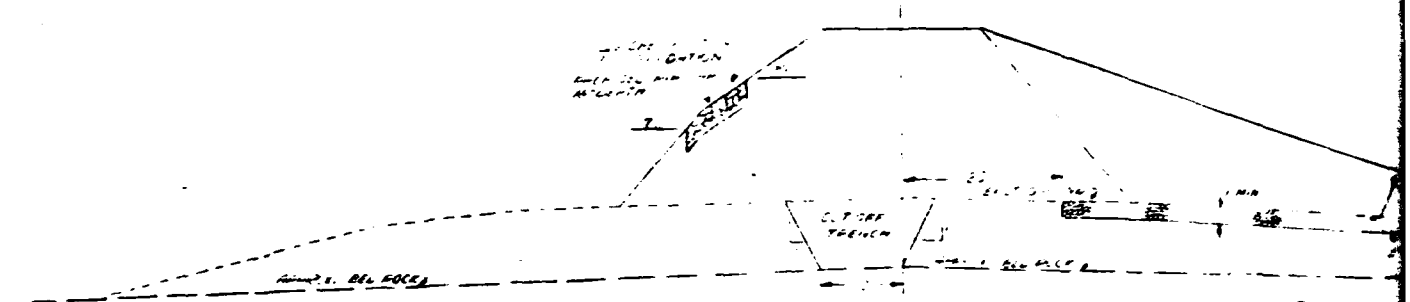


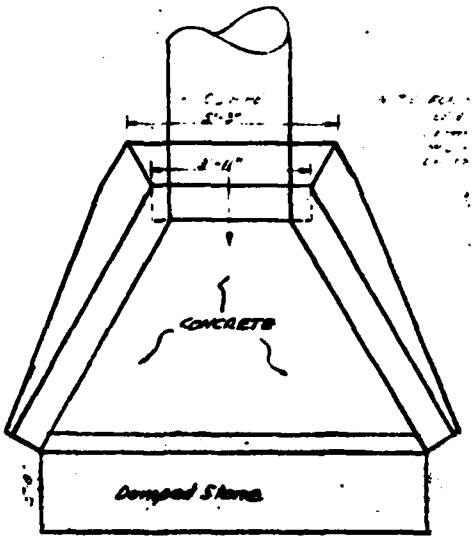
PLATE NO 2
SHEET 1 of 1

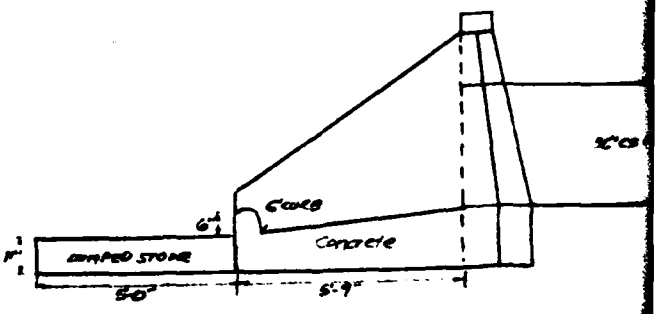


PROFILE ALONG CENTERLINE OF EMERGENCY SPILLWAY



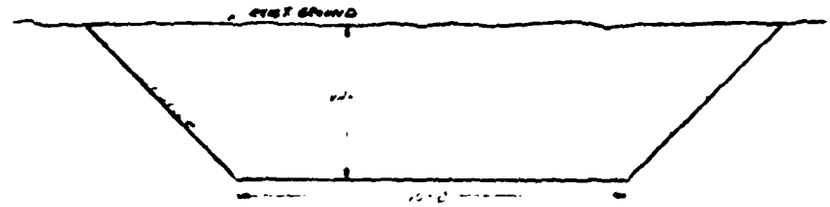
TYPICAL SECTION OF CUT OFF TRENCH & GRAVEL FILTER



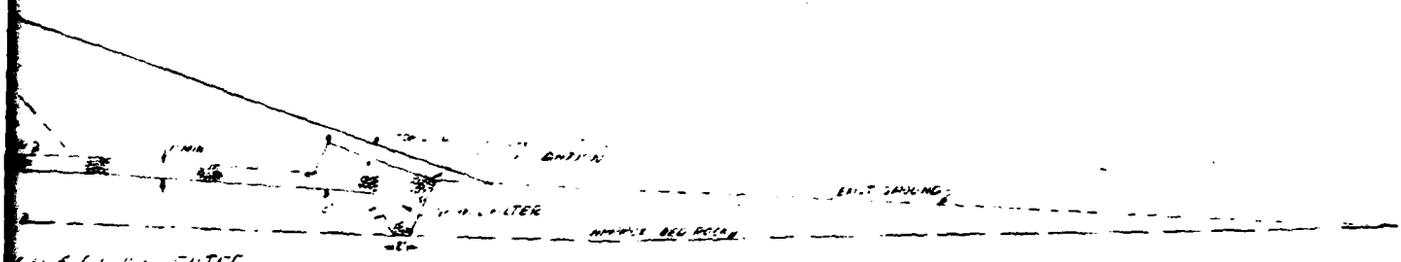


DETAIL OF EM-2 MODIFIED FOR SPILLWAY

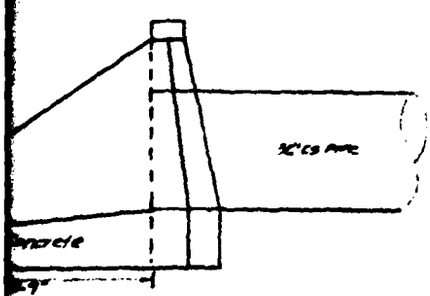
Scale 1"=2'0"



