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NATIONAL DAM SAFETY PROGRAM. BUFFALO RIVER NUMBER 2 JAMES RIVER--ETC(U)
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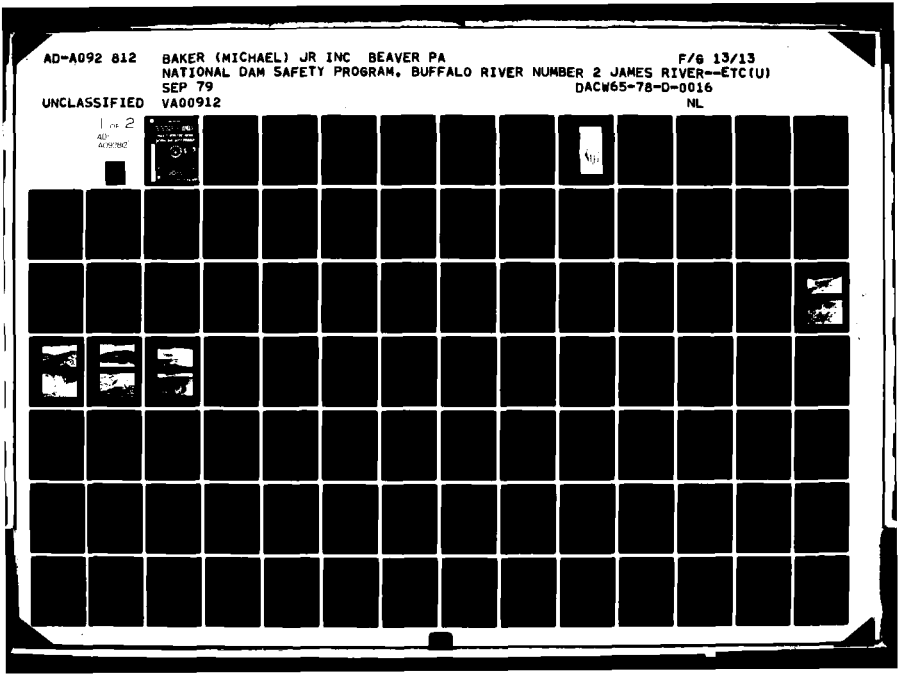

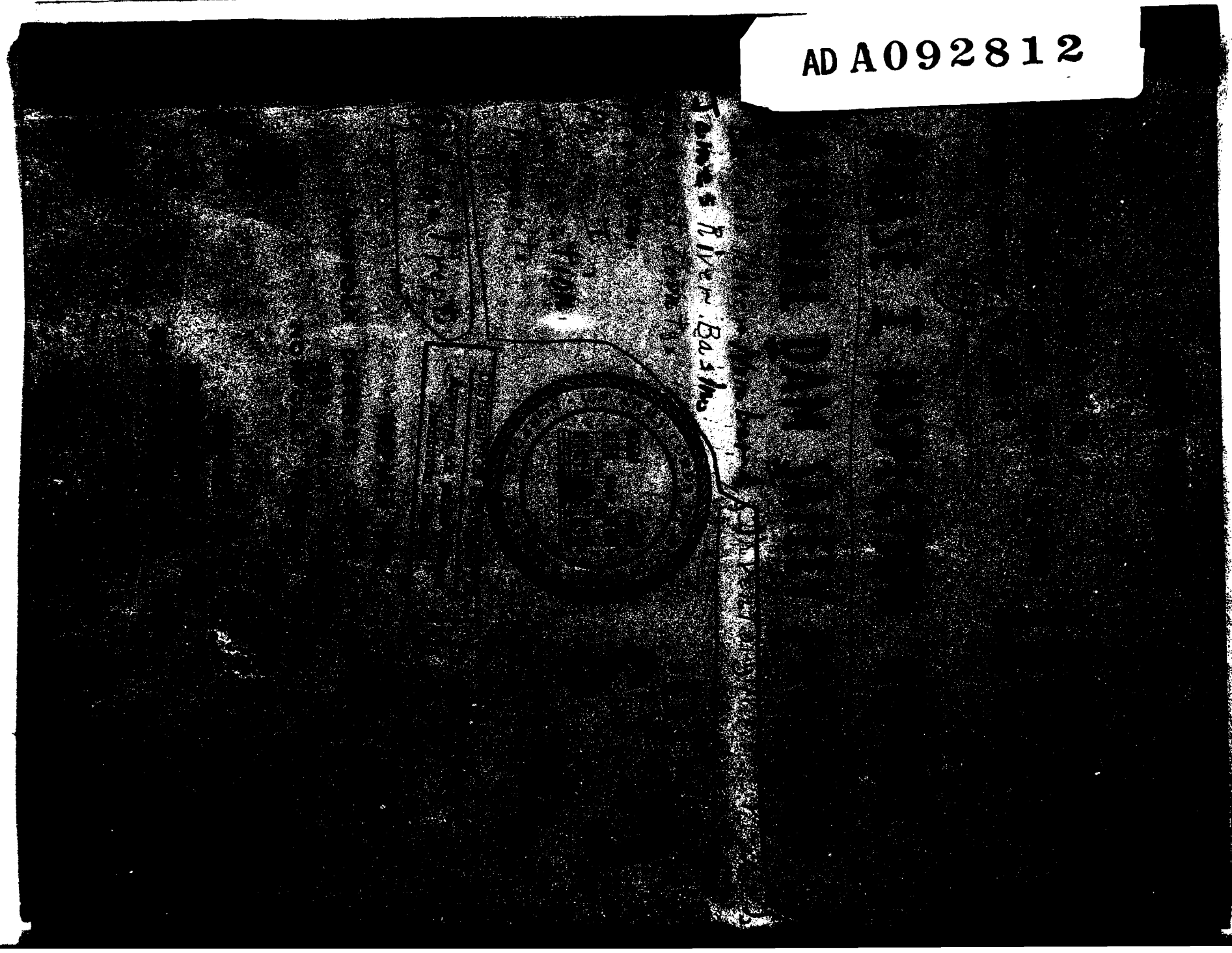

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20. Abstract

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.

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 the 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 continued care and inspection can there be any chance that unsafe conditions be detected.

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

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

CONTENTS

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Buffalo River No. 2
State: Virginia
County: Amherst
U.S.G.S. 7.5 Minute Quandrangle: Forks of Buffalo, VA
Stream: Thrashers Creek
Date of Inspection: 24 May 1979

BRIEF ASSESSMENT OF DAM

Buffalo River No. 2 Dam is a zoned, earthfill dam approximately 800 feet long and 71 feet high. The dam, located on Thrashers Creek approximately 7.5 miles northwest of Amherst, Virginia, is used for flood control. Buffalo River No. 2 Dam is an "intermediate" size - "high" hazard structure as defined by the Recommended Guidelines for Safety Inspection of Dams. Visual inspection and office analyses indicate no deficiencies requiring emergency attention.

Using the Corps of Engineers' screening criteria for initial review of spillway adequacy, the Probable Maximum Flood (PMF) was selected as the spillway design flood (SDF). The Soil Conservation Service (SCS) freeboard hydrograph (which establishes top of dam) is essentially equal to the PMF hydrograph. The spillways will essentially pass the PMF without overtopping the dam, and are therefore considered adequate.

The dam and appurtenant structures were found to be in generally good overall condition. No conditions indicating embankment instability were detected during the field inspection and office analyses. The safety factors determined during design are greater than those required for minimum accepted stability.

It is recommended that the following remedial measures be accomplished as part of the annual maintenance program: remove sloughing soil near left upstream abutment and replace with compacted earth, grade and seed eroded bare areas and erosion gullies on the embankment, seed and fertilize areas with dead grass, remove debris from shoreline and gutters, place additional riprap in the stilling basin, remove the small tree beside impact basin, fill and seed gullies in emergency spillway discharge channel, install a staff gage in the reservoir.

MICHAEL BAKER, JR., INC.

Michael Baker, III, P.E.
Chairman of the Board and
Chief Executive Officer

COMMONWEALTH OF VIRGINIA
MICHAEL
BAKER III
NO. 3176
CERTIFIED PROFESSIONAL ENGINEER

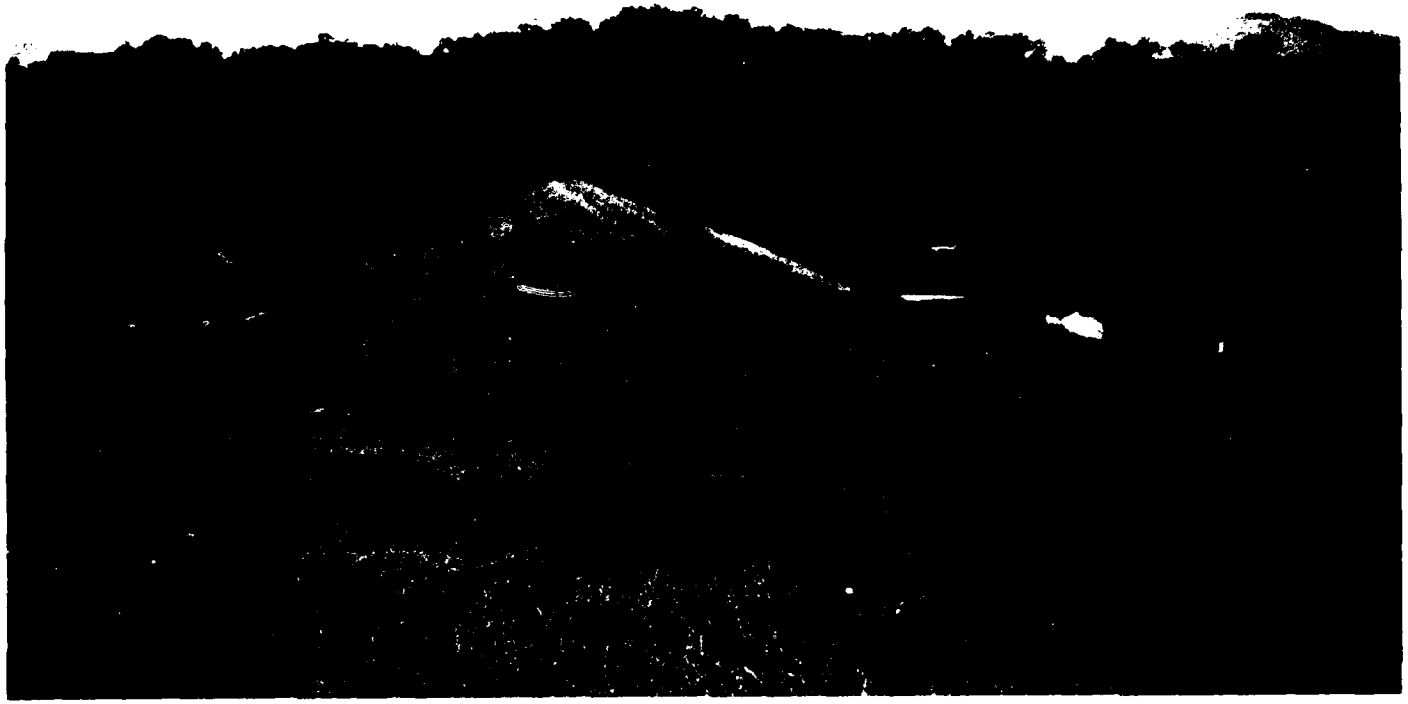
SUBMITTED: Original signed by JAMES A. WALSH

James A. Walsh
Chief, Design Branch

RECOMMENDED: ORIGINAL SIGNED BY: CARL S. ANDGREEN, JR.
for Jack G. Starr
Chief, Engineering

APPROVED: ORIGINAL SIGNED BY: GERALD W. BARNES
for Douglas L. Haller
Colonel, Corps of Engineers
District Engineer

Date: SEP 11 1979



OVERALL VIEW OF DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NAME OF DAM: BUFFALO RIVER No. 2 ID #VA 00912

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. The main responsibility is to expeditiously identify those dams which may be a potential hazard to human life or property.

1.2 Description of Project

1.2.1 Description of Dam and Appurtenances: Buffalo River No. 2 Dam is a zoned, earthfill embankment approximately 71 feet high[1] and 800 feet long with a crest width of 14 feet. The upstream and downstream slopes are 2.5:1 (horizontal to vertical) and the upstream slope changes to 3:1 below a 20 foot wide berm.

The principal spillway is a drop-inlet structure consisting of a reinforced concrete riser which is 3 feet wide, 9 feet long, and 35 feet high. A 36 inch reinforced concrete pipe discharges into the stilling basin at the toe of the downstream embankment.

The emergency spillway, a 300 foot wide, vegetated, earth side channel, is located outside the left[2] abutment of the dam. The approach channel slope is approximately 2 percent to the 30 foot long level control section. The discharge slope of the spillway is approximately 3 percent.

[1]Measured from downstream embankment toe to the embankment crest.
[2]Facing downstream.

The principal spillway inlet is located on either side of the riser at elevation 726.0 feet Mean Sea Level (M.S.L.). The reservoir can be drained using the 36 inch pond drain with manually operated sluice gate at invert elevation 691.0 feet M.S.L. The plan and typical sections of the dam are shown in Plates 2 through 6.

1.2.2 Location: Buffalo River Dam No. 2 is located on Thrashers Creek approximately 7.5 miles northwest of Amherst, Virginia. A Location Plan is included in this report.

1.2.3 Size Classification: The maximum height of the dam is 71 feet and the reservoir storage capacity to the top of dam elevation 759.7 feet M.S.L. is 2562 acre-feet. Therefore, the dam is in the "intermediate" size category as defined by the Recommended Guidelines for Safety Inspection of Dams.

1.2.4 Hazard Classification: Since houses are located less than 1/2 mile downstream, loss of life may be possible in event of failure of the dam. Therefore, Buffalo River No. 2 Dam is considered in the "high" hazard category as defined by the Recommended Guidelines for Safety Inspection of Dams. The hazard classification used to categorize dams is a function of location only and has nothing to do with the stability or probability of failure.

1.2.5 Ownership: The dam is owned by Amherst County, Virginia.

1.2.6 Purpose of Dam: The dam is used for flood control within Amherst County. The County also has future plans for recreational use of the dam and reservoir.

1.2.7 Design and Construction History: The existing facility was designed by the Department of Agriculture, Soil Conservation Service (SCS). The dam, completed in 1977, was built by E.W. Yeatts, Inc.

1.2.8 Normal Operational Procedures: The reservoir is maintained at normal pool elevation (726.0 feet M.S.L.). No formal operating procedures are followed for the dam. For a more detailed operating assessment, see paragraph 4.1.

1.3 Pertinent Data

1.3.1 Drainage Area: The drainage area for Buffalo River No. 2 is 6.80 square miles.

1.3.2 Discharge at Dam Site: The maximum discharge at the dam site is unknown.

Principal Spillway:
Pool level at top of dam . . 219 c.f.s.

Emergency Spillway:
Pool level at top of dam . .24,300 c.f.s.

1.3.3 Dam and Reservoir Data: Pertinent data on the dam and reservoir are shown in the following table:

TABLE 1.1 DAM AND RESERVOIR DATA

Item	Elevation feet M.S.L.	Reservoir Capacity Area Acres	Acre-feet	Watershed inches	Length feet
Top of dam	759.7	109.5	2562	7.06	5600
Maximum pool, design surcharge	753.8	93	2002	5.52	4800
Emergency spillway crest	750.5	84	1740	4.80	4300
Principal spillway crest (normal pool)	726.0	36	477	1.32	2200
Streambed at downstream toe of dam	689±	-	-	-	-

SECTION 2 - ENGINEERING DATA

2.1 Design: The site was investigated and the embankment designed by the SCS. It was found that the floodplain on which the dam was to be constructed consisted of 3 to 7 foot thick deposits of moderately plastic silty alluvium (ML to CH or MH soils) overlying gravelly alluvium (GP). Bedrock is granite gneiss, granite, and syenite. The total soil cover is up to 13 feet thick. (For a complete geologic report, see Appendix VII.) The silty alluvial soils were removed to provide a stable foundation for the embankment.

The soils available for construction of the dam were primarily residual, moderately plastic silts (MH and ML soils) from emergency spillway excavation and borrow areas. Lesser amounts of nonplastic silts (ML) and sandy silts (SM) were also available. Consolidated undrained triaxial shear tests were made on remolded samples of the MH and nonplastic ML borrow soils, compacted to approximately 95 percent maximum density and saturated. The following are the resulting parameters:

	Total Stress		Effective Stress	
Unified Classification	ϕ	c(p.s.f.)	$\bar{\phi}$	$\bar{c}$(p.s.f.)
MH	14°	725	30.5°	250
ML	18°	1650	36°	0

The original Typical Section for Compacted Fill shown on the as-built drawings (see Plate 5) indicates that the embankment was to have been constructed of two sections. Zone I, including the cut-off trench backfill and upstream section of the embankment, consists of the plastic silty MH and ML soils. Zone II, the downstream section, was built of the nonplastic ML and SM silty and sandy silt material. All material was to have been compacted to 95 percent maximum density, at or slightly above optimum moisture. However, at least one modification to this typical section was made, apparently during construction. The as-built Revised Zoning typical section, "Modification #4" (see Plate 6) called for placing Zone II materials on the upstream side of the embankment above elevation 706.0 feet M.S.L. instead of the Zone I originally specified. (No information on Modifications 2 and 3 were provided.) However, slope configuration for the embankment was not changed; the upstream slope from the base of the fill to elevation 726.5 feet M.S.L. is 3:1 with a 20 foot wide berm, breaking to 2:1 to the crest; the downstream slopes are

2.5:1 with a 10 foot wide berm at elevation 727.0 feet M.S.L.

During design, the SCS performed a series of stability analyses using the Bishop and Swedish Circle Methods as well as four Sliding Block Analyses (NAVDOCKS Method). These analyses used the parameters for borrow materials listed above and shear strength parameters of $\underline{\emptyset}$ = 14.5° and c = 325 p.s.f. (total stress) and $\bar{\emptyset}$ = 32° and $\bar{c}$ = 125 p.s.f. (effective stress) for the plastic silt (ML) foundation soils. No shear tests were made on the underlying GP gravels. They were assumed to have sufficiently high strength to preclude failure. As with the borrow material, parameters for the foundation materials were obtained from unconsolidated undrained triaxial shear tests on saturated samples. Although the analyses were based on a slope configuration essentially the same as that constructed, the analyses were made for a homogeneous embankment. Full drawdown conditions on the upstream slope and steady seepage conditions on the downstream slope were assumed. Because the Sliding Block Analyses showed low safety factors of 1.08 and 1.20 for the upstream and downstream slopes respectively, a 100 foot wide berm was recommended on the upstream embankment and a 74 foot wide berm on the downstream side. However, an alternate recommendation for undercutting the weak alluvial soils in lieu of the wide berms was chosen for construction. This resulted in minimum safety factors of 1.36 upstream and 1.48 downstream for the upstream and downstream slopes respectively using the Swedish Circle Method. With the Bishop Method, minimum safety factors of 1.37 and 1.53 were obtained for the upstream and downstream slopes respectively. No Sliding Block Analysis was given to determine safety factors for a similar design.

A 20 foot wide cut-off trench to bedrock and a foundation trench drain (c/b = 0.6) were constructed as recommended. The foundation drain consists of perforated 6 inch corrugated metal pipe.

2.2 Construction: The dam, constructed by E.W. Yeatts, Inc., was completed in 1977. Construction records were not available for the inspection; however, as-built drawings were reviewed and were subsequently verified in the field. Construction reports are on file in Washington, District of Columbia.

2.3 Operation: There are no formal operating records for this dam.

2.4 Evaluation

2.4.1 Design: The as-built drawings and design report were available to assess all aspects of design. The hydrologic and hydraulic data provided was adequate for design review. The assessments made in this report are based on the design data along with field observations.

2.4.2 Construction: No construction logs were available for review. The as-built drawings indicate any changes or modifications that were made during construction.