TYPICAL SECTION CHANNEL CHANGE



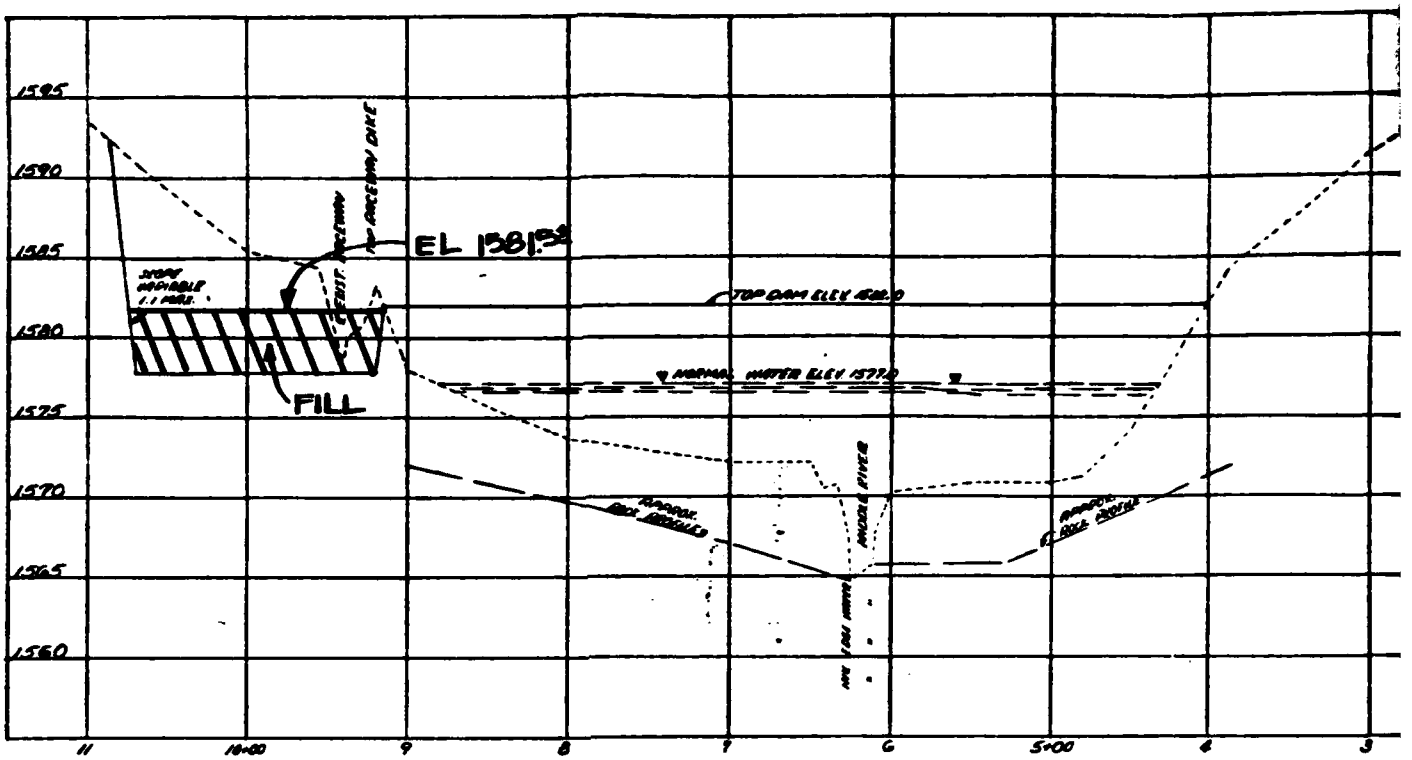
CHANNEL FILTER



SPILLWAY

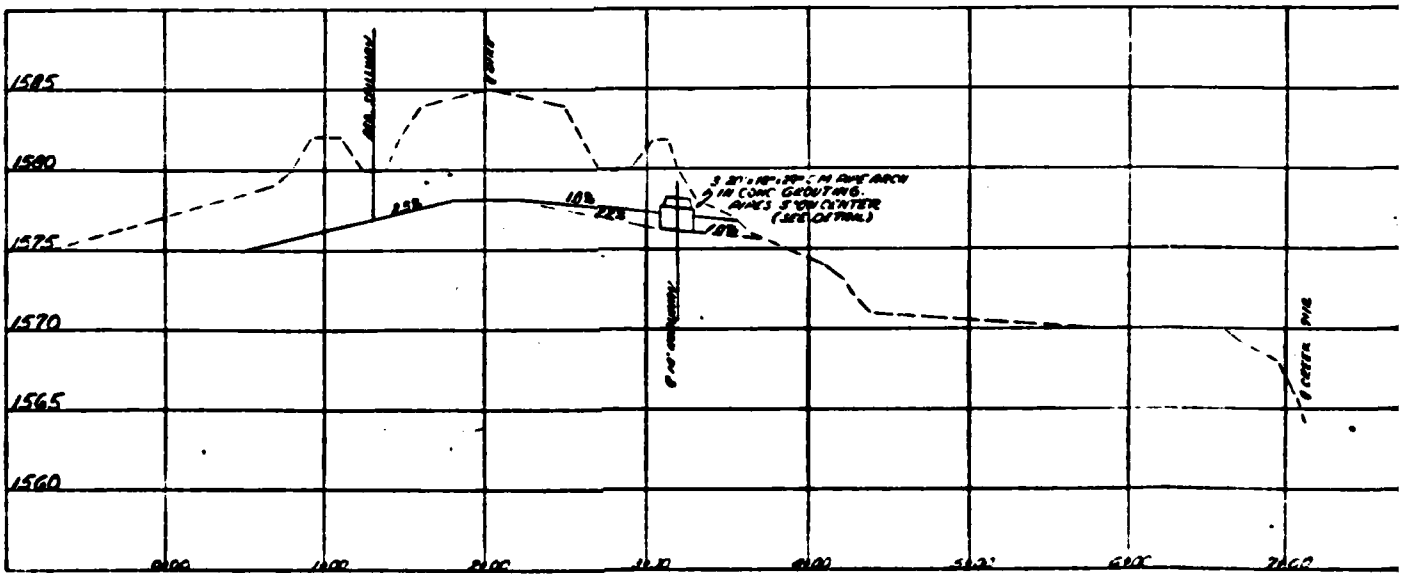
PLATE No 3

SHEET 2 of 4



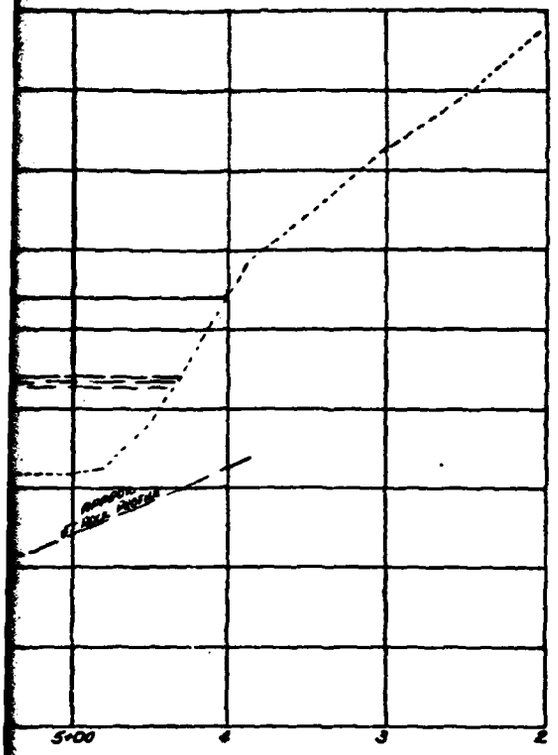
PROFILE OF BASELINE PROPOSED DAM SITE

SCALE: 1"=5' VERT.
1"=50' HORZ.

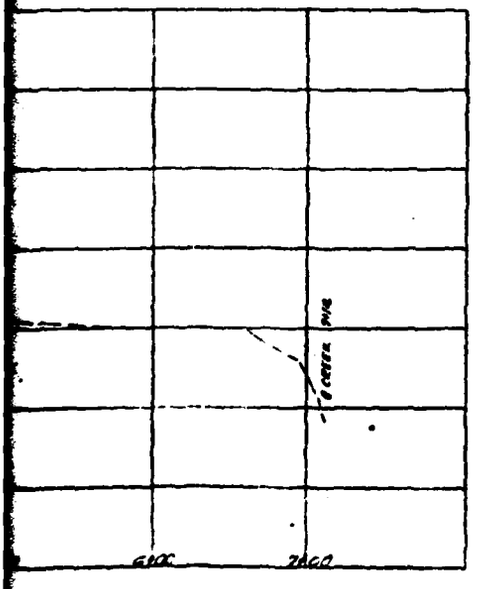


PROFILE OF PROPOSED EMERGENCY SPILLWAY

SCALE: 1"=5' VERT.
1"=50' HORZ.