2.4.3 Operation: Two annual operation and maintenance inspection reports were available for review (see Appendix V).

SECTION 3 - VISUAL INSPECTION

3.1 Findings

3.1.1 General: The field inspection was made on 24 May 1979. The weather was overcast with showers and the temperature was 65°F. The reservoir was at normal pool elevation and ground conditions were wet from the rain. The embankment and appurtenant structures were found to be in generally satisfactory condition except for minor wet sloughing on the upstream slope (see Photo 2), small erosion gullies on the downstream slope, and missing riprap stone in the stilling basin (see Field Sketch and Photos 3 and 6). No major stability problem is indicated by the deficiencies. The following are brief summaries of deficiencies found during the inspection. A Field Sketch of conditions is shown as Plate 1. The complete visual inspection check list is given in Appendix III.

3.1.2 Dam: The embankment was found to be in generally good condition, with no surface cracks, serious slumps, or other indications of structural instability either on the embankment or at the toe.

The slopes are generally covered with thick vegetation except in the wet minor slough area (100 feet by 20 feet maximum width) on the upstream slope 50 feet from the left abutment and in a 5 foot to 20 foot wide strip with gullies (0.5 foot deep). This area is near the bench on the downstream slope (see Field Sketch and Photo 2) approximately 5 to 10 feet above normal pool. There are erosion gullies (1 foot to 2 feet deep) at the extremities of the rock gutter on the downstream left abutment. Shallow gullies have also formed adjacent to the lower end of the rock gutter on the right upstream slope (see Field Sketch). There are a few traces of small driftwood on the upstream shore and fallen tree branches on the rock gutters.

No seepage was observed on the downstream slope.

3.1.3 Appurtenant Structures: The principal spillway was functioning satisfactorily (see Photo 6) and no structural deficiencies were found on the appurtenant structures.

3.1.4 Reservoir Area: No serious deficiencies were observed in the reservoir area. A staff gage should be installed in the reservoir to monitor water levels above normal pool.

3.1.5 Downstream Channel: The stilling basin and outlet channel were functioning properly. Small sections of the stone riprap have been washed away (see Photo 6).

3.2 Evaluation: Generally, the dam and appurtenant structures are in good condition. The wet sloughing soil and imbedded branches near the left abutment of the upstream slope should be removed and replaced with compacted fill. The eroded bare areas on the slopes should be manually graded and seeded. It is recommended that the uncovered steep bank in the stilling basin be regraded and stone riprap replaced. The small tree near the impact basin should also be removed. Loose branches on the rock gutters and driftwood on the upstream shore can be removed as part of the regular maintenance program.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures: There are no formal operating procedures for Buffalo River No. 2 Dam. The water level in the reservoir is maintained by the orifice located on both sides of the riser. During periods of heavy inflow, the excess water is diverted around the dam by means of the emergency spillway.

4.2 Maintenance of Dam: Annual maintenance inspections are performed by the owner with cooperation from the local SCS office. During these visual inspections (see Appendix V), remedial measures are recommended for corrective maintenance. Operation and maintenance of the dam is the responsibility of the owner.

4.3 Maintenance of Operating Facilities: Maintenance of the operating equipment is the responsibility of the owner. The only operational equipment on this dam are the lift pedestal, stem, and sluice gate.

4.4 Warning Systems: At the present time, there is no formal warning system or evacuation plan in operation.

4.5 Evaluation: Maintenance of the dam is considered adequate.

SECTION 5 - HYDRAULIC/HYDROLOGIC DATA

5.1 Design: Normal pool (elevation 726.0 feet M.S.L.) is maintained by the crest of the concrete riser. The riser crest elevation was established at an elevation sufficient to store the 100-year sediment accumulation. The crest (elevation 750.5 feet M.S.L.) of the emergency spillway was established at the elevation needed to store the 100-year flood. The elevation at the top of dam (759.7 feet M.S.L.) was established by the maximum elevation reached in routing the freeboard hydrograph. The freeboard hydrograph is that computed from rainfall comparable to Probable Maximum Precipitation (PMP) as used by the Corps of Engineers and is therefore comparable to Probable Maximum Flood (PMF). The PMF is an estimate of flood discharges that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in a region.

5.2 Hydrologic Records: No rainfall or stream flow records were available at the dam site.

5.3 Flood Experience: No exact high water marks or dates were available. However, the maximum known reservoir level was approximately 7 feet above normal pool.

5.4 Flood Potential: Design features of the dam and reservoir were established by the SCS by routing the principal spillway, the emergency spillway, and the freeboard hydrographs. Hydrograph data was determined by using the SCS - National Engineering Handbook - Chapter 4, Hydrology (Reference 7, Appendix VIII) with the time of concentration and curve numbers established by basin characteristics.

5.5 Reservoir Regulation: Pertinent dam and reservoir data is shown in Table 1.1, paragraph 1.3.3.

Regulation of flow from the reservoir is automatic. Normal flows are maintained by the riser crest at an elevation of 726.0 feet M.S.L. Water flowing over the riser crest passes through the dam in a 36 inch diameter reinforced concrete conduit. Water also flows past the dam through the ungated, vegetated, emergency spillway in the event water in the reservoir rises above an elevation of 750.5 feet M.S.L.

Outlet discharge capacity, reservoir area and storage capacity, hydrograph data, and routings were taken from the SCS Design Report. Flood routings were begun with the reservoir level 0.5 foot above normal pool.

Outlet discharge capacity includes discharge from both the principal and emergency spillways.

5.6 Overtopping Potential: The probable rise of the reservoir and other pertinent information on reservoir performance are shown in the following table:

TABLE 5.1 RESERVOIR PERFORMANCE

Item	Normal	Hydrographs Principal Spillway (a)	Emergency Spillway (b)	Free Board (c)
Peak flow, c.f.s.				
Inflow	7	4940	8000	26,800
Outflow	7	200	4700	24,500
Peak elev., ft. M.S.L.	726.0	750.5	753.8	759.7
Emergency spillway (d) (elev. 750.5 feet M.S.L.)				
Depth of flow, ft.	-	-	2.2	6.2
Average velocity, f.p.s.	-	-	8.4	14.1
Duration of flow, hrs.	-	-	7.5	10.2
Non-overflow section (elev. 759.7 ft. M.S.L.)				
Depth of flow, ft.	-	-	-	-
Average velocity, f.p.s.	-	-	-	-
Total duration of overtopping, hrs.	-	-	-	-
Tailwater elev., ft. M.S.L. (e)	689.1	-	-	-

(a) Based on a 24 hour rainfall of 8.9 inches.
(b) Based on a 6 hour rainfall of 12.0 inches.
(c) Based on a 6 hour rainfall of 27.9 inches - PMF by Corps of Engineers standards.
(d) Depth and velocity estimates based on critical depth at control section.
(e) Tailwater at time of inspection.

5.7 Reservoir Emptying Potential: The time for the reservoir level to automatically decrease from the emergency spillway crest (elevation 750.5 feet M.S.L.) to the riser crest (elevation 726.0 feet M.S.L.) is approximately 4 days. The reservoir may be dewatered from the riser crest elevation (normal pool) in approximately 2 days by use of the 36 inch sluice gate located on the upstream face of the riser. Reservoir drawdown was computed neglecting inflow.

5.8 Evaluation: Buffalo River No. 2 Dam is an "intermediate" size-"high" hazard dam requiring evaluation for a spillway design flood (SDF) equal to the PMF. The SCS freeboard hydrograph is essentially equal to the Corps of Engineers PMF hydrograph. The freeboard hydrograph was used to established the top of dam elevation of 759.7 feet M.S.L. Therefore, the spillways will pass the PMF without overtopping.

SECTION 6 - DAM STABILITY

6.1 Foundation and Abutments: Foundation conditions were determined from records of borings, test pits, laboratory analyses, and the as-built drawings in conjunction with observations made in the field.

The 3 feet to 7 feet of clayey and silty (ML to CH and MH) alluvial soils of low density were apparently removed from the floodplain for the foundation of the dam, thereby placing the dam directly on the underlying gravel (GP) which overlies granite, granite gneiss, and syenite bedrock. Seepage control measures consist of a 20 foot wide cut-off trench, a foundation drain beneath the downstream slope, and an impervious core. The cut-off trench was dug to the top of firm bedrock and backfilled with more impervious MH and ML silts. The foundation drain consists of a 6 inch diameter perforated corrugated metal pipe embedded in filter material. The impervious core was constructed of MH and ML plastic silts.

Red clayey silt overlies highly fractured weathered gneiss at a depth of 3 feet on the left abutment. There are outcrops of granite gneiss on the steep slope at the right abutment with a thin soil mantle of sand (SM). The dip of the gneissic structure is 45 degrees in a downstream direction with a strike approximately parallel to the alignment of the dam.

6.2 Stability Analysis

6.2.1 Visual Observations: No evidence of movement, such as tension cracks or bulging of the embankment, was noted. There was some erosion and slight sloughing located 50 feet from the left abutment in the soft wet clayey silt (100 foot by 20 foot area) just above the toe of the upstream slope. Several tree branches are imbedded in the soil. There are minor erosion gullies on the downstream slope. Otherwise, the embankment is in good condition with no visible seepage on the downstream slope.

The downstream slope is constructed to a 2.5:1 slope ratio with a 10 foot wide berm at elevation 727.0 feet M.S.L. The upstream slope is 3:1 from the embankment toe to elevation 726.5 feet M.S.L. where a 20 foot wide berm is provided. Above this berm to

the crest elevation 759.7 feet M.S.L., the slope is 2.5:1. The 6 inch corrugated metal seepage drains empty into the stilling basin on both sides of the principal spillway drainage pipe.

6.2.2 Design Data: Slope stability analyses were performed by using the ICES computer program showing results for the Bishop and Swedish Circle Methods and the NAVDOCKS Sliding Block Analysis. A full drawdown was assumed on the upstream slope with steady seepage on the downstream slope. A homogeneous embankment was used. The data for the slope stability, sliding block, and seepage analyses from the Design Report are presented in Appendix VI. The following shear strength parameters were used based on the results of consolidated undrained triaxial shear tests:

	Ø	c (p.s.f.)
Embankment Soils (MH)	30.5°	250 (effective)
Embankment Soils (ML)	36.0°	0 (effective)
Foundation (ML)	14.5°	325 (total)

The analyses are discussed in greater detail in Section 2.1.

As a result of these analyses, the SCS concluded that the soft silty alluvium on the floodplain did not have adequate strength to support the proposed embankment. Therefore, it recommended the construction of a 100 foot wide berm on the upstream slope and a 74 foot wide berm on the downstream side or, as an alternate, the removal of the unstable silty alluvium. The as-built drawings show that the alluvium was undercut and the slope configuration as given in Section 6.2.1 was constructed. As a result, the embankment was built on the gravelly GP soils.

Based on the SCS' assumption that the GP soils have sufficient strength to limit a potential failure to the embankment itself, the analyses which the SCS made for an embankment only condition would apply, assuming complete removal of the weak silty alluvium. Therefore, their analysis for a downstream slope configuration similar to that built, assuming steady seepage and using total

stress parameters, indicates safety factors of 1.53 and 1.48 for the Bishop Method and Swedish Circle Method respectively. The SCS analysis of an upstream slope similar to that construction, for full drawdown, using effective stress parameters, gave safety factors of 1.37 and 1.36 respectively with the Bishop Method and Swedish Circle Method. No Sliding Block Analyses were made for an embankment only condition. These safety factors for both the upstream and downstream slopes are equal or greater than those required for minimum accepted stability.

6.2.3 Operating Records: The inspection reports for the past 2 years indicate that the wet sloughing area on the left side of upstream slope should be seeded and the stone riprap that washed away on the downstream channel should be replaced. Other maintenance work that should be performed include repairs to the rock gutters and fertilization and seeding of the eroded bare areas.

6.2.4 Post-Construction Changes: There were no alterations made to the dam since it was constructed.

6.2.5 Seismic Stability: Buffalo River No. 2 Dam is located in Seismic Zone 2 and is considered to have no hazard from earthquakes, according to the text of the Recommended Guidelines for Safety Inspection of Dams, provided that static stability conditions are satisfactory and conventional safety margins exist.

6.3 Evaluation: The embankment slope configuration chosen for the stability analyses is compatible with the typical section as built. Although the SCS analyzed a homogeneous embankment and a modified zoned embankment was constructed (refer to Section 2.1 and Plates 5 and 6), the analyses are considered adequate since the strength parameters used are considered representative of the weakest material in the as-built embankment. The unstable silty alluvial soils were removed in the floodplain to provide a firm foundation.

The deficiencies in the riprap on the downstream channel and the slight sloughing on the upstream slope do not affect the stability of the embankment.

The dam appears to be in a satisfactory condition with adequate stability.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment: The dam and appurtenant structures are generally in good overall condition. No deficiencies were discovered during the field inspection and office analysis which would indicate the need for emergency attention.

Using the Corps of Engineers' screening criteria for initial review of spillway adequacy, the PMF was selected as the SDF for the "intermediate" size-"high" hazard classification of Buffalo River No. 2 Dam. The freeboard hydrograph as computed by the SCS is essentially equal to the PMF. The freeboard hydrograph is used to establish the minimum top of dam elevation, and therefore the dam will pass the PMF without overtopping.

The recommended remedial measures are not considered urgent and, therefore, may be accomplished as part of the annual maintenance and inspection program.

7.2 Recommended Remedial Measures: The following repair items should be completed as part of the annual maintenance of the dam:

1) Remove wet sloughing soil with imbedded branches near the left upstream abutment and replace with compacted earth.

2) Grade and seed eroded bare areas near the bench on the downstream slope. Also, grade and seed erosion gullies in the vicinity of the rock gutters at the left downstream abutment and right upstream abutment.

3) Seed and fertilize areas with dead grass.

4) Remove driftwood on shoreline of dam and fallen branches from rock gutters.

5) Place additional stone riprap on the banks of the stilling basin where discharge has washed it away.

6) Remove small tree from stone riprap adjacent to left wing wall of impact basin.

7) Fill and seed erosion gullies in discharge channel of emergency spillway.

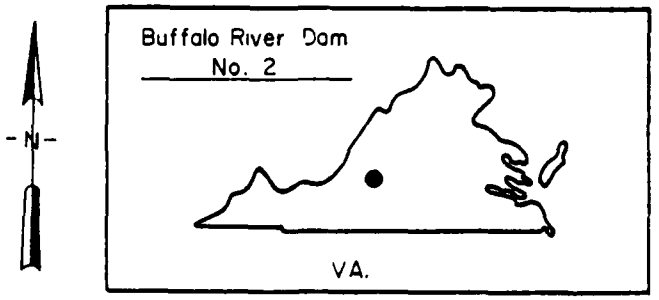
8) Install a staff gage to monitor reservoir levels above normal pool.