DAM SITE



SPILLWAY

DETAIL OF 18"x29" C M ARCH PIPE
CONC. ENCASED
SCALE: 1"=3'-0"

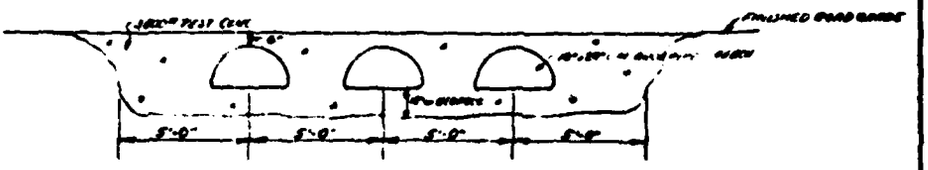
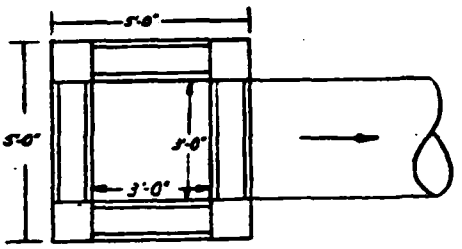
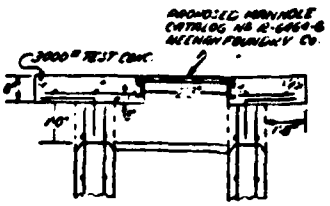


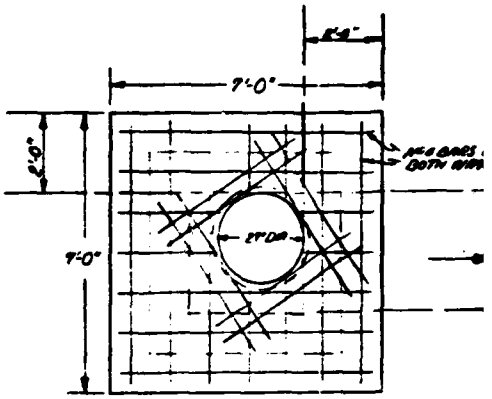
PLATE N°4
SHEET 1 of 1



TOP VIEW
"AA"

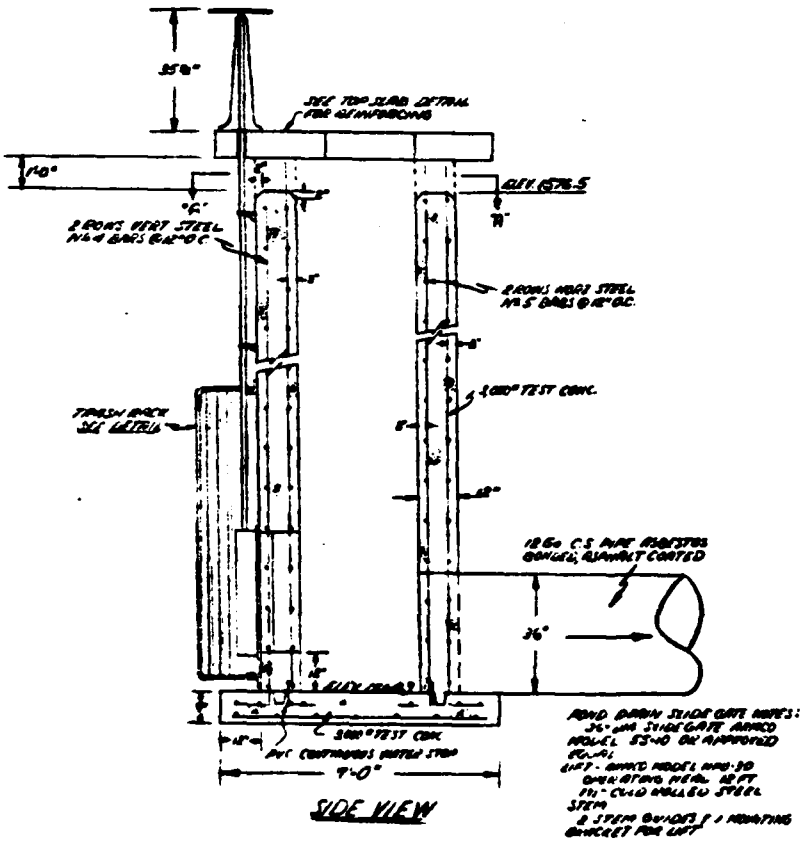


SIDE VIEW



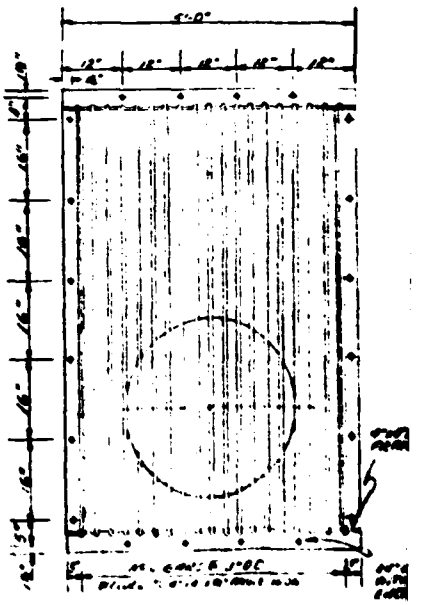
TOP VIEW

SLAB DETAILS
Scale: 1/4"=1'-0"



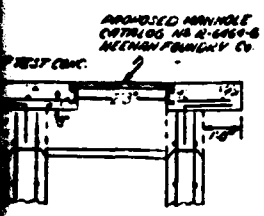
SIDE VIEW

RISER DETAILS
Scale: 1/2"=1'-0"

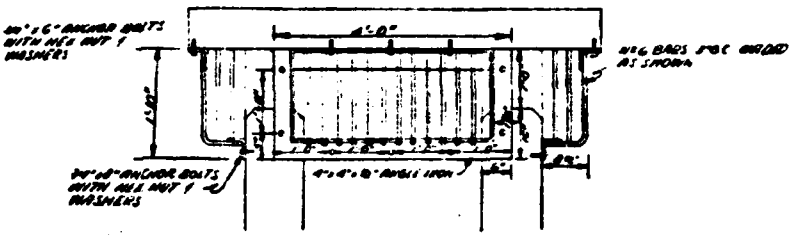


FRONT VIEW

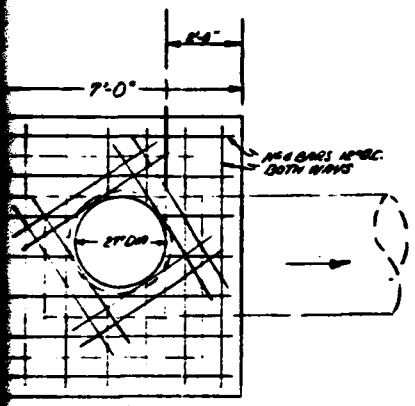
TRASH



SIDE VIEW

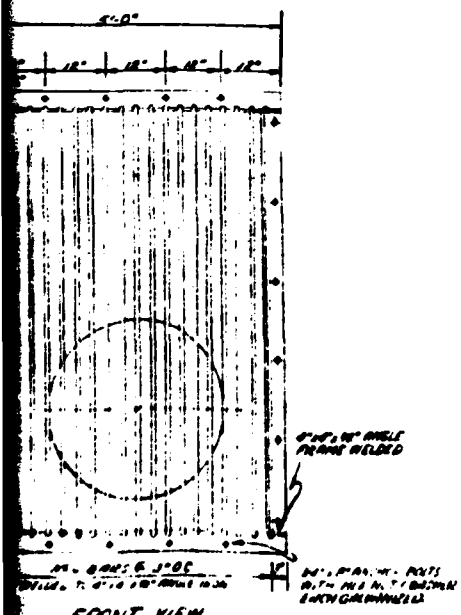


TRASH RACK ON RISER
Scale: 1/4"=1'-0"

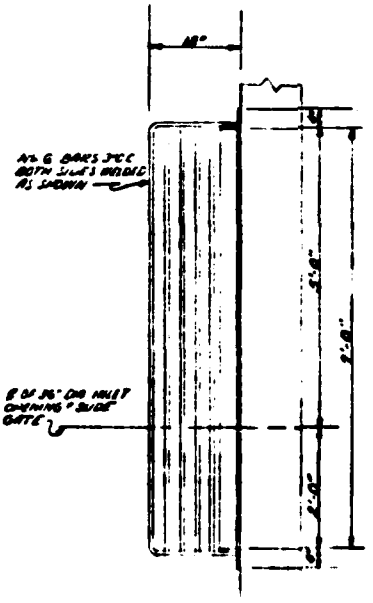


TOP VIEW

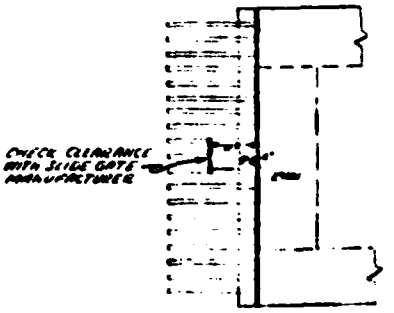
SLAB DETAILS
Scale: 1/2"=1'-0"



FRONT VIEW



SIDE VIEW

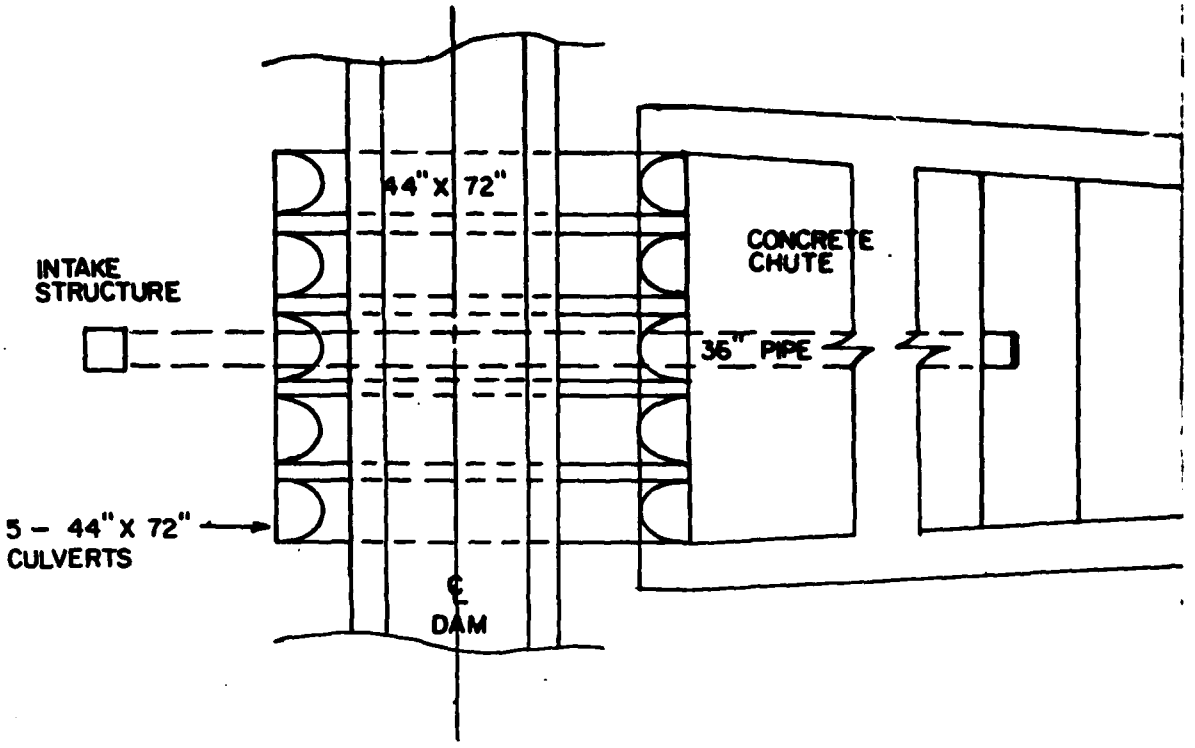


TOP VIEW

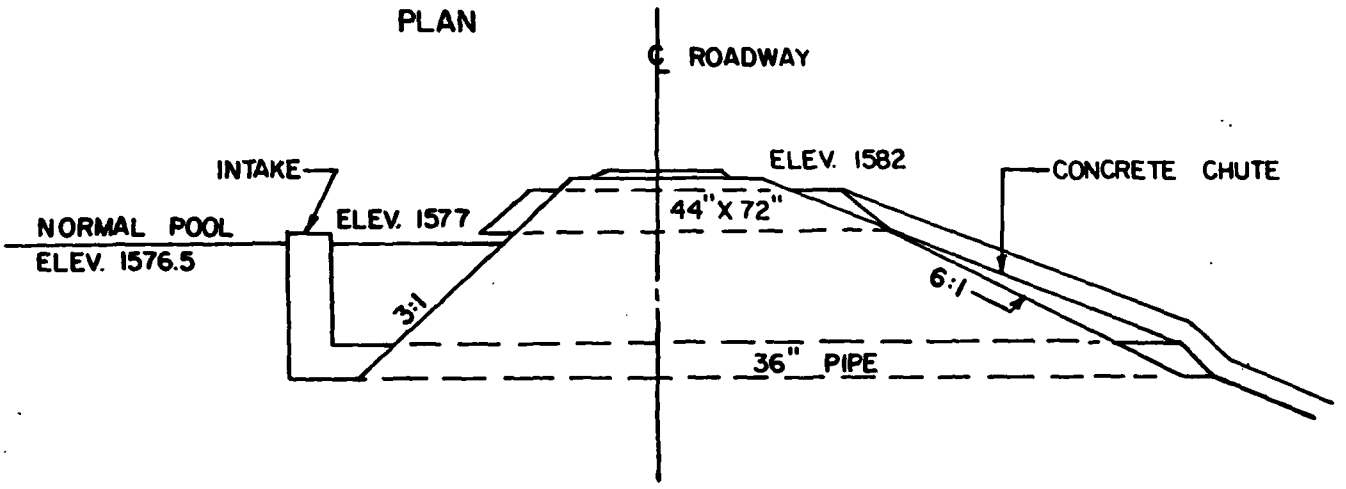
TRASH RACK POND DRAIN Scale: 1/4"=1'-0"