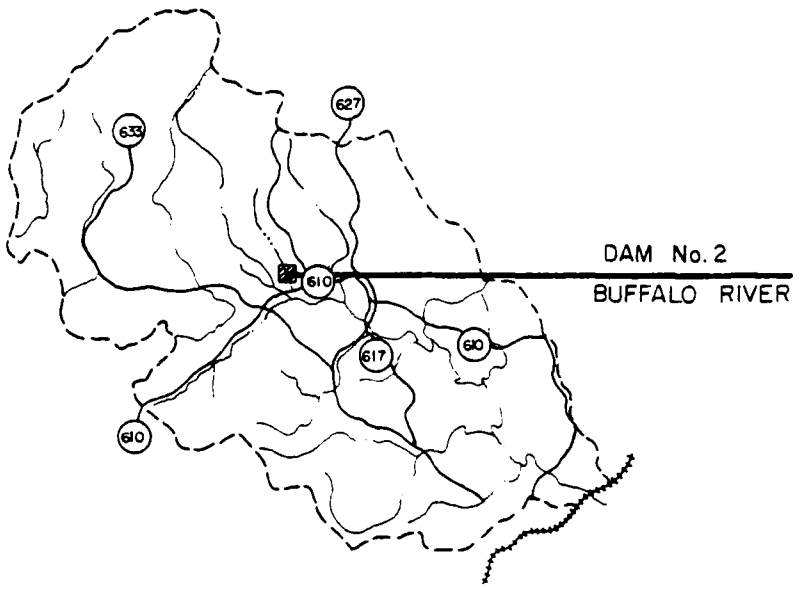
APPENDIX I

PLATES

CONTENTS

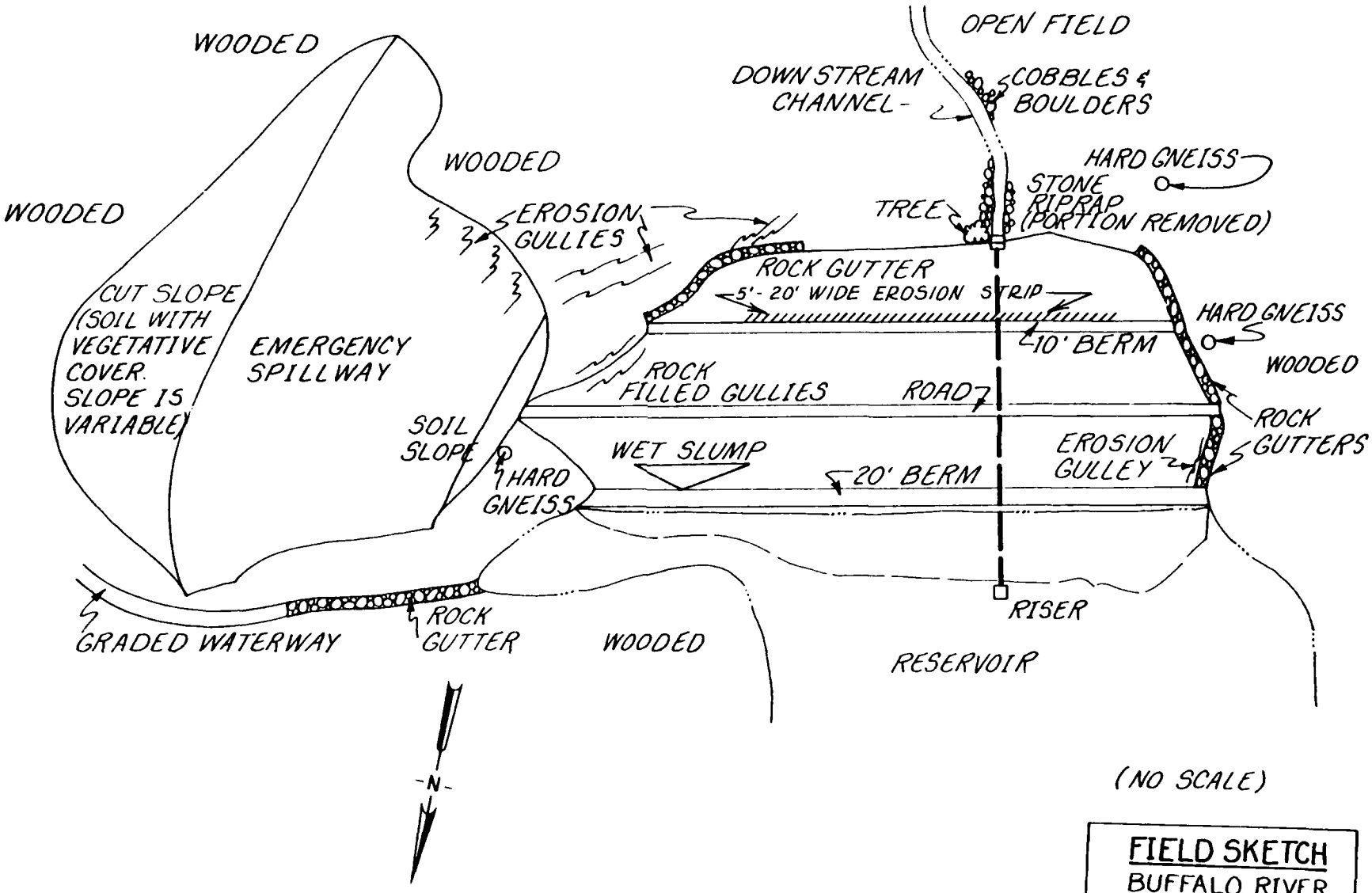
NAME OF DAM: BUFFALO RIVER No. 2



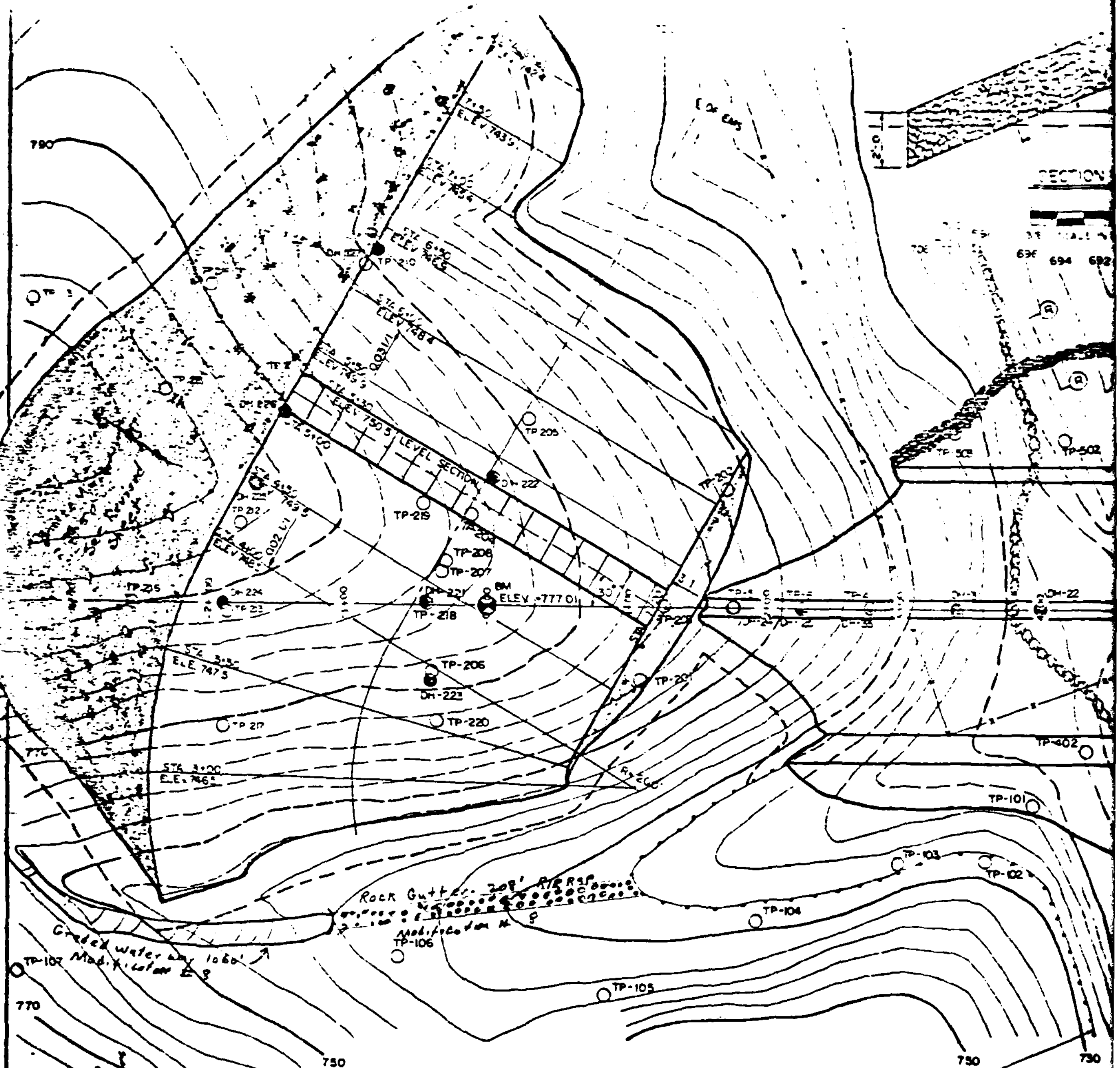


LOCATION PLAN

BUFFALO RIVER DAM
NO. 2



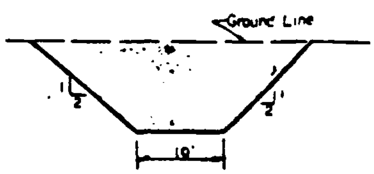
FIELD SKETCH
BUFFALO RIVER
DAM NO. 2
Michael Baker Jr., Inc.
July 1979
PLATE I



Additional Rock Riprap Placed By Paradise Builders (see Pg. 5)

EMERGENCY SPILLWAY CURVE DATA			
STA	DEF ∠	CHORD	ELEVATION
PT. 4+00	0	0	748.5
3+75	7°-9.7'	24.98'	748.0
3+50	14°-19.4'	↓	747.5
3+25	21°-29.2'	↓	747.0
3+00	28°-38.9'	↓	746.5
2+75	35°-48.6'	↓	746.0
PC 2+50	42°-58.3'	↓	745.5

R = 200' — D = 28.6478°
Chord Factor = 0.1249



SECTION AA
INLET CHANNEL

LEGEND

- ○ DH DRILL HOLES
- ○ TP TEST HOLES
- 790 CONTOUR
- WOODS BOUNDARY
- STREAM
- SEDIMENT POOL
- BM ● TOP OF IRON

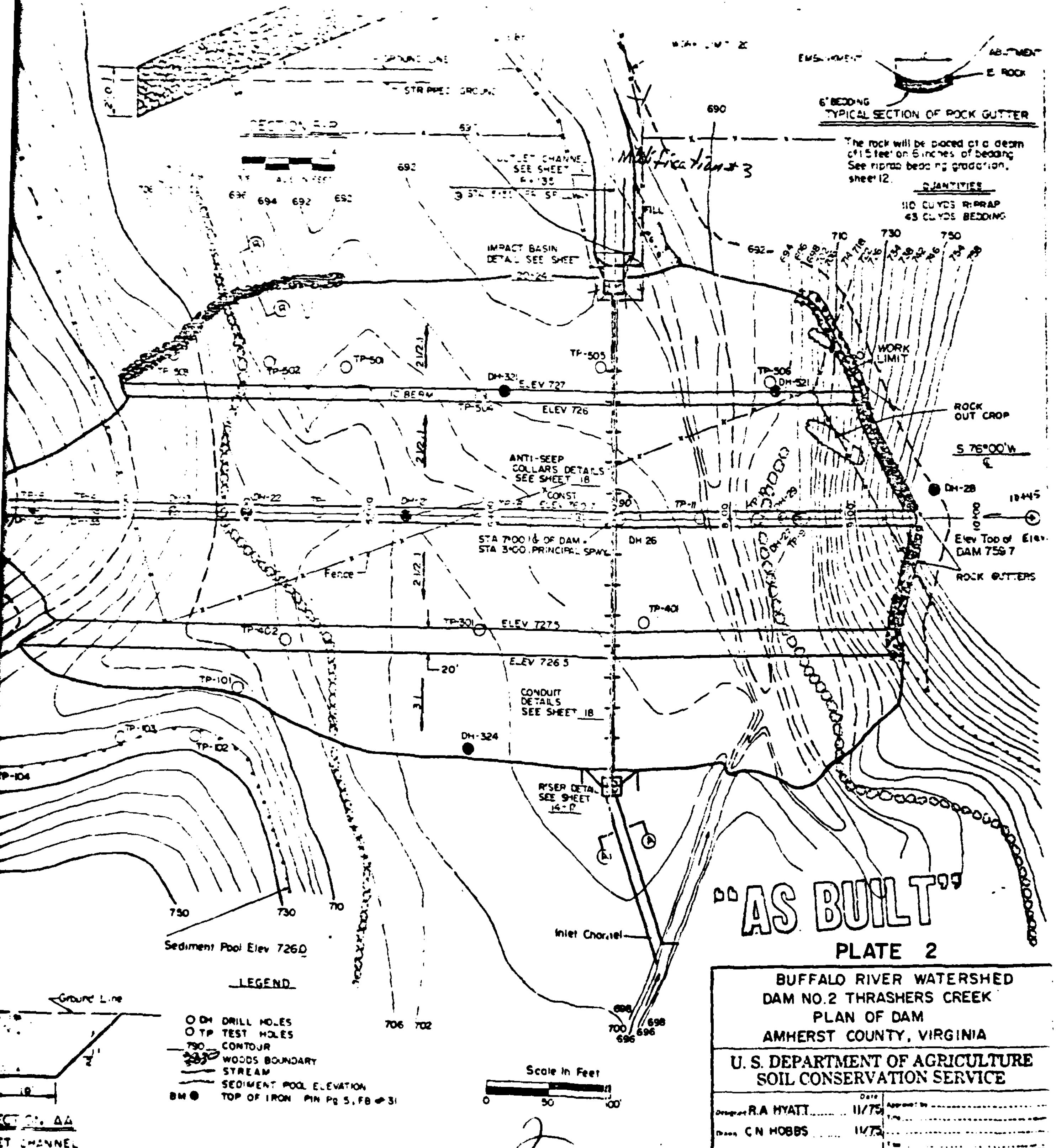


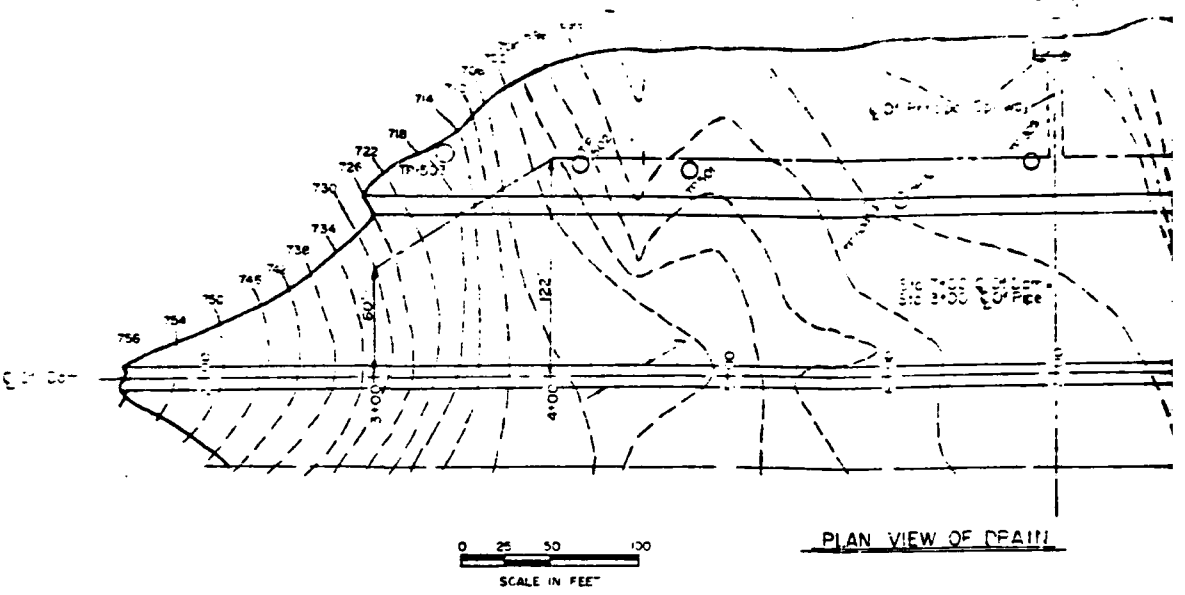
PLATE 2

BUFFALO RIVER WATERSHED
DAM NO.2 THRASHERS CREEK
PLAN OF DAM
AMHERST COUNTY, VIRGINIA

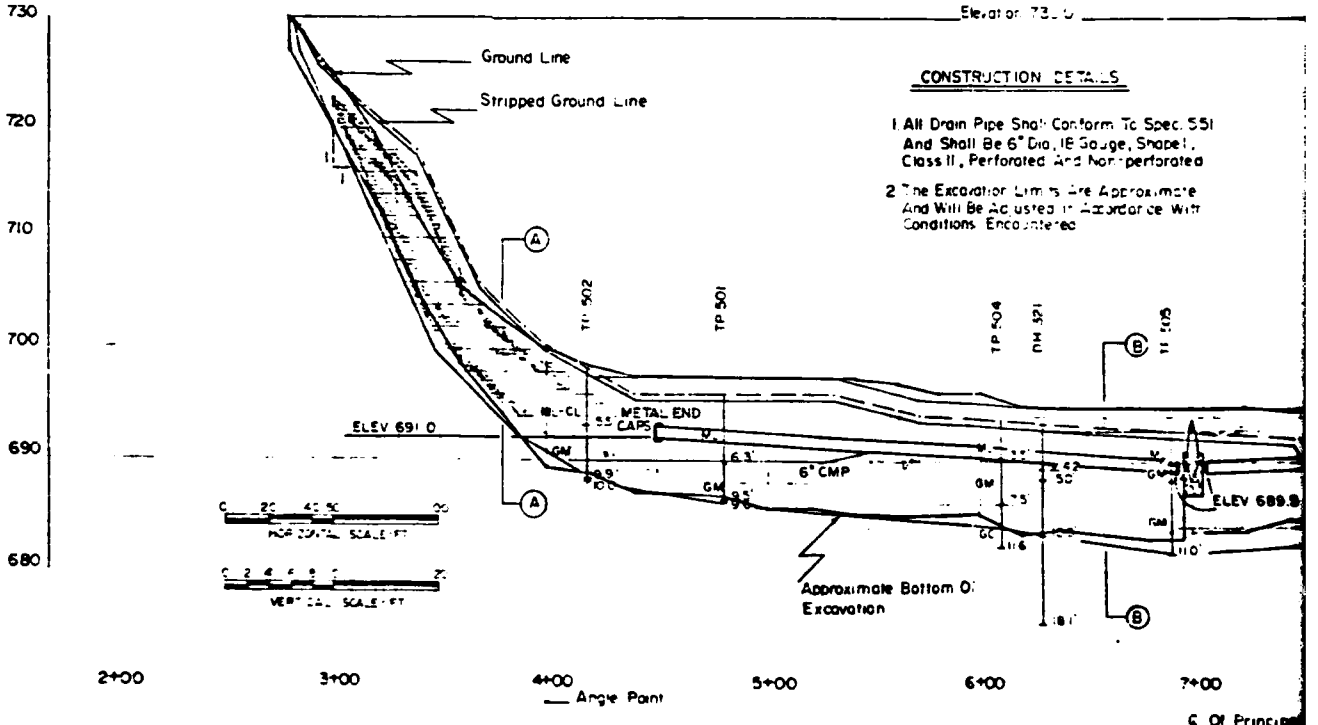
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed R.A HYATT	11/75	Approved by
Drawn C.N HOBBS	11/75	
Checked	2/76	VA-1002-P

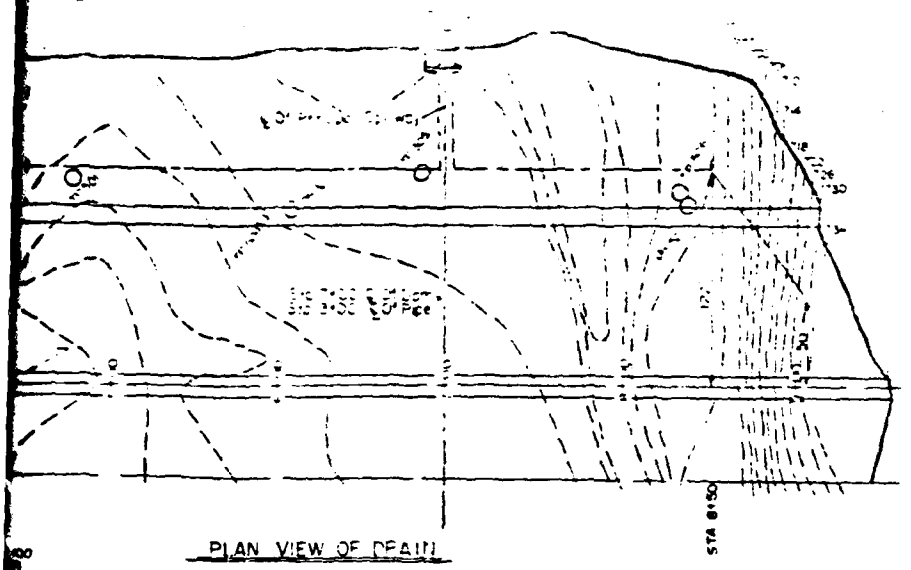
2



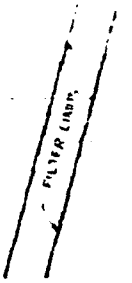
PLAN VIEW OF DRAIN



PROFILE LOOKING DOWNSTREAM ALONG CENTERLINE OF
(STATIONING ALONG CENTERLINE OF D



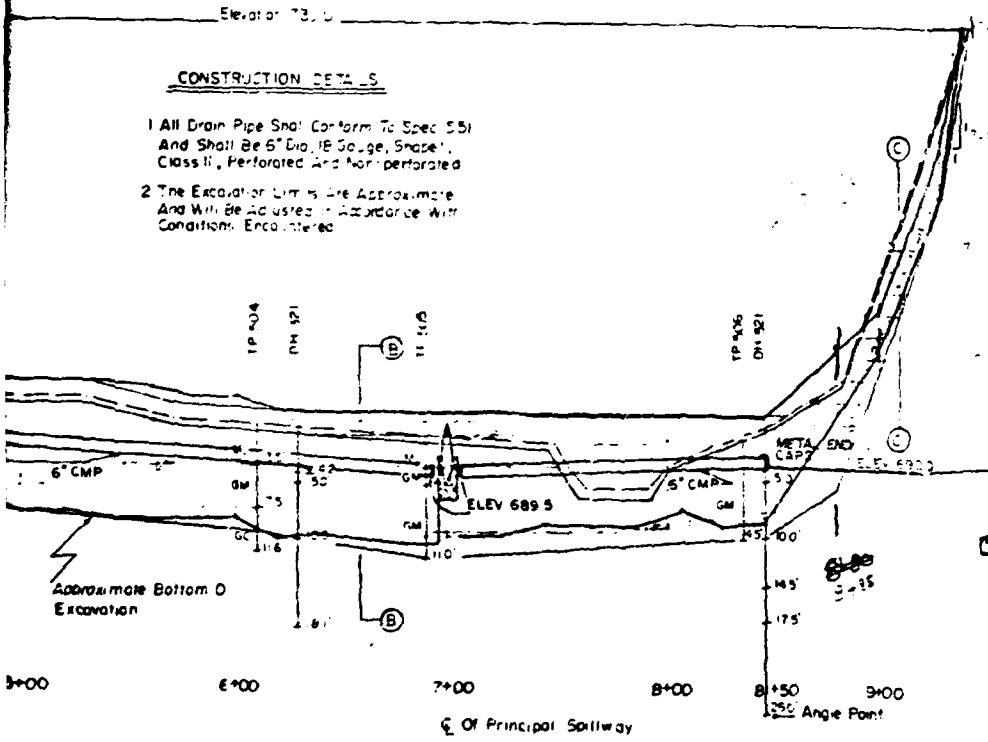
PLAN VIEW OF DRAIN



COARSE FILTER FOR FOUNDATION DRAINAGE AND OUTLET

SIEVE NO	% PASSING
3"	Min 100
2"	81-100
1 1/2"	67-100
1"	48- 90
3/4"	34- 77
1/2"	15- 58
3/8"	0- 42
#4	0- 12

SEE SHEET 11 FOR DRAINAGE SYSTEM SECTIONS AND DETAILS



E LOOKING DOWNSTREAM ALONG CENTERLINE OF DRAIN SYSTEM
(STATIONING ALONG CENTERLINE OF DAM)