PLATE NO 5

SHEET 1 OF 1



PLAN



PROFILE

FIELD SKETCH
EMERGENCY SPILLWAY
SMITHLEIGH DAM

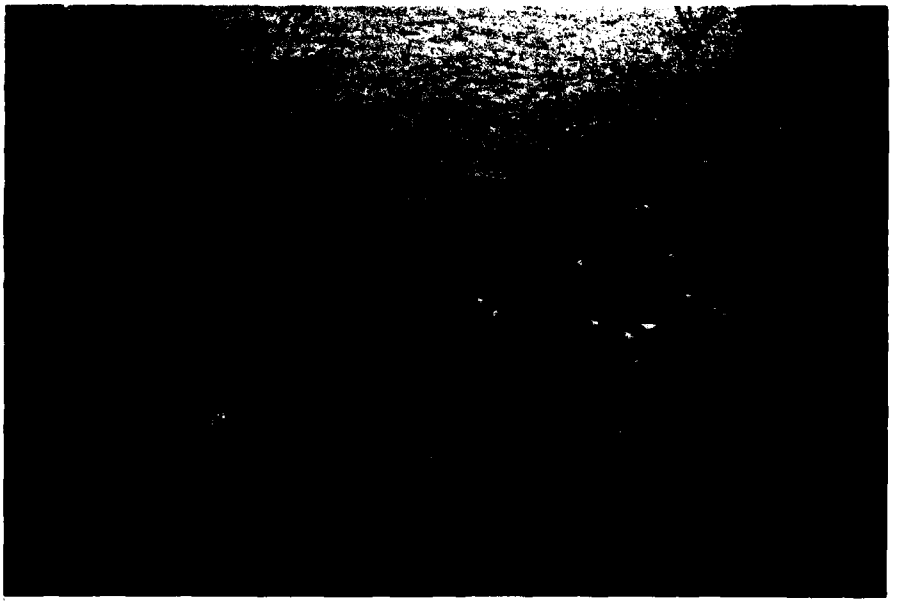
PLATE NO. 6

APPENDIX II

PHOTOGRAPHS

Intake Structure (Submerged by High Water)

Photograph No. 1



Emergency Spillway

Photograph No. 2

Outlet Channel

Photograph No. 3

Downstream Channel

Photograph No. 4

Downstream Face of Dam and Roadway
Across Top of Dam

Photograph No. 5

Abandoned (original) Emergency Spillway
Located at Right Abutment

Photograph No. 6

APPENDIX III

FIELD OBSERVATIONS

Check List
Visual Inspection
Phase I

Name Dam R. R. Smith County Augusta State Virginia Coordinators Lat. 38°-09.1' Long. 79°-12.8'

Date(s) Inspection 4/15/80 Weather Cloudy, Windy Temperature 40° F

Pool Elevation at Time of Inspection 1578 msl Tailwater at Time of Inspection 1566± msl

Inspection Personnel:

Schnabel Engineering Associates, P.C.
Raymond A. DeStephen, P.E.
Stephen G. Werner (recorder)

J. K. Timmons and Associates, Inc.
Robert G. Roop, P.E.
Donald Balzer (recorder)

Mr. Carl Cox, Farm Manager

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	The slopes, crest, emergency spillway, and abutment contacts were inspected and no cracks were noted. The downstream slope was grassed and well maintained. Numerous small trees (approximately 6 ft± high and 1 to 3" diameter) occur along the upstream slope, which is blanketed with riprap.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None observed. The embankment and abutment slopes are grassed and are well maintained.	
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	Appeared to be good.	
RIPRAP FAILURES	None observed. Limestone blocks ranging from 3 to 12 inches extend to a height of 2 ft± above the existing pool level. The riprap is present along the upstream slope and extends up the reservoir approximately 175 ft along both sides.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Good, no erosion was observed except along the edges of the concrete spillway. The embankment and abutments are well grassed. The existing riprap provides excellent protection for the upstream slope and lower reservoir slopes. The stream channel includes sandy to clayey materials with some gravel (alluvial). The dam and surrounding hillsides consist of silty clays and clayey silts with rock fragments. No bedrock was encountered. Erosion is described on the accompanying field sketch. No faults were observed and none are indicated on existing geologic maps.	
ANY NOTICEABLE SEEPAGE	Ponded water was observed in two areas: (1) along the downstream toe, several 100 ft left of the concrete discharge channel and (2) in an area 60 ft x 25 ft± about 75 ft below and to the left of the left edge of the concrete channel. No iron staining was observed and both areas are believed to represent ponded runoff from rainfalls of the proceeding day. Just right of area (2) water was flowing through a small opening in the concrete channel at a rate of 5 to 10 gpm±. This water is believed to represent water which was flowing beneath and along the side of the spillway. Water also flowing from beneath the concrete channel at rate of 25 to 30 gpm±. See accompanying field sketch.	
STAFF GAGE AND RECORDER	None observed	
DRAINS	None observed; however, Mr. Cox recalls seeing several when there was no flow in the spillway.	

EMERGENCY SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
OUTLET	Earth spillway at right abutment was modified by raising the crest to within 0.5 ft of top of dam. Five 72" x 44" CMP arches located at center of dam adjacent to the intake structure. Invert elevation approximately 1.5 ft above intake elevation.	Good condition, no erosion Depth of flow was one ft± in the CMP arches.
APPROACH CHANNEL	None	-
DISCHARGE CHANNEL	Conrete chute tying into the principal spillway channel. Concrete is good condition. Channel flowing approximately 6" deep.	-
BRIDGE AND PIERS	None	-

Note: Comments from Mr. Cox indicated that the 72" x 44" CMP arches were installed recently and the original emergency spillway crest raised because of severe erosion occurring in the emergency spillway due to the magnitude and frequency of use. The emergency spillway as designed was used several times a year.

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Outlet conduit was submerged by emergency spillway overflow and could not be observed.	-
INTAKE STRUCTURE	Partially submerged, but appeared to be in good condition. Value was reported to be operational.	-
OUTLET STRUCTURE	Submerged, not visible	No apparent problems
OUTLET CHANNEL	Ten ft long and 1 to 2 ft wide erosion gully located behind the right end of the concrete channel, extending 25 ft back along the side. This erosion occurred during the storm of April, 1977 according to Mr. Cox. See field sketch.	Repair erosion and line with riprap
EMERGENCY GATE	Reported to be operable and appeared to be in good condition.	-

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Gentle to moderate grassed slopes (4H:1V±) surround the reservoir. No debris was observed in the reservoir.	Good condition
SEDIMENTATION	Some sediment in the upper reaches of the lake according to Mr. Cox	Not serious

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Erosion in stream channel to a point 100 ft± downstream on right and 50 ft± downstream on left side from the concrete spillway. Erosion consists basically of 3 ft high vertically eroded slopes.	Provide riprap lining of stream banks for 100 ft downstream of outlet channel termination.
SLOPES	Gentle (4:1), grassed slopes (pasture) occur above the stream bank. The stream is 20 ft± wide, with vertical slopes 2 ft high.	Good condition
APPROXIMATE NO. OF HOMES AND POPULATION	One house is located ¼ mile± downstream. Water level was up to the yard of this house in April 1977. The house is 15 ft± above the streambed.	Dam failure presents a hazard to this house.
Note:	The dam was overtopped by 3 to 6 inches for a period of one hour in April 1977.	

INSTRUMENTATION

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

J. K. TIMMONS & ASSOCIATES, INC.
ENGINEERS • SURVEYORS • PLANNERS
711 NORTH COURTHOUSE ROAD • RICHMOND, VIRGINIA 23235 • (804) 794-3500

J. K. TIMMONS, President
J. H. HENSON, Vice-President
J. E. ADAMS, Secy.-Treasurer

July 22, 1980

MEMORANDUM FOR RECORD:

FROM: R. G. Roop, J. K. Timmons & Associates, Inc.