CONSTRUCTION DETAILS

1 All Drain Pipe Shall Conform To Spec 551 And Shall Be 6" Dia, 18 Gauge, Shape 1, Class II, Perforated And Non-perforated

2 The Excavation Limits Are Approximate And Will Be Adjusted In Accordance With Conditions Encountered

DESIGN DATA FOR DRAIN FILL MATERIAL
(IMPACT BASIN ONLY)

1 COARSE CONCRETE AGGREGATE VA SIZE NO 78, USED FOR COARSE DRAIN FILL.

SIEVE NO	% PASSING
3/4"	MIN 100
1/2"	90-100
3/8"	40-80
#4	0-20
#8	0-8
#16	0-3

2 FINE CONCRETE AGGREGATE ASTM C-33 USED FOR FINE DRAIN FILL

SIEVE NO	% PASSING
3/8"	MIN 100
#4	95-100
#8	80-100
#16	50-85
#30	25-60
#50	10-30
#100	2-10

QUANTITIES FOR FOUNDATION DRAIN AND OUTLET

1686 CU YDS COARSE DRAIN FILL (COARSE CONCRETE AGG.)

477 FT 6" CORRUGATED METAL PIPE PERFORATED
48 FT 6" CORRUGATED METAL PIPE NON-PERFORATED
2 METAL END CAPS
8 90°- 6" ELBOW 3- PIECE

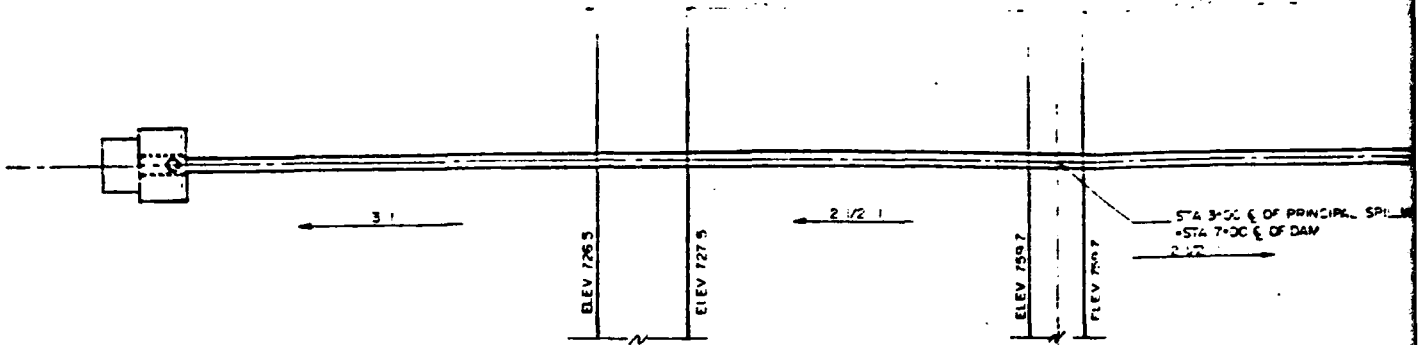
"AS BUILT"

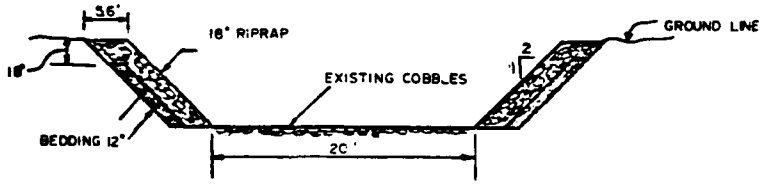
PLATE 3

BUFFALO RIVER WATERSHED
DAM NO. 2
AMHERST COUNTY, VIRGINIA
DRAIN LAYOUT

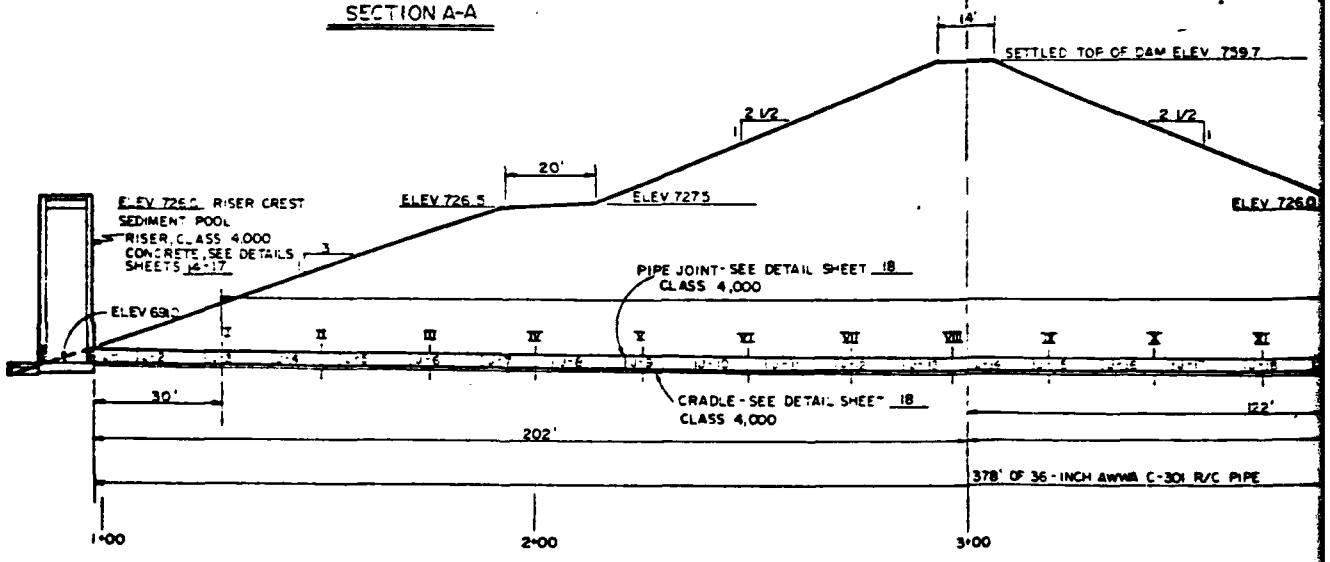
DESIGNED	R A HYATT	11/75
DRAWN	R A HYATT	
TRACED	C N HOBBS	11/75
SUBMITTED		
RECOMMENDED		
APPROVED		

DRAWING NO. VA-1002-P
SHEET NO. 34

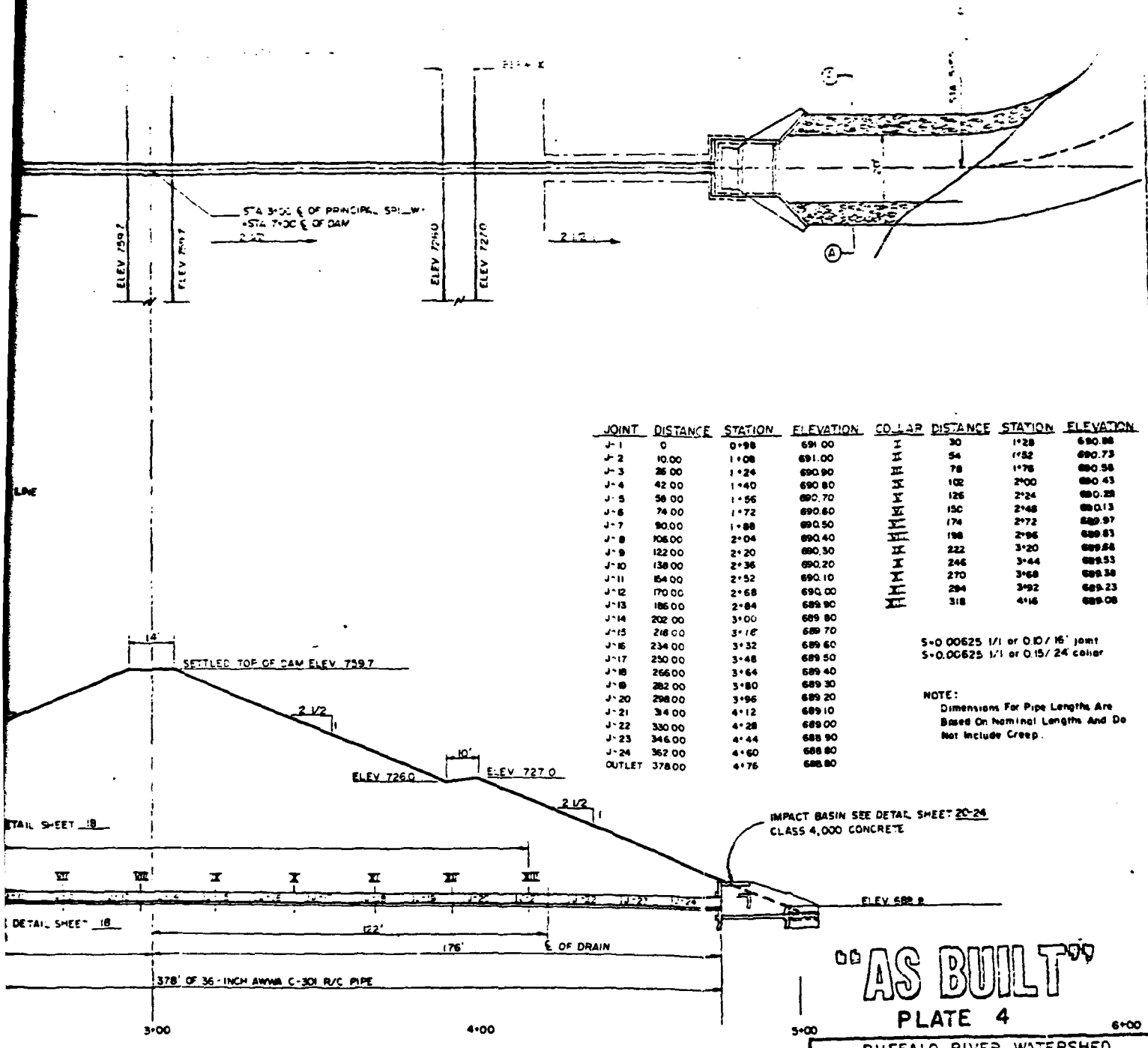




SECTION A-A



PROFILE ALONG ℄ OF PRINCIPAL SPILLWAY



JOINT	DISTANCE	STATION	ELEVATION	COLLAR	DISTANCE	STATION	ELEVATION
J-1	0	0+98	691.00	I	30	1+28	690.88
J-2	10.00	1+08	691.00	II	54	1+52	690.73
J-3	26.00	1+24	690.90	III	78	1+76	690.58
J-4	42.00	1+40	690.80	IIII	102	2+00	690.43
J-5	58.00	1+56	690.70	IIIII	126	2+24	690.28
J-6	74.00	1+72	690.60	IIIIII	150	2+48	690.13
J-7	90.00	1+88	690.50	IIIIIII	174	2+72	689.97
J-8	106.00	2+04	690.40	IIIIIIII	198	2+96	689.83
J-9	122.00	2+20	690.30	IIIIIIIII	222	3+20	689.68
J-10	138.00	2+36	690.20	IIIIIIIIII	246	3+44	689.53
J-11	154.00	2+52	690.10	IIIIIIIIIII	270	3+68	689.38
J-12	170.00	2+68	690.00	IIIIIIIIIIII	294	3+92	689.23
J-13	186.00	2+84	689.90	IIIIIIIIIIIII	318	4+16	689.08
J-14	202.00	3+00	689.80				
J-15	218.00	3+16	689.70				
J-16	234.00	3+32	689.60				
J-17	250.00	3+48	689.50				
J-18	266.00	3+64	689.40				
J-19	282.00	3+80	689.30				
J-20	298.00	3+96	689.20				
J-21	314.00	4+12	689.10				
J-22	330.00	4+28	689.00				
J-23	346.00	4+44	688.90				
J-24	362.00	4+60	688.80				
OUTLET	378.00	4+76	688.80				

S=0.00625 1/1 or 0.10/16' joint
S=0.00625 1/1 or 0.15/24' collar

NOTE:
Dimensions For Pipe Lengths Are Based On Nominal Lengths And Do Not Include Creep.

"AS BUILT"

PLATE 4

IFILE ALONG ℄ OF PRINCIPAL SPILLWAY

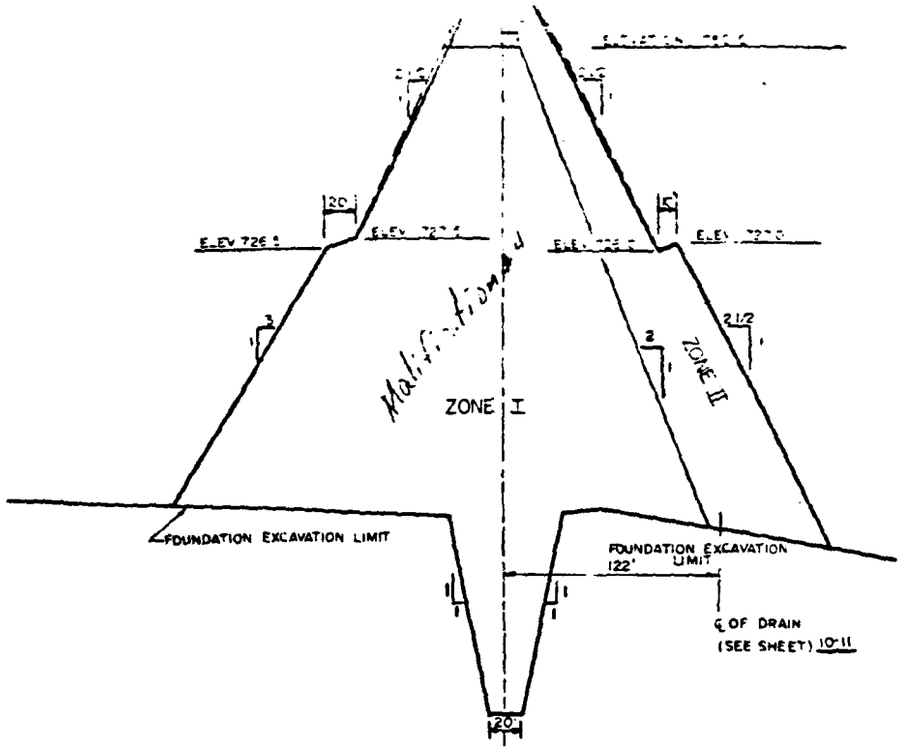
CONSTRUCTION DETAILS

1 ROCK RIPRAP SHALL BE WELL GRADED FROM A MIN. SIZE OF 6" TO A MAX SIZE OF 18" WITH AT LEAST 50% ≥ 12".
2 BEDDING SHALL MEET THE GRADATION REQUIREMENTS FOR COARSE DRAIN FILL.
3 PIPE SUPPLIER'S NOTE, CAST OUTSIDE OF SPIGOT JOINT WITH CONCRETE ON ONE 16'-0" SECTION

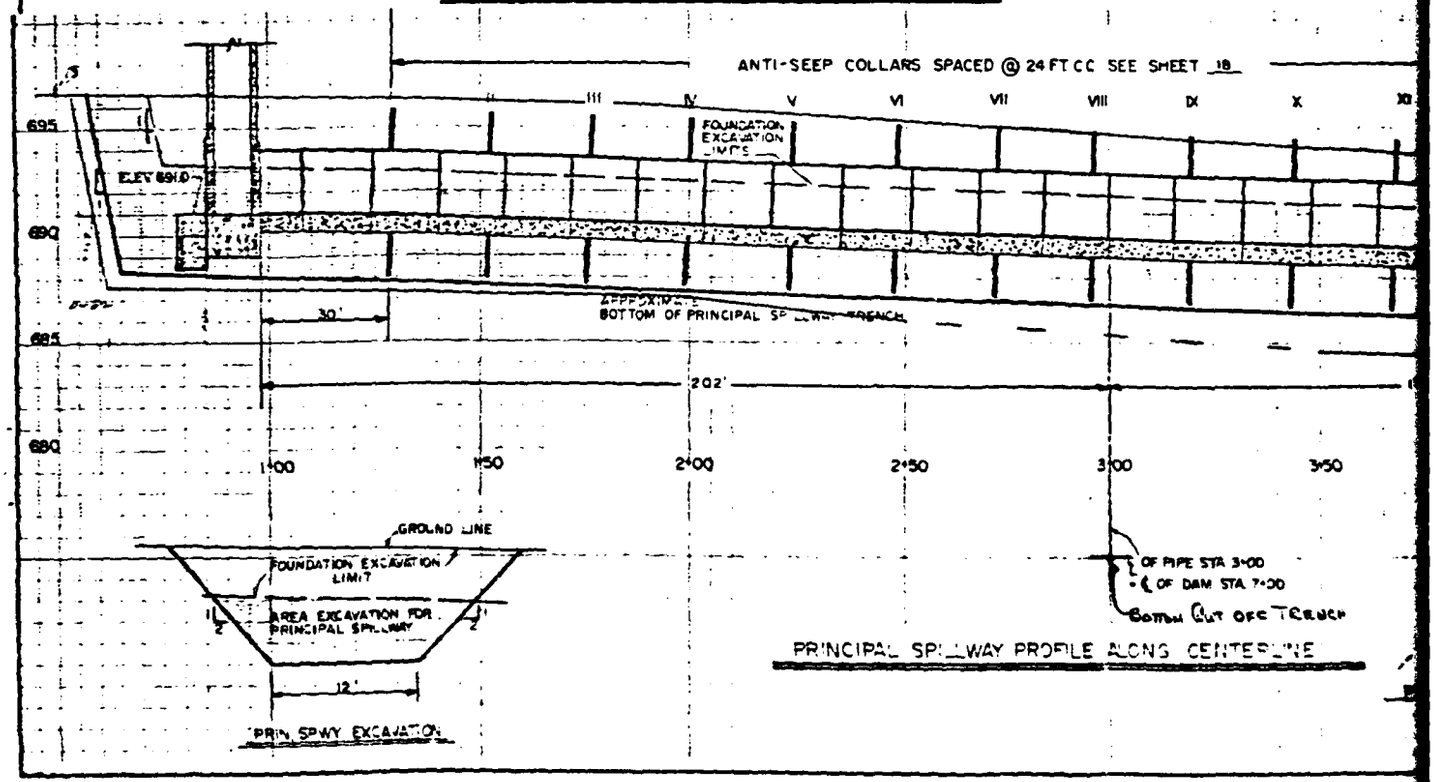
BUFFALO RIVER WATERSHED
DAM NO 2 THRASHERS CREEK
PRINCIPAL SPILLWAY
AMHERST COUNTY, VIRGINIA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Design	R A HYATT	11/75	
Drawn	C N HOBBS	11/75	
Traced			
Checked	RL	2/76	VA-1002-P



TYPICAL SECTION OF COMPACTED FILL
NOT TO SCALE



PRINCIPAL SPILLWAY PROFILE ALONG CENTERLINE

		OPTIMUM	95 % MAXIMUM DENSITY
	BORROW AREA "A" SAMPLE 110 1 SAMPLE 107 1	6° 9°	480+E OPTIMUM A	BY ASTM D-698 METHOD A
SANDY SILT (SM)	EMERGENCY SPILLWAY SAMPLE 206 1			
SILTY (ML)	EMERGENCY SPILLWAY SAMPLE 204 2			

NOTE: USE PLASTIC MATERIAL FROM BORROW AREA A AND EMERGENCY SPILLWAY IN ZONE I
USE NON-PLASTIC MATERIAL FROM BORROW AREA A AND EMERGENCY SPILLWAY IN ZONE II

DRAIN
SHEET) 10-11

S SPACED @ 24 FT C C SEE SHEET 18

VII VIII IX X XI XII XIII

GROUND LINE

AS BUILT

ELEV 688.8

PLATE 5

S = 0.045 V/I

76'