SUBJECT: Smithleigh Dam, Phase I Inspection Report
Augusta County, VA

DATE: July 22, 1980

A meeting was held this date at the Smithleigh Dam site to discuss the preliminary Phase I Inspection Report for the dam. The following persons were present at the meeting:

1. R. G. Roop - J. K. Timmons & Associates (Corps Representative)
2. Robert V. Gay - State Water Control Board (SWCB)
3. Hugh Gildea - SWCB
4. R. R. Smith - Owner
5. Marshall Craig - Betz , Converse, Murdoch, Inc. (Owner's Engineer)
6. R. C. Newman - " " " " "
7. Bob Noland - " " " " "

A discussion was held in which the dam assessment and remedial measures as recommended in the preliminary report were explained to the owner and his engineer. Discussion included the predicted overtopping of the dam during the spillway design flood (SDF), and the resulting increase in hazard to the downstream dwelling.

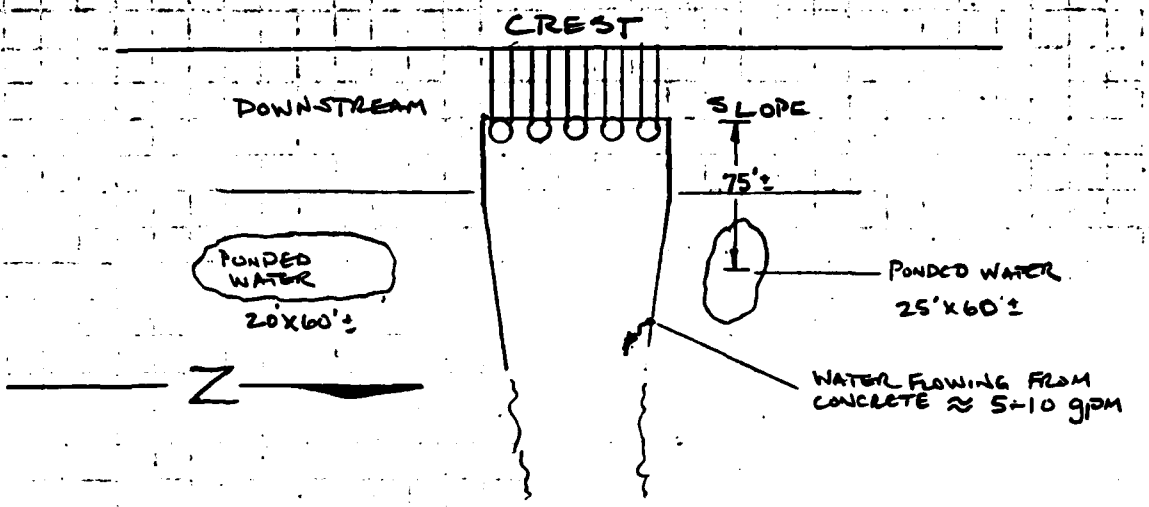
After much discussion concerning this matter, it was determined that the owner could effectively reduce the downstream hazard because the dwelling of concern is the property of the owner, and the occupants are in his employ. The owner indicated that he would reduce the downstream hazard by providing an early warning system. The SWCB representatives indicated that they would provide a guideline to the owner for the early warning system, and review his submittal.

BY SW DATE 4/15/80 **SCHNABEL ENGINEERING ASSOCIATES** SHEET NO. 1 OF 1

CHKD. BY ..... DATE ..... **CONSULTING ENGINEERS** JOB NO. V80101

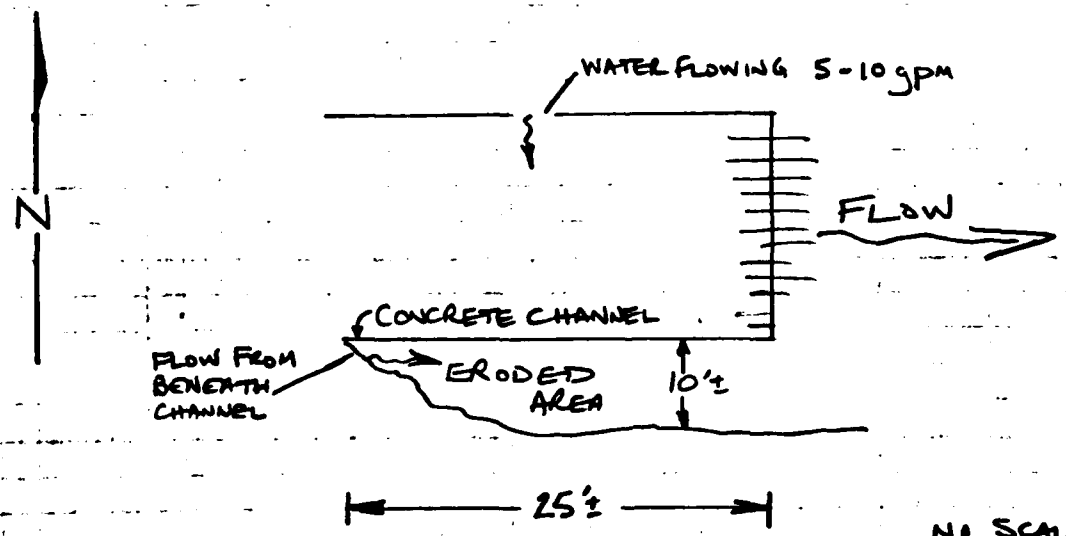
SUBJECT FIELD SKETCHES – SMITHLEIGH DAM

PONDED AREAS ALONG DOWNSTREAM SLOPE



NO SCALE

EROSION, CONCRETE DISCHARGE CHANNEL



NO SCALE

APPENDIX IV

TEST BORING LOGS

TEST BORING RECORD
E.O. GOOCH AND ASSOCIATES
CHARLOTTESVILLE, VIRGINIA

HOLE NO A-1 SURFACE ELEV. _____ FOR R.L. SMITH DAM

DATE _____ DEPTH _____ LOCATION SWOOPE VA

GROUND WATER DRY STARTED 7-1-62 COMPLETED 7-1-62

SAMPLER HAMMER WT. 140 LB DROP 30 INCHES SAMPLER SIZE 2" IN O.D.

LEVATION	DEPTH	CASING HAMMER BLOWS	LOG	REMARKS	SAMPLE DEPTH	BLOWS ON SAMPLER
	0					
	6		YELLOW CLAY			
			ROCK			

TEST BORING RECORD
E O GOOCH AND ASSOCIATES
CHARLOTTESVILLE, VIRGINIA

OLE NO A-2 SURFACE ELEV. _____ FOR R R SMITH DAM
ATE _____ DEPTH _____ LOCATION SWOOPE VA
ROUND WATER DRY STARTED 7-1-67 COMPLETED 7-1-67
AMPLER HAMMER WT. 140 LB. DROP 30 INCHES SAMPLER SIZE 2" IN O.D

EVATION	DEPTH	CASING HAMMER BLOWS	LOG	REMARKS	SAMPLE DEPTH	BLOWS ON SAMPLER
	0					
	2'		YELLOW CLAY	NO SAMPLE		
			ROCK			
			(LARGE LS OUT CROP 20' FROM HOLE)			

TEST BORING RECORD
E D. GOOCH AND ASSOCIATES
CHARLOTTESVILLE, VIRGINIA

HOLE NO. B-3 SURFACE ELEV. _____ FOR R. R. SMITH DAM
DATE _____ DEPTH _____ LOCATION SWOOPE VA.
GROUND WATER DRY STARTED 7-1-67 COMPLETED 7-1-67
SAMPLER HAMMER WT. 140 LB. DROP 30 INCHES SAMPLER SIZE 2" IN OD

ELEVATION	DEPTH	CASING HAMMER BLOWS	LOG	REMARKS	SAMPLE DEPTH	BLOWS ON SAMPLER
	0'					
	4'		YELLOW CLAY SILT	BAG SAMPLE		
			ROCK			

TEST BORING RECORD
E O GOOCH AND ASSOCIATES
CHARLOTTESVILLE, VIRGINIA

OLE NO A-4 SURFACE ELEV. _____ FOR R.R. SMITH DAM
ATE _____ DEPTH _____ LOCATION SWOOPE VA.
ROUND WATER 3.0 STARTED 7-1-67 COMPLETED 7-1-67
AMPLER HAMMER WT. 140 LB. DROP 30 INCHES SAMPLER SIZE 2" IN O.D.

EVATION	DEPTH	CASING HAMMER BLOWS	LOG	REMARKS	SAMPLE DEPTH	BLOWS ON SAMPLER
	0'					
	3'		DARK GREY SILTY CLAY	NO SAMPLE		
	5'		WET BLUE SANDY CLAY			
			ROCK			

TEST BORING RECORD
E O GOOCH AND ASSOCIATES
CHARLOTTESVILLE, VIRGINIA

ÖLE NO. A-5 SURFACE ELEV. _____ FOR P. R. SMITH DAM
ATE _____ DEPTH _____ LOCATION SWOOPE VA
ROUND WATER 5.0 STARTED 7-1-67 COMPLETED 7-1-67
AMPLER HAMMER WT. 140 LB DROP 30 INCHES SAMPLER SIZE 2" IN O.D.

EVATION	DEPTH	CASING HAMMER BLOWS	LOG	REMARKS	SAMPLE DEPTH	BLOWS ON SAMPLER
	0'					
	6'		BROWN SILTY CLAY			
	7'		WET BROWN SILTY CLAY			
			ROCK			

TEST. BORING RECORD
E O GOOCH AND ASSOCIATES
CHARLOTTESVILLE, VIRGINIA

HOLE NO. A-6 SURFACE ELEV. _____
DATE _____ DEPTH _____
GROUND WATER DRY
SAMPLER HAMMER WT. 140 LB DROP 30 INCHES

FOR R. R SMITH DAM
LOCATION SWOOPE VA.
STARTED 7-1-67 COMPLETED 7-1-67
SAMPLER SIZE 2" IN O.D.

ELEVATION	DEPTH	CASING HAMMER BLOWS	LOG	REMARKS	SAMPLE DEPTH	BLOWS ON SAMPLER
	0					
	8		YELLOW PLASTIC CLAY	BAG SAMPLE		
			ROCK			

TEST BORING RECORD
E O GOOCH AND ASSOCIATES
CHARLOTTESVILLE, VIRGINIA

OLE NO A-7 SURFACE ELEV. _____ FOR R. R. SMITH DAM
ATE _____ DEPTH _____ LOCATION SWOOPE, VA.
ROUND WATER DRY STARTED 7-1-67 COMPLETED 7-1-67
AMPLER HAMMER WT. 140 LB DROP 30 INCHES SAMPLER SIZE 2" IN O.D.

EVATION	DEPTH	CASING HAMMER BLOWS	LOG	REMARKS	SAMPLE DEPTH	BLOWS ON SAMPLER
	0					
	7		YELLOW PLASTIC CLAY	SAMPLE INCLUDED W/ A-8		
			Rock			

TEST BORING RECORD
E.O GOOCH AND ASSOCIATES
CHARLOTTESVILLE, VIRGINIA

HOLE NO A-8 SURFACE ELEV. _____ FOR C.R. SMITH DAM
DATE _____ DEPTH _____ LOCATION SWOOPE VA.
GROUND WATER DRY STARTED 7-1-67 COMPLETED 7-1-67
SAMPLER HAMMER WT. 140 LB DROP 30 INCHES SAMPLER SIZE 2" IN O.D.

ELEVATION	DEPTH	CASING HAMMER BLOWS	LOG	REMARKS	SAMPLE DEPTH	BLOWS ON SAMPLER
	0					
	8		YELLOW CLAY	BAG SAMPLE		
	13		WET YELLOW CLAY			
			ROCK			

TEST BORING RECORD
E O GOOCH AND ASSOCIATES
CHARLOTTESVILLE, VIRGINIA

HOLE NO A-9 SURFACE ELEV _____
DATE _____ DEPTH _____
GROUND WATER 2.5'
SAMPLER HAMMER WT 140 LB. DROP 30 INCHES

FOR R. R. SMITH DAM
LOCATION SWOOPE VA
STARTED 7-1-67 COMPLETED 7-1-67
SAMPLER SIZE 2" IN O.D.

ELEVATION	DEPTH	CASING HAMMER BLOWS	LOG	REMARKS	SAMPLE DEPTH	BLOWS ON SAMPLE
	0					
	5		DARK GREY SILTY CLAY			
			Rock			

TEST BORING RECORD
E O GOOCH AND ASSOCIATES
CHARLOTTESVILLE, VIRGINIA

HOLE NO. A-10 SURFACE ELEV. _____
DATE _____ DEPTH _____
GROUND WATER 4.0
SAMPLER HAMMER WT. 140 LB. DROP 30 INCHES

FOR R. R. SMITH DAM
LOCATION SWOOPE VA
STARTED 7-1-67 COMPLETED 7-1-67
SAMPLER SIZE 2" IN O.D

ELEVATION	DEPTH	CASING HAMMER BLOWS	LOG	REMARKS	SAMPLE DEPTH	BLOWS ON SAMPLE
	0'					
	3'		TAN CLAY			
	10'		BLUE SANDY CLAY (MUCK)	NO SAMPLE		

TEST BORING RECORD
E O GOOCH AND ASSOCIATES
CHARLOTTESVILLE, VIRGNIA

HOLE NO. A-11 SURFACE ELEV. _____ FOR R.R. SMITH DAM
DATE _____ DEPTH _____ LOCATION SWOOPE VA
GROUND WATER DRY STARTED 7-1-67 COMPLETED 7-1-67
SAMPLER HAMMER WT. 140 LB DROP 30 INCHES SAMPLER SIZE 2" IN O.D.

LEVATION	DEPTH	CASING HAMMER BLOWS	LOG	REMARKS	SAMPLE DEPTH	BLOWS ON SAMPLER
	0					
	14		YELLOW TAN SANDY CLAY	BAG SAMPLE		
			Rock			

TEST BORING RECORD
E O GOOCH AND ASSOCIATES
CHARLOTTESVILLE, VIRGINIA

HOLE NO. A-12 SURFACE ELEV. _____ FOR P. R. SMITH DAM
DATE _____ DEPTH _____ LOCATION SWOOPE VA
GROUND WATER DRY STARTED 7-1-67 COMPLETED 7-1-67
SAMPLER HAMMER WT. 140 LB. DROP 30 INCHES SAMPLER SIZE 2" IN O.D

LEVATION	DEPTH	CASING HAMMER BLOWS	LOG	REMARKS	SAMPLE DEPTH	BLOWS ON SAMPLE
	0					
	3		YELLOW CLAY			
			ROCK			

TEST BORING RECORD
E. O. GOOCH AND ASSOCIATES
CHARLOTTESVILLE, VIRGINIA

HOLE NO A-13 SURFACE ELEV. _____ FOR R. R. SMITH DAM
DATE _____ DEPTH _____ LOCATION SWOOPE VA
GROUND WATER 4.0 STARTED 7-1-62 COMPLETED 7-1-67
SAMPLER HAMMER WT. 140 LB. DROP 30 INCHES SAMPLER SIZE 2" IN O.D.