3+50 4+00 4+50 5+00 5+50

℄ OF PIPE STA 3+00
℄ OF DAM STA 7+00
BOTTOM CUT OFF TRENCH

SPILLWAY PROFILE ALONG CENTERLINE

DH 221 DH 222 DH 223

FLOW
ELEV 750.5
LEVEL SECTION
30'
GROUND LINE
3% Slope
COMPACTED FILL CLASS A ZONE I MATERIAL

PROFILE ALONG ℄ OF EMERGENCY SPILLWAY

780 770 760 750 740 730 720

4+00 5+00 6+00 7+00 8+00 9+00

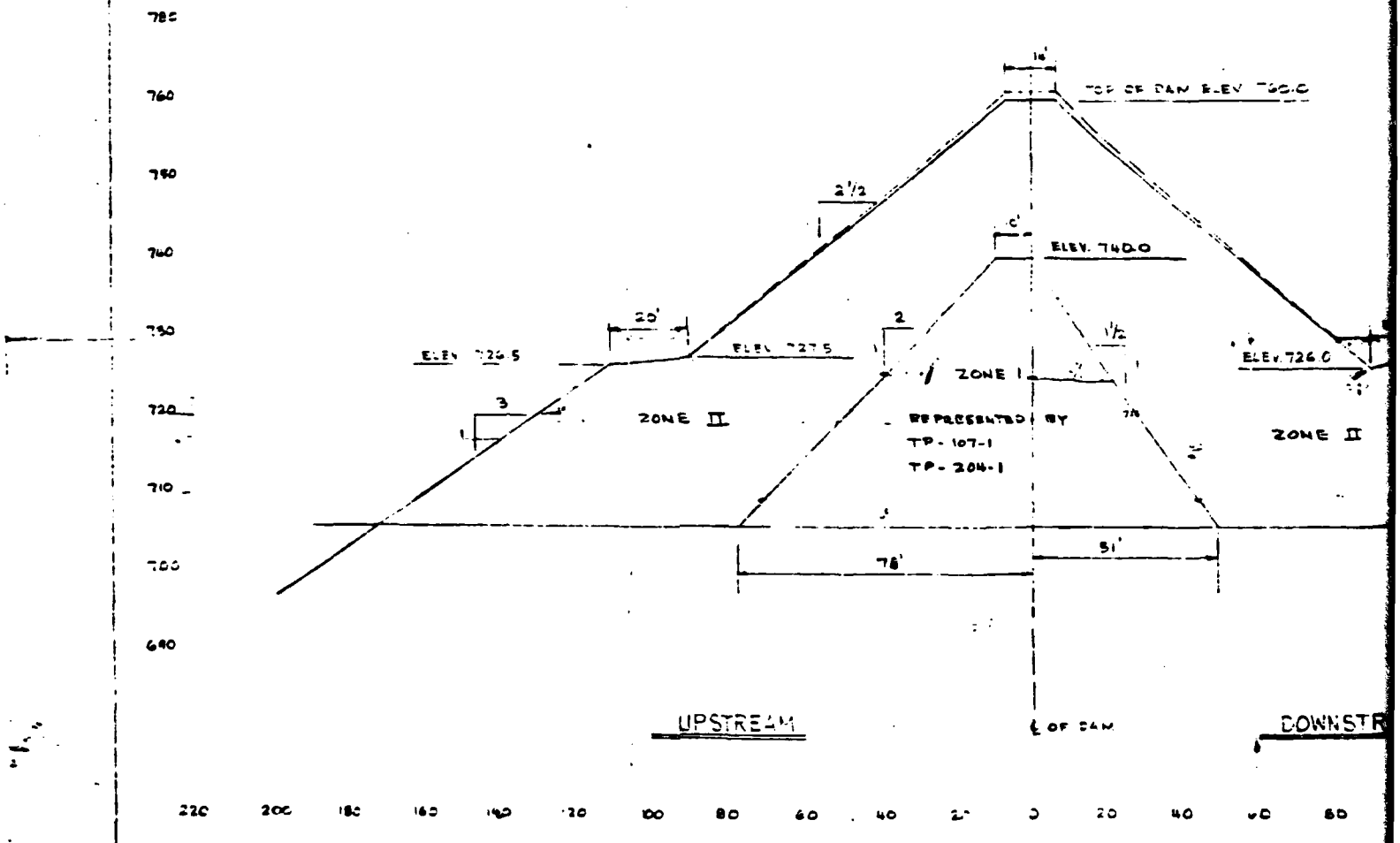
2

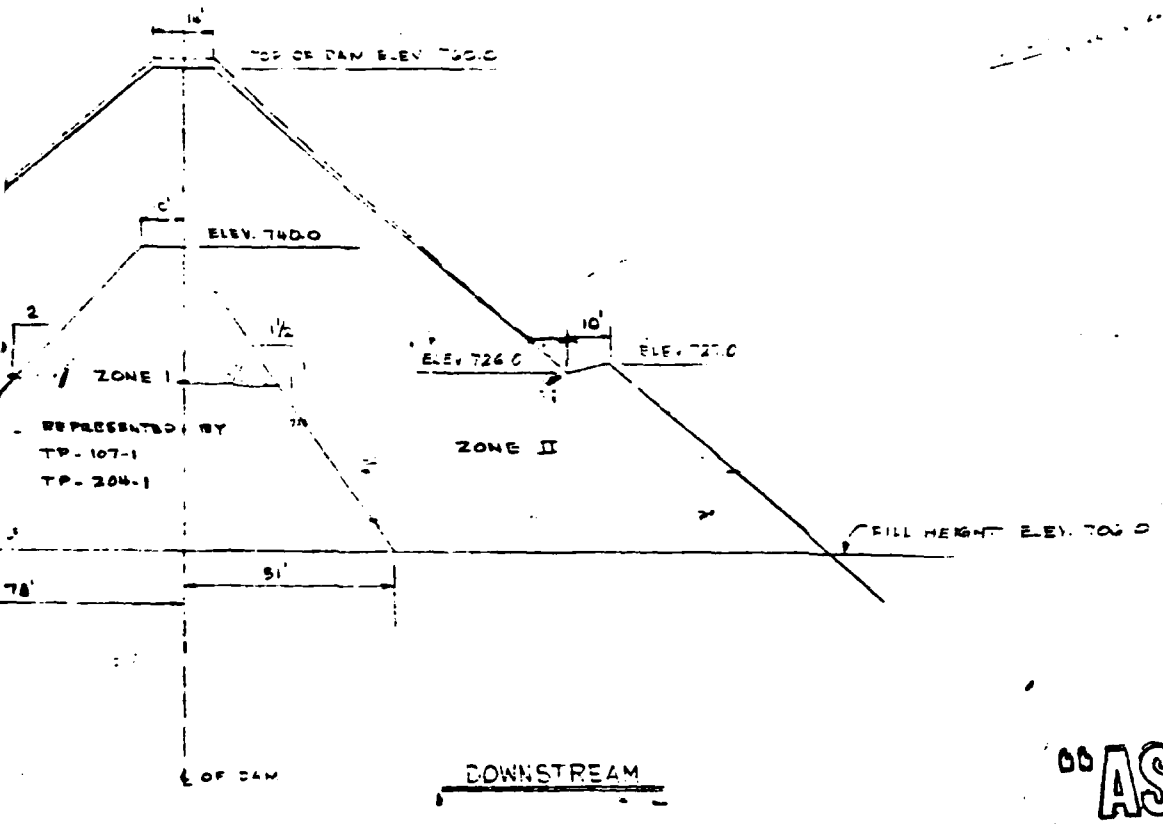
BUFFALO RIVER WATERSHED
DAM NO. 2 THRASHERS CREEK
FILL PLACEMENT & PRIN. SPWY EXCAVATION
AMHERST COUNTY, VIRGINIA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed R.A. HYATT	Date 12/75	Approved by	
Drawn C.N. HOBBS	12/75		
Traced		Title	
Checked		Sheet No. 13 of 34	Drawing No. VA-1002-P

FORM SCS-378 (NOV 1967)


780
760
740
720
710
700
640
16'
TOP OF DAM ELEV 760.0
2½
1
C'
ELEV. 740.0
20'
ELEV 726.5
ELEV 727.5
2
1
½
1
ELEV. 726.0
3
1
ZONE II
ZONE I
REPRESENTED BY
TP-107-1
TP-204-1
ZONE II
78'
51'
UPSTREAM
℄ OF DAM
DOWNSTR
220
200
180
160
140
120
100
80
60
40
20
0
20
40
60
80



"AS BUILT"

PLATE 6

Modification #1

BUFFALO RIVER WATERSHED
DAM NT. NO 2
REVISED ZONING

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

R A HYATT

R A. HYATT

VA-10C2-R

APPENDIX II

PHOTOGRAPHS

CONTENTS

Note: Photographs were taken on 24 May 1979.

NAME OF DAM: BUFFALO RIVER No. 2

BUFFALO RIVER No. 2 DAM

PHOTO 1. Upstream Face of Dam Looking Toward Approach to Emergency Spillway

PHOTO 2. Sloughing and Erosion Area Near Upstream Left Abutment

PHOTO 3. Downstream Face of Dam

PHOTO 4. Junction of Downstream Embankment and Right Abutment

PHOTO 5. View of Riser and Reservoir from Crest of Dam

PHOTO 6. Outlet of Principal Spillway, Impact Basin and Riprap-Lined Channel

PHOTO 7. View of Emergency Spillway and Left Abutment Looking Downstream

PHOTO 8. Downstream Area with VA Route 610 and Farmhouse in Background

APPENDIX III

CHECK LIST - VISUAL INSPECTION

Check List
Visual Inspection
Phase 1

Name of Dam Buffalo River No. 2 County Amherst State Virginia Coordinates Lat. 3740.2
Long. 7908.3

Date of Inspection 24 May 1979 Weather Overcast, Showers Temperature 65°F.

Pool Elevation at Time of Inspection 726.2 ft. M.S.L. Tailwater at Time of Inspection 689.1 ft. M.S.L.

Inspection Personnel:

Virginia Water Control Board:	Michael Baker, Jr., Inc.:	Owner's Representatives:
R. Gay	T. W. Smith J. M. Thompson W. L. Sheafer	R. J. Mayo, Amherst County Administrator

Soil Conservation Service:

W. G. Friend

W. L. Sheafer Recorder

EMBANKMENT

Name of Dam: BUFFALO RIVER No. 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed The area beyond the toe is smoothly graded and well seeded.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	The embankment and abutment slopes are generally well seeded. There is some sloughing and erosion in a 100 ft. long by 20 ft. wide maximum area of the upstream slope 50 ft. from the left abutment at 0 ft. to 10 ft. above the shoreline bench. The soil is wet, spongy, soft, light brown, micaceous clayey silt with some interspersed tree branches. There is a strip (5 ft. to 20 ft. wide) across the downstream slope near the bench that is partially bare with erosion rivulets in red clayey and sandy silt. There are 1 ft. to 2 ft. deep erosion gullies above and below the rock gutter at the left downstream abutment and adjacent to the lower end of the rock gutter on the right side of the upstream slope.	The wet soil and branches should be removed from the sloughing area and refilled and compacted with soil. The eroded bare areas should be manually graded and seeded.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	The vertical and horizontal alignment coincides with the as-built drawings.	

EMBANKMENT

Name of Dam: BUFFALO RIVER No. 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
RIPRAP FAILURES	Riprap sections were not designed or constructed for the embankment.	
SLOPES	The slopes were formed at 2.5:1 except for 3:1 below the upstream bench. The grass cover is thick and green except for some scattered small dried out brown areas. There are a few traces of small driftwood on the upstream shore.	
CONSTRUCTION MATERIALS	Red and brown clayey and sandy silts with variable amounts of rock fragments were observed on the surface. The as-built plans show a core, Zone 1, which extends down into the cut-off trench consisting of MH-ML plastic silt and clay. Zone 2 is comprised of non-plastic sandy silt SM and silty ML in the outside shell.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	The junctions of the embankment to the abutments are generally well seeded. The rock gutters located on the upstream and downstream slope on the right side and the lower left downstream slope have some grass growth and fallen branches. The soil consists of red and brown sandy and clayey silt with rock fragments at the abutment and junction areas. Limited exposures of hard gneiss with a 45° dip downstream to the south were observed on the upstream left abutment and the lower right abutment.	Branches in the rock gutters should be removed.
ANY NOTICEABLE SEEPAGE	None observed	

EMBANKMENT

Name of Dam: BUFFALO RIVER No. 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
STAFF GAGE AND RECORDER	None observed	A staff gage should be installed to monitor reservoir levels above normal pool.
DRAINS	A 6 in. perforated C.M.P. is shown in the as-built construction plans installed beneath the toe of the dam to collect drainage and outlets at the lower end of the principal spillway into the impact basin.	The drains were submerged by the tailwater; therefore, the flow could not be observed.
FOUNDATION	No indication of foundation distress, such as heaving, bulging, or seepage, was noted in the toe area of the downstream embankment.	

OUTLET WORKS

Name of Dam: BUFFALO RIVER No. 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	No spalling or cracking was observed on the exposed concrete surfaces of the outlet conduit.	
INTAKE STRUCTURE	The exposed concrete surfaces of the riser were in good condition at the time of inspection.	
OUTLET STRUCTURE	No cracks or spalling was observed on the impact basin surfaces.	
OUTLET CHANNEL	The outlet channel is lined for 100 ft. downstream from the impact basin with stone riprap except for portions washed away by swift currents. A small tree is growing through the rocks next to the left wing wall of the impact basin.	The sections where the stone has been washed away should be recovered. The tree should be removed.
EMERGENCY GATE	A 30 in. slide gate is located on the riser and may be used to drain the reservoir. The lift pedestal and stem appear in good working order.	

UNGATED SPILLWAY

Name of Dam: BUFFALO RIVER No. 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONTROL SECTION	The control section is 300 ft. wide and 30 ft. long with a crest elevation of 750.5 ft. M.S.L.	
APPROACH CHANNEL	There is a rock gutter for surface run off in a swale between the reservoir and the beginning of the spillway. Grass covers the red clayey silt in the approach channel. Highly weathered granite was excavated in a portion of the area. The approach channel has a 2% adverse slope.	
DISCHARGE CHANNEL	Grass covers most of the channel in red clayey silt with scattered shallow erosion gullies at the outlet end where soft decomposed granite is exposed. The channel outlets into a wooded swale. The discharge slope is approximately 3%.	It is recommended that the gullies be filled with compacted earth and seeded.
BRIDGE AND PIERS	Not Applicable	
SLOPES	The slopes of the spillway are cut at 3:1 on both sides in red clayey silt and brown sandy silt with rock fragments. Highly weathered granite extends above grade in a few areas as indicated by the Geologic Report. The slopes are covered by a good growth of grass with some small dried brown areas.	

INSTRUMENTATION

Name of Dam: BUFFALO RIVER No. 2

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	Bench marks noted on the as-built drawings were not located in the field.	
OBSERVATION WELLS	None observed	
WEIRS	None observed	
PIEZOMETERS	None observed	
OTHER		

RESERVOIR

Name of Dam: BUFFALO RIVER No. 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	The slopes are gentle to moderately steep in sandy and clayey silt with rock fragments. There is an occasional exposure of bedrock. The slopes are primarily wooded with grass in the flatter open areas adjacent to the shore.	
SEDIMENTATION	No sedimentation was noted that would deter the proper functioning of the dam and reservoir.	

DOWNSTREAM CHANNEL

Name of Dam: BUFFALO RIVER No. 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	The downstream channel was in good condition with no obstructions or debris.	
SLOPES	The slopes are approximately 5 ft. deep in silty sand and gravel in an open field. The right bank at a curve just downstream from the impact basin is covered with cobbles and boulders for erosion protection. The slope of the stream channel downstream of the dam is approximately 1%.	
APPROXIMATE NO. OF HOMES AND POPULATION	One house is located in the flood plain to the left of the stream approximately 1500 ft. downstream of the dam. Several other houses are located approximately 2 mi. downstream where Route 778 crosses the Buffalo River.	
CHANNEL	The bottom of the channel is in silty sand gravel and cobbles which protect it from down cutting.	

APPENDIX IV

CHECK LIST - ENGINEERING DATA

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

Name of Dam: BUFFALO RIVER No. 2

ITEM	REMARKS
PLAN OF DAM	The plan of dam is shown on the as-built drawings and is included in this report as Plate 2.
REGIONAL VICINITY MAP	The vicinity map is presented in this report as the Location Plan.
CONSTRUCTION HISTORY	The contractor and completion date were obtained from the as-built drawings. The dam was constructed by E. W. Yeatts, Inc. in 1977.
TYPICAL SECTIONS OF DAM	The typical sections are included in the as-built drawings and are presented in this report as Plate 5.
HYDROLOGIC/HYDRAULIC DATA	Hydrologic and hydraulic calculations were available.
OUTLETS - PLAN and DETAILS	Shown on the as-built drawings.
- CONSTRAINTS and DISCHARGE RATINGS	Contained in the hydrologic/hydraulic calculations.
RAINFALL/RESERVOIR RECORDS	No rainfall or reservoir records are available at the dam.

Name of Dam: BUFFALO RIVER No. 2

ITEM	REMARKS
DESIGN REPORTS	Design Reports were obtained from the SCS.
GEOLOGY REPORTS	Data on detailed geologic investigations are contained in the Design Report and included in Appendix VII.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS	Hydrology and hydraulic calculations were available for this inspection report.
DAM STABILITY SEEPAGE STUDIES	Stability and seepage analyses were available for this inspection report and are included in Appendix VI.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Test pit and boring records, compaction curves, and results of the laboratory analyses were printed in the as-built drawings and/or in the Detailed Geologic Report.
POST-CONSTRUCTION SURVEYS OF DAM	No known post-construction surveys were found.
BORROW SOURCES	Borrow sources in the reservoir area are shown on the as-built drawings and are discussed in the Geologic Report.

Name of Dam: BUFFALO RIVER No. 2

ITEM	REMARKS
MONITORING SYSTEMS	No monitoring systems have been provided.
MODIFICATIONS	Data obtained during the inspection agrees closely with the as-built drawings, indicating that no major modifications were made other than modifications recorded on the as-built drawings.
HIGH POOL RECORDS	None available
POST-CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None available
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	No prior accidents or failure of the dam have been noted.
MAINTENANCE OPERATION RECORDS	Annual inspections are conducted by the SCS and County personnel. Copies of the reports are included in Appendix V.

Name of Dam: BUFFALO RIVER No. 2

ITEM	REMARKS
SPILLWAY PLAN, SECTIONS, and DETAILS	Information contained in the as-built drawings.
OPERATING EQUIPMENT PLANS & DETAILS	Information contained in the as-built drawings.

APPENDIX V

OPERATION AND MAINTENANCE INSPECTION REPORTS

CHECK LIST FOR SAFETY INSPECTION OF DAMS

Ref: Advisory ENG VA-31 Dec. 29, 1977

Site #2 Buffalo River Inspection Date JAN. 1979

1. Embankment

a. Settlement

None

b. Slope Stability

Back berm holds water

Outlet end need to be lower

c. Seepage

none

d. Drainage Systems

Ok

e. Slope Protection

Need Fertilizer & Lime

Outlet ends of Guthens need Ripair

2. Principal Spillway

a. Riser Concrete

Ok

b. Trash Racks

Ok

c. Control Gates & Operating Machinery

Ok

c. Potential Upstream Hazard Areas

None

d. Watershed Runoff Potential

Same AS DESIGNED

6. Maintenance

d. Conduit

OK

e. Cradle & Bent

OK

f. Stilling Basin or Impact Basin

high WATER HAS MOVED RIPRAP ON Slope & BOTTOM OF CHANNEL

g. Outfall Channel

OK

3. Emergency Spillway

a. Approach & Outlet Channels

Good

b. Level Section

Good

c. Cut and/or Fill Slopes

Good

Cover poor
Need RESEEDING
FERTILIZER & Lime

4. Borrow Areas STEEP AREAS HAVE SMALL WASHES SOME AREAS NEED RE SEEDING, FERTILIZER LIME

5. Reservoir

a. Shoreline

Good

b. Sedimentation

None

Warren G. Friend	SUBJECT
E. R. Simmons	WS - Buffalo River Sites 2 & 3

(WRITE CONCISE MESSAGE. SIGN AND FORWARD PARTS 1 AND 2 TO ADDRESSEE. RETAIN PART 3)

Have you looked at Buffalo River structures # 2 and # 3 to determine if any vegetative work needs to be done this fall?