LEVATION	DEPTH	CASING HAMMER BLOWS	LOG	REMARKS	SAMPLE DEPTH	BLOWS ON SAMPLER
	0					
	5'		YELLOW CLAY SILT	NO SAMPLE		
			ROCK			

TEST BORING RECORD
E.D. GOOCH AND ASSOCIATES
CHARLOTTESVILLE, VIRGINIA

HOLE NO. P-1 SURFACE ELEV. _____ FOR R. R. SMITH DAM
DATE _____ DEPTH _____ LOCATION S. WOOFE VA.
GROUND WATER 4.0 STARTED 1-1-62 COMPLETED 2-1-62
SAMPLER HAMMER WT. 140 LB. DROP 30 INCHES SAMPLER SIZE 2" IN O.D.

ELEVATION	DEPTH	CASING HAMMER BLOWS	LOG	REMARKS	SAMPLE DEPTH	BLOWS ON SAMPLER
	0					
	4'		BROWN PLASTIC CLAY			
			ROCK			

TEST BORING RECORD
E O GOOCH AND ASSOCIATES
CHARLOTTESVILLE, VIRGINIA

HOLE NO P-2 SURFACE ELEV. _____ FOR R. R. SMITH DAM

DATE _____ DEPTH _____ LOCATION SWOOPE, VA

GROUND WATER 3.5 STARTED 7-1-67 COMPLETED 7-1-67

SAMPLER HAMMER WT. 140 LB. DROP 30 INCHES SAMPLER SIZE 2" IN O.D.

LEVATION	DEPTH	CASING HAMMER BLOWS	LOG	REMARKS	SAMPLE DEPTH	BLOWS ON SAMPLE
	0					
	4'		BROWN PLASTIC CLAY	NO SAMPLE	2 3	7
			ROCK			

TEST BORING RECORD
E O GOOCH AND ASSOCIATES
CHARLOTTESVILLE, VIRGINIA

OLE NO P-3 SURFACE ELEV. _____ FOR R. R. SMITH DAM
ATE _____ DEPTH _____ LOCATION SWOOPE VA.
ROUND WATER 2.0 STARTED 7-1-67 COMPLETED 7-1-67
AMPLER HAMMER WT. 140 LB. DROP 30 INCHES SAMPLER SIZE 2" IN O.D.

EVATION	DEPTH	CASING HAMMER BLOWS	LOG	REMARKS	SAMPLE DEPTH	BLOWS ON SAMPLER
	0					
	5		BROWN PLASTIC CLAY	NO SAMPLE	2-3	8
			Rock			

TEST BORING RECORD
E O GOOCH AND ASSOCIATES
CHARLOTTESVILLE, VIRGINIA

HOLE NO. P-4 SURFACE ELEV. _____ FOR R. R. SMITH DAM
DATE _____ DEPTH _____ LOCATION SWOOPE VA
GROUND WATER 4.0 STARTED 7-1-67 COMPLETED 7-1-67
SAMPLER HAMMER WT. 140 LB DROP 30 INCHES SAMPLER SIZE 2" IN O.D

ELEVATION	DEPTH	CASING HAMMER BLOWS	LOG	REMARKS	SAMPLE DEPTH	BLOWS ON SAMPLER
	0					
	4		GREY SILTY CLAY	No Sample	2 3	6
			Rock			

TEST BORING RECORD
E O GOOCH AND ASSOCIATES
CHARLOTTESVILLE, VIRGINIA

HOLE NO P-5 SURFACE ELEV. _____ FOR R. R. SMITH DAM
DATE _____ DEPTH _____ LOCATION SWOOPE VA
GROUND WATER 3.0 STARTED 7-1-67 COMPLETED 7-1-67
SAMPLER HAMMER WT. 140 LB DROP 30 INCHES SAMPLER SIZE 2" IN O.D.

LEVATION	DEPTH	CASING HAMMER BLOWS	LOG	REMARKS	SAMPLE DEPTH	BLOW ON SAMPLE
	0					
	4		DARK GREY SILTY CLAY	100% REC.	2 3	7
	5		SATURATED BLUE SANDY CLAY			
			ROCK			

TEST BORING RECORD
E O GOOCH AND ASSOCIATES
CHARLOTTESVILLE, VIRGINIA

OLE NO P-6 SURFACE ELEV. _____
ATE _____ DEPTH _____
ROUND WATER 4.0
AMPLER HAMMER WT. 140 LB DROP 30 INCHES

FOR R. L. SMITH DAM
LOCATION SWOOPE, VA.
STARTED 7-1-67 COMPLETED 7-1-67
SAMPLER SIZE 2" IN O.D.

:VATION	DEPTH	CASING HAMMER BLOWS	LOG	REMARKS	SAMPLE DEPTH	BLOWS ON SAMPLER
	0					
	5		DARK GREY PLASTIC CLAY	100% REC.	2 3	7
				100% REC	5 6	5
	10		WET BLUE PLASTIC SANDY CLAY			
			ROCK			

TEST BORING RECORD
E O GOOCH AND ASSOCIATES
CHARLOTTESVILLE, VIRGINIA

OLE NO B-6 SURFACE ELEV. _____ FOR R. R. SMITH DAM
ATE _____ DEPTH _____ LOCATION SWOOPE VA.
ROUND WATER 4.0 STARTED 7-1-67 COMPLETED 7-1-67
AMPLER HAMMER WT. 140 LB DROP 30 INCHES SAMPLER SIZE 2" IN O.D.

:VATION	DEPTH	CASING HAMMER BLOWS	LOG	REMARKS	SAMPLE DEPTH	BLOWS ON SAMPLER
	0					
	5		DARK GREY PLASTIC CLAY	100% REC.	2 3	7
	10		WET BLUE PLASTIC SANDY CLAY	100% REC.	5 6	5
			ROCK			

TEST BORING RECORD
E O GOOCH AND ASSOCIATES
CHARLOTTESVILLE, VIRGINIA

HOLE NO P1 SURFACE ELEV. _____ FOR R.R. SMITH DAM
DATE _____ DEPTH _____ LOCATION SWOOPE, VA.
GROUND WATER 3.0 STARTED 7-1-67 COMPLETED 7-1-67
SAMPLER HAMMER WT. 140 LB DROP 30 INCHES SAMPLER SIZE 2" IN O.D.

ELEVATION	DEPTH	CASING HAMMER BLOWS	LOG	REMARKS	SAMPLE DEPTH	BLOWS ON SAMPLER
	0					
	4		DARK GREY SILTY CLAY	SAMPLE PULLED OUT	2 3	6
	5		WET BLUE SANDY CLAY			
			ROCK			

APPENDIX V - REFERENCES

1. Recommended Guidelines for Safety Inspection of Dams, Department of Army, Office of the Chief of Engineers, 46 pp.
2. Design of Small Dams, U. S. Department of Interior, Bureau of Reclamation, 1974, 816 pp.
3. Geology of the Staunton, Churchville, Greenville, and Stuarts Draft Quadrangles, Virginia, Report of Investigations 12, Eugene K. Rader, Virginia Division of Mineral Resources, 1967, 43 pp.
4. Section 4, Hydrology, Part 1 Watershed Planning, SCS National Engineering Handbook, Soil Conservation Service, U. S. Department of Agriculture, 1964
5. Hydrometerological Report No. 33, U. S. Department of Commerce, Weather Bureau, U. S. Department of Army, Corps of Engineers, Washington, D. C., April 1956.
6. Technical Paper No. 40, U. S. Department of Commerce, Weather Bureau, Washington, D. C., May 1961