The seeding season is almost here and considering the time required to contract for work, plans should be under way to get it done.

8341

SIGNATURE

(USE THIS SPACE FOR REPLY. SIGN AND DATE. RETURN PART 2 TO SENDER. RETAIN PART 1)

I have looked at the Buffalo River Structures to determine the extent of needed vegetative work.

Site #3 (Stonehouse) - Cover is excellent! Does need fertilizer, especallly on the spillway and spillway slopes. No reseeding necessary. Three or four small gullies need some hand repair. Can do this with AID.

Site #2 (Thrashers) - Cover is generally adequate. There are three relatively small areas of very limited vegetation where the grading was done in the Spring; however, this is the area that will be torn up for the access road, and it does not seem reasonable to plan any revetation. In spots much of the cover is annual - lespedeza, ryegrass, and weeds. It is difficult to tell what percentage of the cover is actually prennial. There is considerable seeding from the mature grasses (both ryegrass and fescue) and this should provide even more dense cover. Even if this provides mainly mulch, it should stabilize the area. It seems that additional fertilization might be in order, but I question the advisability of doing any re-seeding.

I will discuss this in more detail with you on Wednesday.

SIGNATURE | DATE 8/4/78

FORM AD-311 (REV 5-68)

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

P.O. Box 10026 - Richmond, Virginia 23240

SUBJECT: WS - Grass Seeding Recommendations
Buffalo River, Site 2

DATE: April 7, 1978

TO:
E. R. Simmons, Area Conservationist
SCS, Chase City, Virginia

The following recommendations are made for vegetative repair work on Buffalo River, Site 2, after our visit on 4/6/78:

1. Topdress entire seeded area with 500 lbs./acre of 10-10-10 fertilizer or equivalent as soon as possible. Consider mixing 15 lbs./acre of KY31 tall fescue seed into bulk fertilizer before spreading.

2. Reseed selected areas which are being measured and delineated by Warren Friend (approximately 8.5 acres). Where possible, use a no-til pasture seeder (zip-seeder) to insure direct soil-seed contact. In areas that are too steep or have too much straw mulch for proper operation of the no-til seeder, lightly disk the areas, broadcast seed with a cyclone seeder, and follow with a drag harrow and cultipacker. Use 35 lbs. of KY-31 tall fescue seed and 15 lbs. of Korean lespedeza seed per acre. Consider going to 50 lbs. of fescue per acre on these areas if the 15 lbs. of seed is not mixed in bulk fertilizer for spreading on the entire site.

3. On the small area that has sloughed off on the front side of the dam, consider applying 500 lbs. of lime and some hand work to scarify the soil, seed with a hand cyclone seeder using the above mentioned seeding rates, cover the seed with hand rakes, and mulch with straw. Excess soil material that has moved down slope can be spread back on area to be seeded.

Willis Miller
Willis Miller
Conservation Agronomist

cc: Warren Friend

W. G. Friend

FROM

E. R. Simmons

SUBJECT

WS - Seeding, Site 2
Buffalo River Watershed

MESSAGE

I talked with Willis Miller today about the seeding of sericea on Dam # 2 this spring. We concluded that overseeding at this late date would probably prove to be fruitless. We decided to take a close look at both Sites 2 and 3 in July to determine needs for repairs at that time.

July 9 was selected as the date to meet with you and go over the dams. Please note that on your calendar.

SIGNATURE

REPLY

SIGNATURE

DATE

(DESTROY THIS PART 3 UPON RECEIPT OF REPLY)

FORM AD-311 (REV. 5-68)

Frank Holt	SUBJECT
E. R. Simmons	ES - Seeding, Site 2, Buffalo River Watershed

GE

Attached is AS-MGT-14 from Warren Friend which deals with Site # 2 of Buffalo River Watershed in Amherst.

I believe the overseeding with sericea is too late for this year. Perhaps, if Willis Miller has time, he should take a look at the site in the near future.

ATURE

NATURE | DATE

STROY THIS PART 3 UPON RECEIPT OF REPLY)

FORM AD-311 (REV. 5-68)

AL SERVICES ADMINISTRATION PROC REG. (41 CFR) 1-16.201	(THIS IS NOT AN ORDER)	1

QUEST NO	2. DATE ISSUED	3. REQUISITION/PURCHASE REQUEST NO.	4. CERTIFIED FOR NATIONAL DEFENSE UNDER DPS REG. 1 AND/OR DMS REG. 1 RATING:
	2-27-78		

SUED BY

USDA, Soil Conservation Service
P. O. Box 10026
Richmond, Virginia 23240

6. DELIVER BY (Date)
As requested by SCS

7. DELIVERY
[X] FOB DESTINATION [ ] OTHER (See Schedule)

NFORMATION CALL (Name, area code and tel. no.) (No collect calls) S. E. Hall (804) 782-2480

) NAME AND ADDRESS (Street, city, state, and ZIP code)

9. DESTINATION (Consignee and address including ZIP code)
Site 2, Buffalo River W/S
Amherst County, Virginia

Please furnish quotations to the issuing office on or before ~~close of business~~ 10:00 AM (date) 3-6-78. Supplies are of domestic origin unless otherwise indicated by or. This is a request for information, and quotations furnished are not offers. If you are unable to quote, please so indicate on this form and return it. This request does not commit the government to pay any costs incurred in the preparation or the submission of this quotation, or to procure or contract for supplies or services.

SCHEDULE

11. ITEM NO.	12. SUPPLIES/SERVICES	13. QUANTITY	14. UNIT	15. UNIT PRICE	16. AMOUNT
1	Rock Riprap	650	Ton		
2	No. 2 Highway Stone	270	Ton		
	The attached Form AD-838, Purchase Order, will be the document used in ordering the services listed herein. Offerors should be aware of the terms and conditions on the reverse of form AD-838 and the continuations thereto.				

PRICES QUOTED INCLUDE APPLICABLE FEDERAL, STATE, AND LOCAL TAXES.

COUNT FOR PROMPT PAYMENT _____ % 10 CALENDAR DAYS _____ % 20 CALENDAR DAYS _____ % 30 CALENDAR DAYS _____ % _____ CALENDAR DAYS

NOTE: Reverse must also be completed by the quoter.

NAME AND ADDRESS OF QUOTER (Street, city, county, State, including ZIP Code)	19. SIGNATURE OF PERSON AUTHORIZED TO SIGN QUOTATION	20. DATE OF QUOTATION
	21. SIGNER'S NAME AND TITLE (Type or print)	22. TELEPHONE NO. (Include area code)

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

P. O. Box 10026, Richmond, Virginia 23240

JBJECT: AS - Buffalo River Watershed, Site 2 DATE: March 28, 1978

O: Warren Friend
District Conservationist
SCS, Amherst, VA

This is to advise that bids received for vegetation of the above site were in excess of our engineer's estimate. Therefore, a decision was made to reject all bids.

As discussed by telephone with Willis Miller, Conservation Agronomist, the stone will be purchased, but the site will not be seeded at this time.

Bernard Perry
State Administrative Officer

cc: E. R. Simmons, AC, Chase City

APPENDIX VI

STABILITY ANALYSES

UNITED STATES DEPARTMENT OF AGRICULTURE

SUBJECT: ENG 13-18, Virginia WF-08, Buffalo River, Thrashers Creek, Site No. 2 (Amherst County) DATE November 25, 1975

TO: Louis S. Button, Jr.
State Conservation Engineer
Soil Conservation Service
Richmond, Virginia

ATTACHMENTS

1. Form SCS-ENG-354, Soil Mechanics Laboratory Data, 3 sheets.
2. Form SCS-ENG-128 & 128A, Consolidation Test Data, 1 test, 3 sheets.
3. Form SCS-127, Soil Permeability Data, 1 sheet.
4. Form SCS-ENG-355A & B, Triaxial Shear Test Data, 3 tests, 6 sheets.
5. Form SCS-352, Compaction and Penetration Resistance, 7 sheets.
6. Form SCS-130, Drain Materials, 1 sheet.
7. Form SCS-357, Summary - Slope Stability Analysis, 5 sheets.
8. Form RTSC-FW-ENG-42, Determination of s and Probable Joint Gaps, 1 sheet.
9. Investigational Plans and Profiles, 13 sheets.

INTRODUCTION

The proposed 73-foot high, class c hazard embankment is located in the Inner Piedmont physiographic area in west central Virginia in Amherst County.

The silty alluvial materials in the upper portion of the floodplain are weak and have low density. Considerable berming is required if the weak foundation alluvium is not removed.

DISCUSSION

FOUNDATION

A. Classification. The floodplain has 3 to 7 feet of silty alluvium overlying gravelly deposits. The samples of the shallow silty alluvium from the left side of the floodplain vary from moderately plastic ML to CH or MH materials. The two deeper gravelly samples from the drain line are GP materials with only 5% fines.

Highly fractured and weathered granite occurs to depths of 59 feet in the left abutment.

The steeper right abutment has granite gneiss at or near the surface.

B. Dry Unit Weight. The dry densities of the test specimens from the shallow silty alluvial samples varied from 1.42 gm/cc (88.6 pcf) to 1.55 gm/cc (96.7 pcf).

C. Consolidation. A one-dimensional consolidation test was made on the ML or MH sample, 1.1 (76W39). The test specimen was loaded to 4000 psf in its natural moisture condition (w = 23.3%) to avoid swelling. It was then saturated under the 4000 psf load and loaded to 16000 psf.

The test specimen consolidated approximately 5% under the 6600 psf load of the proposed 58-foot high embankment at dam ℄ station 4+50.

The dial-time curves indicate that well over half of the consolidation will occur during a 90-day construction season.

D. Permeability. The falling head permeability test on the consolidation test specimen was extrapolated to obtain a permeability rate of approximately 0.07 foot per day for the no-load condition. High permeability rates (3 to 12 fpd) were obtained frequently in the field pressure tests in the fractured and weathered rock in both abutments. (See Sheet 7 of 13 in the geologic report.)

E. Shear Strength. A consolidated undrained triaxial shear test was made on the moderately plastic ML, alluvial sample 1.2 (76W40) from the 3- to 4-foot depths at dam ℄ station 4+50. The 1.4-inch diameter test specimens were backpressured to full saturation on the shear machine. Pore pressures were measured during shear testing so that the effective stress shear parameters could be determined.

The shear test data was interpreted to give total stress shear parameters of $\phi = 14.5°$ and c = 325 psf. The effective stress shear parameters were determined to be $\overline{\phi} = 32°$ and $\overline{c} = 125$ psf.

An unconfined compression test on the same sample at natural moisture content yielded a value of c = 900 psf. The test specimen contained 27.3% moisture, which was calculated to be 90.4% of theoretical saturation.

The underlying gravelly alluvium was not tested; however, it is assumed the coarse, hard, angular, gravelly materials will have sufficient strength to limit a potential failure to the compacted embankment materials, based on the gradation of the samples received and the descriptions in the logs from the field investigation.

EMBANKMENT

A. Classification. The major portion of the embankment will be constructed of residual ML and MH soils from the emergency spillway excavation, the adjacent borrow areas, and the right abutment borrow area. The borrow samples submitted were mostly moderately plastic ML and MH. Plasticity indices of these materials varied from 15 to 22 and the liquid limits varied from 46 to 63.

Some non-plastic ML and SM materials will also be used.

B. Compacted Dry Density. Standard Proctor compaction tests (ASTM D-698, Method A) were made on the 7 borrow samples that were submitted to the Soil Mechanics Laboratory. Maximum dry densities of the two MH samples were 90.0 and 95.0 pcf with optimum moisture contents of 30% and 25%, respectively. Dry densities of the ML samples varied from 101.0 pcf to 104.5 pcf with optimum moisture contents of 20% to 21%. The SM sample yielded a maximum dry density of 108.0 pcf at an optimum moisture content of 17%.

C. Shear Strength. Consolidated undrained triaxial shear tests were made on the MH sample 110.1 (76W50) and on the non-plastic ML sample 110.2 (76W51). The 1.4-inch diameter test specimens were molded slightly wet of optimum to approximately 95% of Standard Proctor density and then backpressured to full saturation on the shear machine. Pore pressures were measured during shear testing.

The results of the two shear tests are tabulated below.

Sample No.		Average Density pcf	Unified Class.	Shear Parameters			
				Total Stress		Effective Stress	
Field	Lab. 76W			ϕ, deg.	c, psf	$\bar{\phi}$, deg.	$\bar{c}$, pcf
110.1	50	86.4	MH	14	725	30.5	250
110.2	51	96.0	ML	18	*1650	36	0

*Negative pore pressures developed for the 10 psi test specimen.

D. Consolidation. Volume change measurements of the triaxial test specimens during the consolidation phase of the shear testing show the compacted fine grain materials will consolidate approximately 4% under the load of the 60-foot high floodplain section.

STABILITY ANALYSIS

The proposed 73-foot high, class c hazard dam was analyzed using the ICES computer program and the NAVDOCKS sliding block method.

The embankment-only analysis of the maximum section shows adequate safety factors for the proposed slopes for materials compacted to 95% of Standard Proctor density; however, the sliding block analysis of the floodplain section at dam ℄ station 6+00 shows the silty foundation alluvium is not adequate without adding wide berms. The full drawdown analysis of $2\frac{1}{2}$:1 over 3:1 upstream slope shows a 100-foot wide berm at elevation 720.0 is required to obtain an adequate safety factor. See trial #10 in the attached slope stability summary for details. The steady seepage analysis of the downstream $2\frac{1}{2}$:1 slope with a drain at c/b = 0.6 shows a 74-foot berm is needed at elevation 725.5 to obtain a satisfactory safety factor.

SEEPAGE ANALYSIS

A seepage analysis was made using the method of R. Chung Y. Lo as taught in the Harvard soil mechanics course. The shape factors were calculated using Dachler's equations.

A 140-foot wide zone of weathered and broken rock with a permeability rate of 9.0 fpd was used for the left abutment. A 100-foot wide permeable zone with a rate of 5.0 fpd was used for the right abutment. A 250-foot wide zone of permeable rock with a rate of 9.0 fpd was considered under the dam to approximate the permeable zones as shown on Sheet 7 of 13 in the plans and profile sheets.

For a full reservoir situation, a permeability rate of approximately 0.15 cfs was calculated for the left abutment. The deeper, more narrow and more sloping permeable zone in the right abutment also yielded approximately 0.15 cfs. The underseepage was calculated at approximately 0.1 cfs for the full reservoir situation.

RECOMMENDATIONS

A. Centerline Cutoff. A 20-foot wide cutoff with 1:1 side slopes extending down through the alluvial silts and gravels to the underlying weathered bedrock is recommended across the floodplain to reduce the amount of seepage under the dam that the drain will need to handle and to reduce the piping potential of the underseepage through the permeable bedrock.

B. Drainage. A foundation trench drain at c/b = 0.6 is recommended below the emergency spillway elevation to provide a controlled outlet for seepage that bypasses the centerline cutoff and for seepage through the highly pervious rock abutments. The drain should extend down to the clean underlying gravelly alluvium. A steeply-graded, coarse gravel with high capacity will be required to drain the GP materials like samples 501-2 (76W44) and 505.1 (76W45). See the attached Form SCS-130 for the suggested filter limits.

C. Principal Spillway. The proposed location at dam ℄ station 6+05 appears satisfactory. Pipe elongation calculations following the method of Technical Release No. 18 (Rev.) show a horizontal strain of less than 0.002 ft/ft. See the attached Form RTSC-FW-ENG-42 for the calculations.

D. Embankment Design. The following are recommended:

1. Selectively place the MH and the more plastic ML borrow materials in the center and upstream sections of the embankment. Place the non-plastic ML and SM materials in the downstream section. The berms can be constructed of anything available as their function is dead weight resistance.

2. Place the embankment materials at or above optimum moisture content and compact to a minimum density of 95% of Standard Proctor density (ASTM D-698, Method A).

3. Provide a 2½:1 upstream slope above a 100-foot wide berm at elevation 720.0 and a 3:1 slope below the berm. Provide 2½:1 downstream slopes with a 74-foot berm at elevation 725.5. The wide berms can be eliminated if the weak silty alluvium is removed from the upper portion of the floodplain on the left side of the channel.

4. Provide an overfill of 1.0-foot across the floodplain to compensate for residual foundation and embankment consolidation after construction is complete.

Prepared by:

Edgar F. Steele
Civil Engineer

Reviewed and Approved by:

Lorn P. Dunnigan
Head, Soil Mechanics Laboratory

Attachments

cc:
Louis S. Button, Jr. (4)
Arthur B. Holland, Broomall, PA

	SOURCE AND USE OF MATERIALS	CLASSIFICATION	ADOPTED DESIGN DATA: Yd (pcf)	Ym (pcf)	Ysat (pcf)	Ysub (pcf)	φ (deg)	tan φ	c (psf)	REMARKS
①	Foundation	ML	90.9		120.0	57.5	14.5	.259	325	
②							32	.625	125	
③	Embankment	MH	86.5	112.5	117.5	55.0	19	.249	725	
④							30.5	.539	250	
⑤	Embankment	ML	96.1	115.5	123.0	60.5	18	.325	1650	
⑥							36	.727	0	
⑦										
⑧										

METHOD OF ANALYSIS: REES

ANALYZED BY:

APPROVED BY:

TRIAL NO.	SLOPE	CONDITIONS	F_s BISHOP	F_s SPENCER CIRCLE E
		Upstream-Fulldrawdown Dnstr.-Steady seepage		
		Maximum Section @ Station 7+90		
1Up	2½:1/3:1	Embank. (30.5°-250) only, 10' berm @ elev. 720.0.	1.27	1.27
1A Up	2½:1/3:1	Embank. (30.5°-250) only, 20' berm @ elev. 720.0.	1.37	1.36
		By interpolation 18' berm @ elev. 720.0.	1.35	1.34
2Dn	2½:1	Embank. (14°-725) only, 10' berm @ elev. 725.5, Drain @ c/b = 0.6.	1.53	1.48
		Flood Plain Section @ Station 6+00		
3Up	2½:1/3:1	Embank. (30.5°-250) & 7' Found. (14.5°-325), 10' berm @ elev. 720.0.	1.06	1.06
4Up	2½:1/3:1	Embank. (30.5°-250) & 7' Found. (14.5°-325), 40' berm @ elev. 720.0.	1.30	1.29
5Up	2½:1/3:1	Embank. (30.5°-250) & 7' Found. (14.5°-325), 50' berm @ elev. 720.0.	1.34	1.37
		By interpolation 46' berm @ elev. 720.0.	1.35	1.34
6Dn	2½:1	Embank. (14°-725) & 7' Found. (14.5°-325), 12' berm @ elev. 725.5. Drain @ c/b = 0.6.	1.53	1.39
7Dn	2½:1	Embank. (14°-725) & 7' Found. (14.5°-325), 20' berm @ elev. 725.5, Drain @ c/b = 0.6.	1.42	1.40
8Dn	2½:1	Embank. (14°-725) & 7' Found. (14.5°-325), 30' berm @ elev. 725.5, Drain @ c/b = 0.6.	1.52	1.50
		By interpolation 28' berm @ elev. 725.5	1.50	1.33

VI-6

Sheet 7 of 13

PROJECT AND STATE: BUFFALO RIVER #1 [illegible]

DATE: 10-31-75

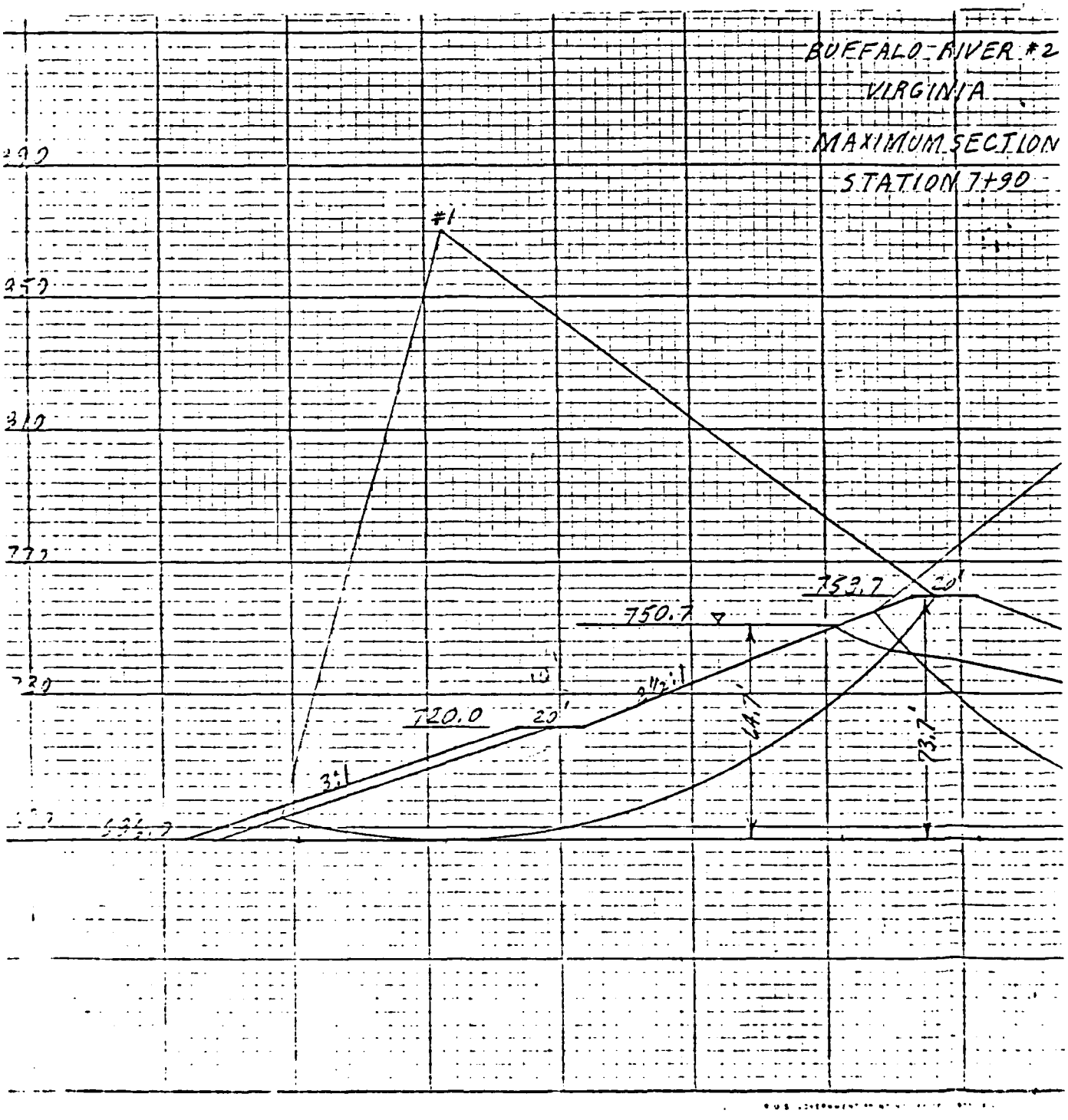
METHOD OF ANALYSIS: SLIDING BLOCK (NEUTRAL [illegible])

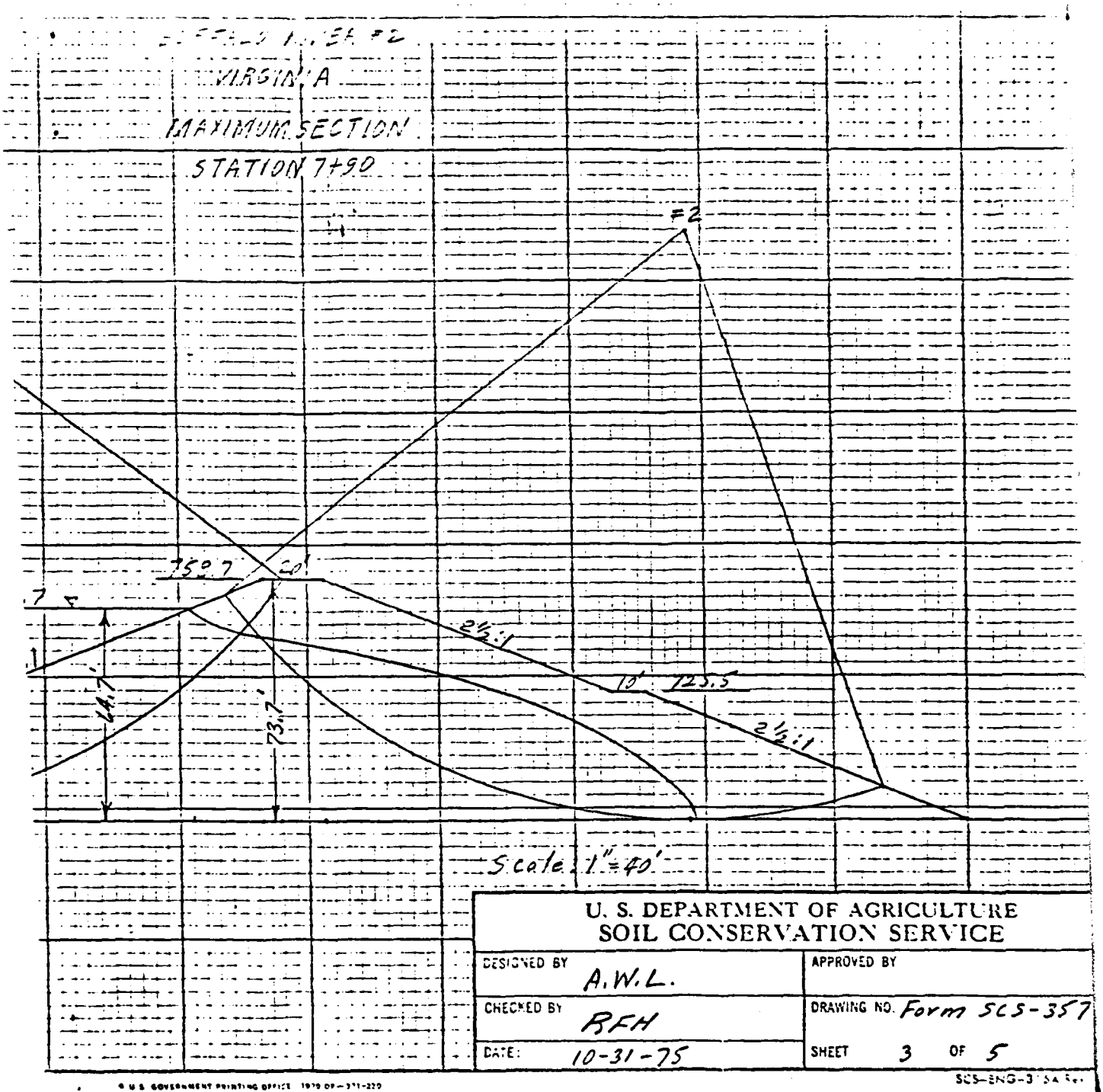
ANALYZED AT: S.M.L., LINCOLN, NE.

APPROVED BY:

	SOURCE AND USE OF MATERIALS	CLASSI-FICA-TION	ADOPTED DESIGN DATA γ_d (pcf)	γ_m (pcf)	γ_{sat} (pcf)	γ_{sub} (pcf)	ϕ (deg.)	tan ϕ	c (psf)	REMARKS
①										
②										
③										
④										
⑤										
⑥										
⑦										
⑧										

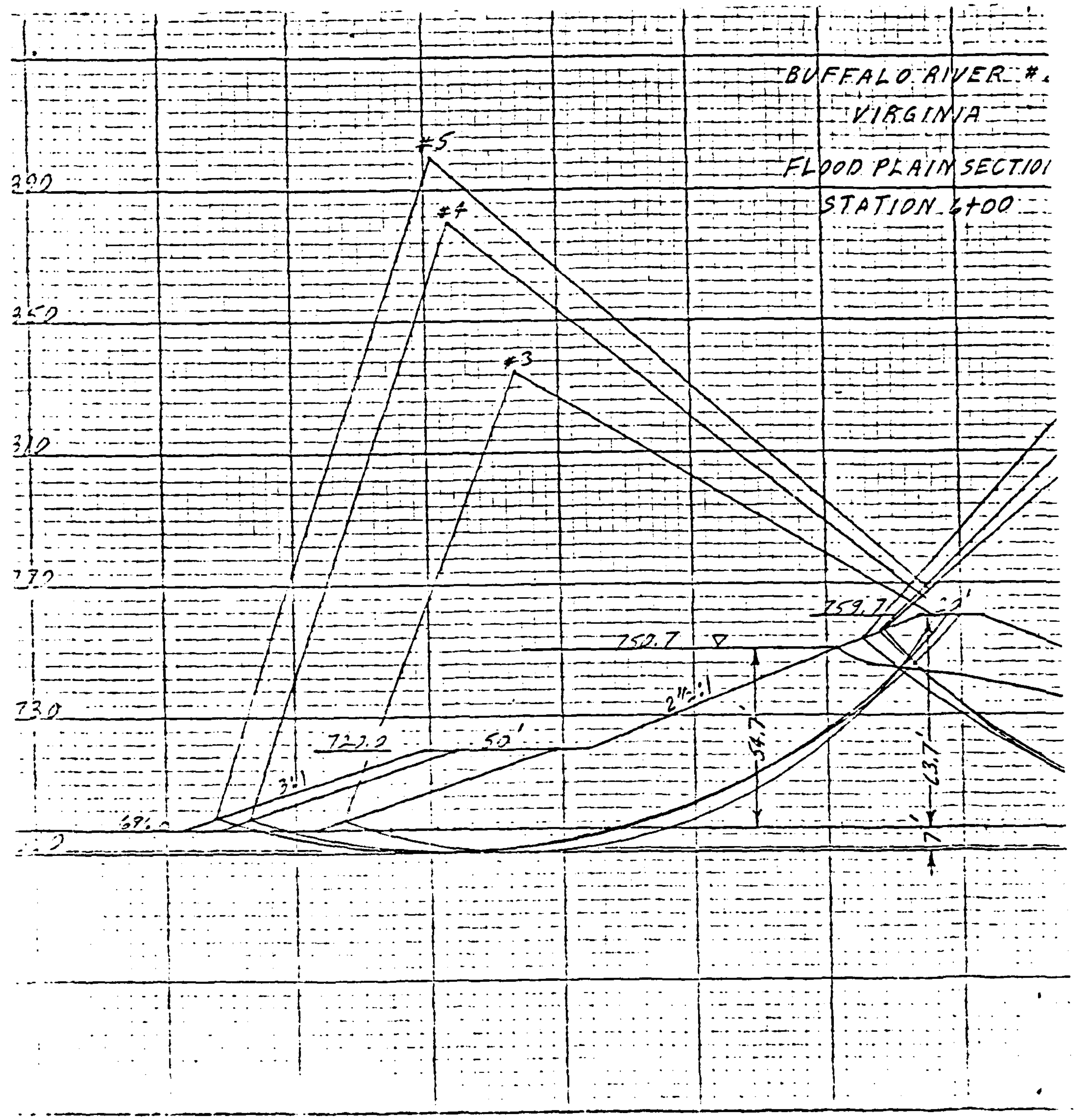
TRIAL NO.	SLOPE	CONDITIONS	F_s
		Upstream-Fulldrawdown CONDITIONS Dnstr.-Steady Seepage	
		Flood Plain Section @ Station 6+00	
9Up	2½:1/3:1	Embank. (30.5°-250) & 7' Found (14.5°-325), 10' berm @ elev. 720.0.	1.08
10Up	2½:1/3:1	Same conditions as trial #9 except 100' berm @ elev. 720.0.	1.35
11Dn	2½:1	Embank. (30.5°-250) & 7' Found. (14.5°-325), 10' berm @ elev. 725.5, Drain @ c/b=0.6.	1.20
12Dn	2½:1	Same conditions as trial #11 except 74' berm @ elev. 725.5.	1.50


BUFFALO RIVER #2
VIRGINIA
MAXIMUM SECTION
STATION 7+90
#1
750.7
753.7
20'
720.0
20'
3:1
2½:1
14.1'
73.7'

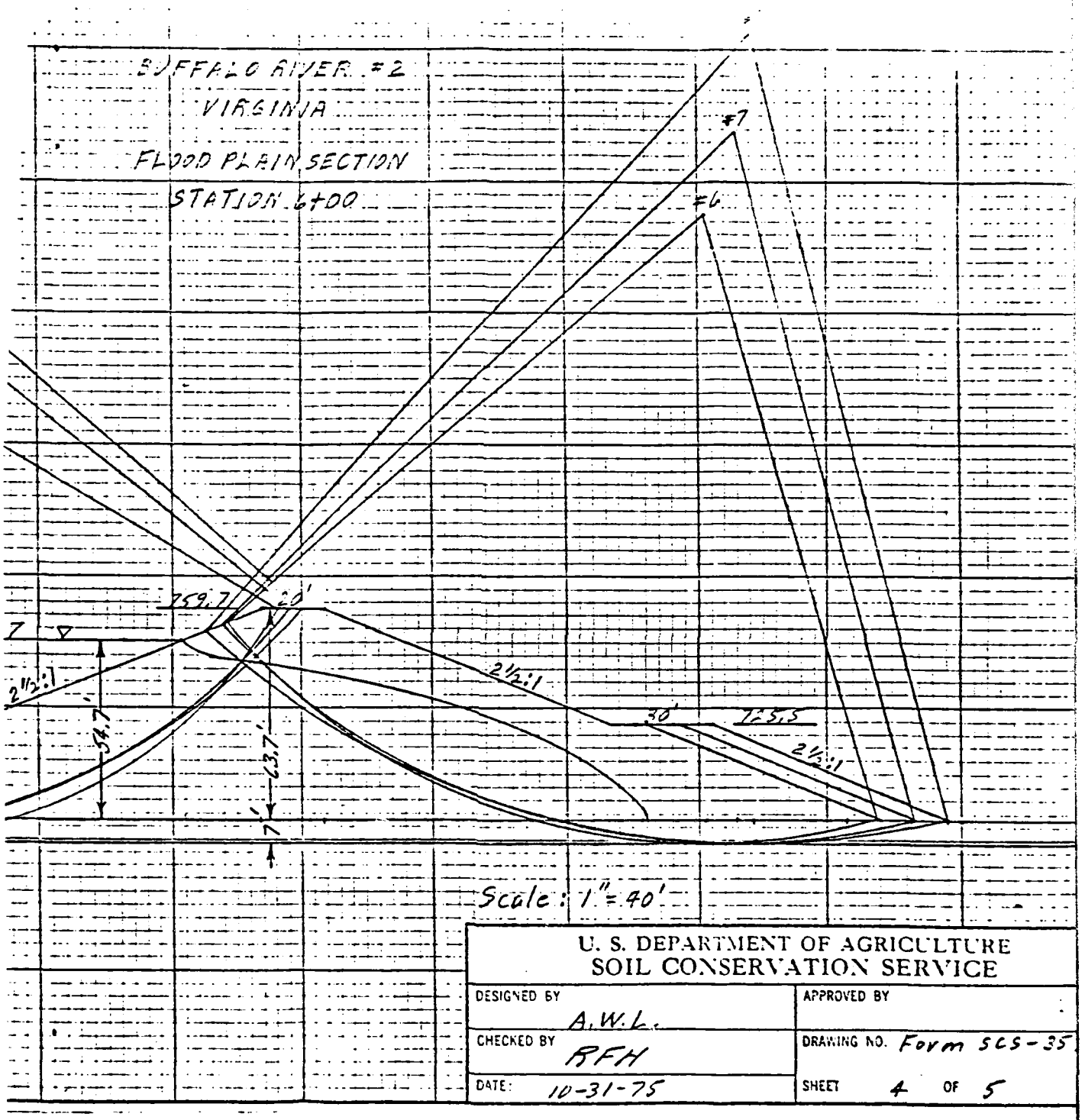


U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	
DESIGNED BY A.W.L.	APPROVED BY
CHECKED BY RFH	DRAWING NO. Form SCS-357
DATE: 10-31-75	SHEET 3 OF 5

SCS-ENG-3 (5A Rev.)



BUFFALO RIVER #
VIRGINIA
FLOOD PLAIN SECTION
STATION 6+00
#5
#4
#3
759.7
752.7
720.0
50'
3:1
54.7'
63.7'
7'



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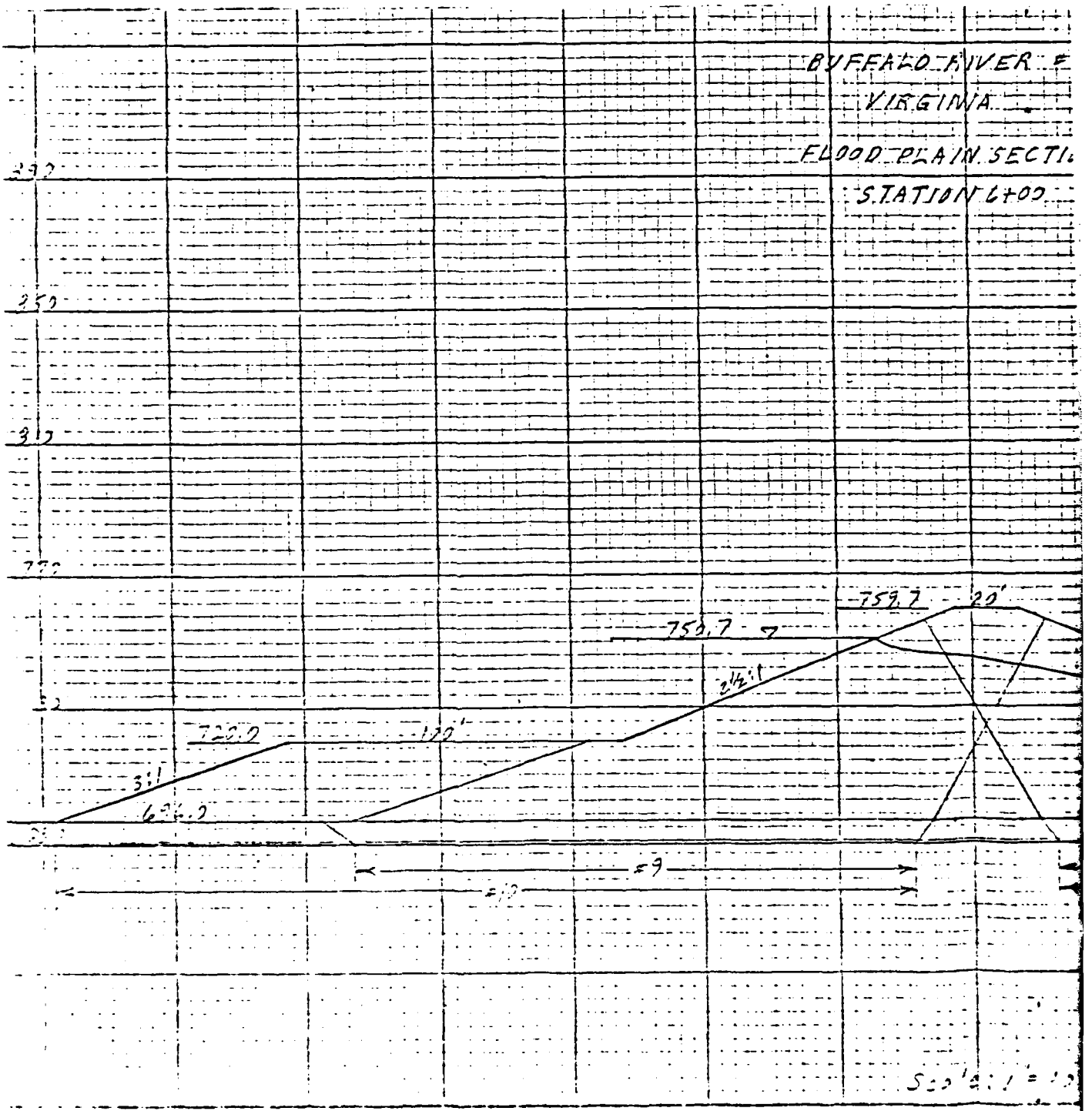
CHECKED BY RFH	DRAWING NO. Form SCS-35
DATE: 10-31-75	SHEET 4 OF 5

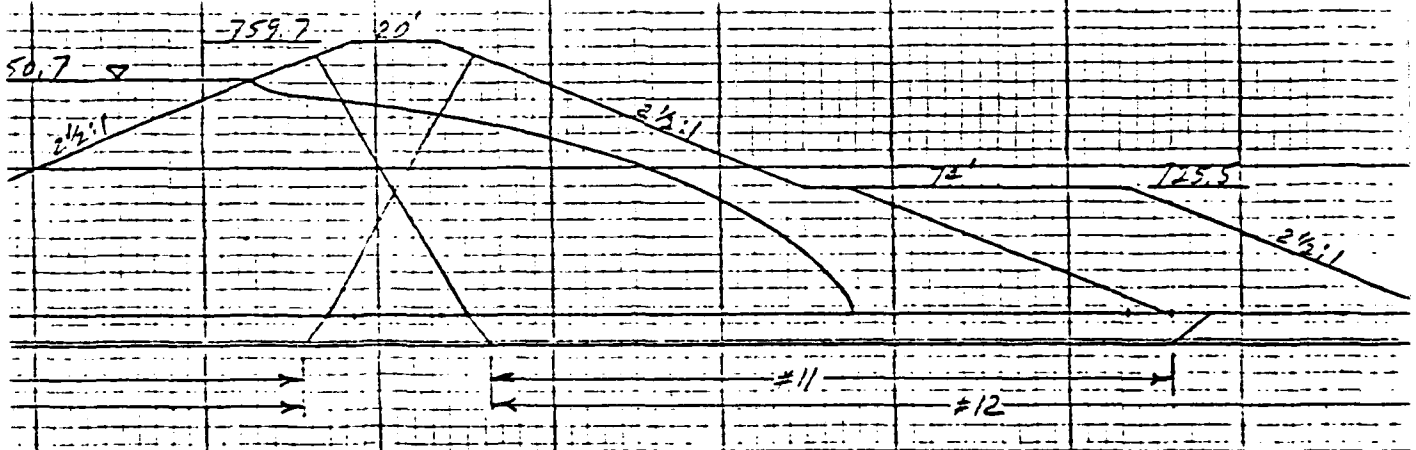

BUFFALO RIVER F
VIRGINIA
FLOOD PLAIN SECTI
STATION 6+00
759.7
20'
753.7
2½:1
720.0
120'
3:1
60'
59

BUFFALO RIVER #2

VIRGINIA

FLOOD PLAIN SECTION

STATION 0+00



Scale: 1" = 40'

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SCS-ENG-315A Rev. 1

APPENDIX VII

GEOLOGIC REPORT

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES
Drilling Supplement

GENERAL

State Virginia County Amherst ; — ¼, — ¼, Sec. —, T —, R —, Watershed Buffalo River

Subwatershed Thrashers Creek Fund class 08 (FP-2, WP-1, etc.) Site number 2 Site group I Structure class C

Investigated by T. Mack, Geologist (signature and title), Equipment used Failing 500 drill (type, size, make, model, etc.), Date

SITE DATA

Drainage area size 6.80 sq. mi., 4352 acres. Type of structure Earth fill Purpose Recreation and Flood control

Direction of valley trend (downstream) southeast Maximum height of fill 69.4 feet. Length of fill 815 feet.

Estimated volume of compacted fill required 252,700 yards

STORAGE ALLOCATION

	Volume (ac. ft.)	Surface Area (acres)	Depth at Dam (feet)
Sediment	477	36	24
Floodwater	1274	78	58
Total	1751		

SURFACE GEOLOGY AND PHYSIOGRAPHY

Physiographic description Inner Piedmont Topography mountainous Attitude of beds: Dip — Strike —

Steepness of abutments: Left 22 percent; Right 66 percent. Width of floodplain at centerline of dam 460 feet

General geology of site:

The drill holes showed that granite rock is present in conjunction with the granite gneiss and pegmatite. Also that a fault occurs on the left abutment with quartzite and chlorite schist present below the fault zone.

Centerline of the dam

Drill holes on the dam centerline showed the depth of the GM alluvial cobbles occurring here to range from 8.5 feet to 13.0 feet. This layer is underlain by weathered granite gneiss and saprolite that ranges in depth from 13.0 feet to 0.5 feet.

Rock types present in the flood plain are granite gneiss, granite and syenite. On the right side of the flood plain the granite is weathered. Depth to

USDA SCS HYATTSVILLE, MD. 1969

unweathered granite in the flood plain ranges from 13.5 to 22.0 feet.

On the left abutment highly fractured and weathered granite extends to depth of 63.0 feet or approximately to elevation 680. A void occurs at depth 55.0 to 56.5 with slickensides present. This void with slickensides is considered to be a fault. It is in quartzite. Chlorite schist and weathered chlorite schist occur below the fault surface.

In this area the depth of permeable rock ranges to 59.0 feet or to elevation 688. Water losses as measured through standard pneumatic testing equipment range to over 20 gpm. In this fractured permeable area core recovery is low. It ranges down to 22 percent at depth of 48 feet in DH 23.

The steep right abutment has granite gneiss present. DH 28 emplaced on this abutment showed this rock to have 100 percent to 96 percent recovery below depth of 30.0 feet. This drill hole had impermeable rock below depth of 55.0 feet or elevation 707. The rock is unfractured below depth of 53.3 in DH 28.

Eleven holes were placed on the dam centerline. These are numbered DH 21 through DH 31.

Centerline of the Pipe

The drill holes placed on the pipe centerline showed alluvial GM and SM material to range in depth from 10.5 to 14.0 feet. Below this is weathered gneiss and saprolite that ranges in depth to 25.5 feet.

Granite, granite gneiss and syenite are the rock types occurring below the pipe centerline. This rock is unfractured from the dam centerline upstream. It is fractured to depth of 19.4 feet downstream as shown by DH 321 and DH 322.

The rock on the pipe centerline is impermeable except for a zone of permeable rock in DH 321 (Station 4+00 centerline pipe) that extends from 15.0 to 18.0 feet in depth. All drill holes show good recovery with almost all runs placing 100 percent of the core in the core box.

DH 321 through DH 324 were placed on the pipe centerline.

Seepage Drain

The two drill holes placed in the approximate area of the seepage drain showed the granite gneiss hard rock surface to be at 15.0 feet in depth. This is overlain by GM material and weathered granite gneiss. Recovery of core is generally good. The gneiss is permeable to slightly permeable to depth of 26.0 feet.

Drill hole 321 was placed in the approximate drain area on the right side of the flood plain.

Emergency Spillway

The seven drill holes placed in the emergency spillway showed the top of granite and fracture granite to range from 14.0 feet above grade to below grade. On the spillway centerline this rock is 14.0 above grade upstream from the dam centerline. On the outside edge of the cut granite occurs above grade downstream from the dam centerline.

On the outside edge of the cut the granite is fractured from 7.0 to 3.0 feet below the top of rock. Below this fractured zone here the rock is highly fractured. Thus it appears that in this area the granite becomes more fractured with depth. On the emergency spillway centerline the granite is fractured and weathered from top of rock to below grade. Above grade in the emergency spillway cut rock recoveries and RQD are low.

DH 221 through DH 227 were emplaced in the emergency spillway cut.

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

WATERSHED	SUBWATERSHED	COUNTY	STATE
Buffalo River	Thrasher's Creek	Amherst	Virginia

SITE NO.	SITE GROUP	STRUCTURE CLASS	INVESTIGATED BY (SIGNATURE OF GEOLOGIST)	DATE
2	I	C	[signature]	4/75

FOR IN-SERVICE USE ONLY

INTERPRETATIONS AND CONCLUSIONS

1. The zone of permeable rock that occurs on the left abutment from station 1+85 to station 3+65 on the dam centerline and to elevation 688 depth endangers the capability of the dam to hold water. Secondary permeability due to faulting is high. Consideration of either grouting this area or removal of this fractured rock below cutoff must be implemented. This measure can be terminated several feet below elevation 688.

2. Of lesser concern to the empoundment ability of the dam is the fractured permeable granite and gneiss on the right side of the flood plain and on the right abutment from station 8+00 centerline of the dam to the top of the dam on the right abutment. This permeable area extends to 38.0 foot depth in the flood plain and to 55.0 foot depth on the right abutment. Parts of this area are considered to be capable of taking grout using the rule of thumb that grout can be pumped into rock where the water take is 10 gpm or over under moderate pressure. The necessity of grouting this area is to be considered.

3. Emplacement of a toe drain in the permeable GM material may prove necessary to insure removal of water from the downstream slope of the embankment if positive cutoff is not to be obtained through extensive grouting of both abutments.

4. The alluvial ML and GM material occurring in the flood plain should have sufficient bearing strength to hold the weight of the embankment.

5. The cutoff should be taken below the GM alluvium into weathered granite gneiss and saprolite. Extension of the cutoff to hard gneissic rock in the flood plain from station 5+75 to station 7+25 should be considered even though this will extend excavation to a depth of 22.0 feet.

6. The fractured and weathered granite and gneiss occurring above grade in the emergency spillway cut should be marginal rippable. Recoveries range from 70 percent to 0 percent. RQD percentages range up to 50.

7. Hard granite occurs under the proposed riser location at elevation 684.0. With the bottom of the pipe at the riser held to 692.0 this would necessitate 8 feet to place the riser foundation on hard granite with 100 percent recovery and 90 percent RQD. Placement of the riser foundation above elevation 684.0 would entail a wider footing placed on weathered gneiss and saprolite. The blow count on this weathered material is 11 blows to the 1/2 foot.

8. Placement of the pipe will be on GM material that is underlain by weathered gneiss.

9. The elevation of hard gneiss at the bent location is 677.7. This will necessitate approximately 12 feet of excavation to place the bent on rock.

10. The majority of borrow material will have to be taken from the emergency spillway cut and from the suggested borrow areas. It is suggested to place in the plans sufficient borrow area to have at least twice the material needed to construct the embankment.

This entails incorporating into the plans the two suggested borrow areas on the left side of the stream below permanent pool elevation. It would also be advisable to place in the plans the majority of the larger suggested borrow area on the left abutment above permanent pool elevation. This should not necessitate the purchase of additional land since at present the county is in the process of purchasing this area for recreation.

A borrow area that could be discounted if sufficient material is considered available is the borrow area downstream from the dam on the right abutment.

Correlation of the borrow material to zones in the fill is given in the soil correlation chart.

Watershed [illegible] Townsite No. 2 State Va. Prepared By [illegible] Date [illegible]

Representative Sample for Lab.			Represents Soils from				Purpose or Suggested Use	Est. Avail. Quantity Cu. Yds.	Remarks
Field No.	Depth From-To	Unif. Class	Hole No.	Depth From-To	Unif. Class	Location			
DS 107-1	1.0-12.0	ML or MH	107	0.5-12.0	ML or MH	Borrow	Core	[illegible] Columbia	
			106	0.5-12.0	ML or MH	Area			
			111	0.5-14.0	ML or MH				
			112	0.5-14.0	ML				
			116	0.5-5.1	ML				
			126	0.5-12.6	ML				
			128	0.5-6.7	ML				
			130	0.5-9.2	ML				
			131	0.5-5.0	ML				

SCS EM&I Unit
Upper Darby, Pa.
January 10, 1962

Watershed Buffalo River Site No. 2 State Virginia Prepared By ____________ Date ________

Representative Sample for Lab.			Represents Soils from				Purpose or Suggested Use	Est. Avail. Quantity Cu. Yds.	Re[illegible]
Field No.	Depth From-To	Unif. Class	Hole No.	Depth From-To	Unif. Class	Location			
110-1	1.0-7.8	ML or MH	110	1.0-7.8	ML or MH	Borrow	Core		B horiz.
			103	0.5-5.6	ML or CL	Area			Hayesville series
			104	0.5-8.4	ML				
			105	0.5-4.0	ML				
			108	0.5-2.5	ML or MH				
			109	0.5-4.8	ML				
			113	0.5-2.3	ML or MH				
			114	0.5-2.8	ML or MH				
			115	0.5-5.8	ML or MH				
			121	0.5-5.4	ML				
			127	0.5-12.5	ML or MH				
			132	0.5-8.4	SM				
110-2	7.8-13.9	SM	110	7.8-13.9	SM	Borrow Area	Shell		C horiz.
			101	0.5-11.6	SM				Hayesville series
			102	0.5-2.7	SM				&
			103	5.6-12.0	SM				Porters series
			104	8.4-12.5	SM				
			104	4.0-14.2	SM				
			108	2.5-13.8	ML				
			109	4.8-11.5	ML and SM				

SCS [illegible]
Upper Darby, Pa.
January 10, 1962

A[illegible] Watershed Buffalo River [illegible] State Virginia Prepared by Mack, T. Date 11/[illegible]

Representative Sample for Lab.			Represents Soils from				Purpose or Suggested Use	Est. Avail. Quantity Cu. Yds.	Re[illegible]
Field No.	Depth From-To	Unit Class	Hole No.	Depth From-To	Unit Class	Location			
110-2 (Cont.)			113	2.3-10.0	ML				
			114	2.8-13.5	ML or SM				
			115	5.8-12.0	ML or SM				
			116	5.1-11.0	SM				
			121	5.4-8.9	ML & SM				
			128	6.7-11.7	SM				
			129	0.5-1.0	SM				
			130	9.2-10.2	GM				
			132	5.0-11.0	ML & SM				
			133	0.5-1.1	ML				
			134	0.5-2.9	ML & SM				
DS 124-1	1.0-2.3	ML	124	0.5-2.3	ML	Borrow Area	Core Shell		wet alluvial can be used on in dry weather
			117	0.5-1.0	ML				
			118	0.5-2.9	CL				
			119	0.5-4.8	ML & CL				
			120	0.5-5.8	ML & CL				
			122	0.5-3.0	ML & CL				
			123	0.5-1.8	ML				

SCS [illegible]
Upper Darby, Pa.
January 10, 1962

[illegible] B[illegible]ffalo River [illegible] 2 State Virginia Prepared [illegible] Mack, T. Date [illegible]

Representative Sample for Lab.			Represents Soils from				Purpose or Suggested Use	Est. Avail. Quantity Cu. Yds.	[illegible]
Field No.	Depth From-To	Unif. Class	Hole No.	Depth From-To	Unif. Class	Location			
204-1	1.0-4.5	ML or MH	204	0.5-4.5	ML or MH	EMS	Core	100,000	B Horiz. Hayesvill series
			201	0.5-2.7	ML				
			202	0.5-4.7	ML or MH				
			203	0.5-6.3	ML or MH				
			205	0.5-6.0	ML or MH				
			207	0.5-3.6	ML or MH				
			208	0.5-4.7	ML				
			209	0.5-4.0	ML or MH				
			210	0.5-5.0	ML				
			211	0.5-3.7	ML or MH				
			212	0.5-5.0	ML or MH				
			213	0.5-7.3	ML or MH				
			214	0.5-5.2	ML or MH				
			215	0.5-3.0	ML or MH				
			216	0.5-7.0	ML				
			217	0.5-8.3	ML or MH				
			218	0.5-6.6	ML or MH				
			219	0.5-5.2	ML				
204-2	4.5-12.6	ML	204	4.5-12.6	ML	EMS	Core & Shell		Hayesvill
			205	6.0-13.4	ML				series

SCS EWP [illegible]
Upper Darby, Pa.
January 10, 1962

[illegible] Buffalo River Site [illegible] 2 State Virginia [illegible] Mack, T. Date 10/7[illegible]

Representative Sample for Lab.			Represents Soils from				Purpose or Suggested Use	Est. Avail. Quantity Cu. Yds.	
Field No.	Depth From-To	Unif. Class	Hole No.	Depth From-To	Unif. Class	Location			
204-2 (Cont.)			208	4.7-11.0	ML or SM				
			209	4.0-5.6	ML				
			211	3.7-8.7	ML				
			212	5.0-14.3	ML or SM				
			213	7.3-13.5	ML or SM				
			214	5.2-10.5	ML or SM				
			217	8.3-13.2	ML				
			219	5.2-14.6	ML				
206-1	1.0-4.0	SM	206	0.5-4.0	SM	Shell			C horiz. Hayesville series
			201	2.7-6.2	SM				
			202	4.7-8.2	SM				
			203	6.3-8.7	SM				
			215	3.0-12.6	SM				
			216	7.0-12.6	SM				
			218	6.6-14.2	SM				
			220	0.5-2.5	SM				

SCS [illegible]
[illegible] Darby, Pa.
January 10, 1962

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

GENERAL

State Virginia County Amherst ; -- ¼, -- ¼, Sec. --, T -- R --; Watershed Buffalo River

Subwatershed Thrashers Creek Fund class OS (FP-2, WP-1, etc.) Site number 2 Site group I Structure class c

Investigated by T. Mack, Geologist (signature and title) Equipment used John Deere 176 backhoe on 4000 tractor & Allis Chalmers #9 dozer (Type, size, make, model, etc.) Date

SITE DATA

Drainage area size 6.80 sq mi., 4352 acres. Type of structure Earth fill Purpose Recreation and Flood control

Direction of valley trend (downstream) southeast Maximum height of fill 69.4 feet. Length of fill 815 fee

Estimated volume of compacted fill required 252,700 yards

STORAGE ALLOCATION

	Volume (ac ft.)	Surface Area (acres)	Depth at Dam (feet)
Sediment	477	36	24
Floodwater	1274	78	58
Total	1751		

SURFACE GEOLOGY AND PHYSIOGRAPHY

Physiographic description Inner Piedmont Topography mountainous Attitude of beds. Dip -- Strike --

Steepness of abutments: Left 22 percent, Right 66 percent. Width of floodplain at centerline of dam 460 feet

General geology of site: Buffalo River Site No. 2 is located approximately 7 1/2 miles northwest of Amherst, Virginia. It is north of Route 60 on Thrashers Creek.

The rock underlying the site is coarse-grained gneiss. The major minerals present in this gneiss are orthoclase feldspar sodic and some calcic plagioclase feldspar, biotite mica, quartz, and some muscovite mica. As a cursory megascopic examination with a hand lense shows considerable twinning in the feldspar the most proper name for the underlying rock is a coarse-grained quartz manganite gneiss.

This metamorphic gneissic rock is cut by munerous intrusions of igneous pegmatite . This is a white colored dike rock that has the major mineral of feldspar with smaller amounts of quartz and mica. The dikes are generally narrow, never appearing to be over five feet in width.

Thrashers Creek flows in strongly entrenched meanders. During the two recent hurricanes, Camille, 1969, and Agnes, 1972, considerable scouring took place in the stream channel. At the dam site the effect is to make the channel degrading.

Deep alluvial cobbles and gravels are present in the stream channel. The slopes of the stream valley above the floodplain are steep with shallow soils and rock outcrops occurring. The higher elevations in the area are have a gentle to moderately steep rolling topography with deeper soils occurring here.

Methods and Procedures

1. The backhoe part of this geologic investigation was made during planning stage of the watershed. As the final dimensions of the dam were not "firmed up" at this stage in planning, discrepancies exist on the "35's" as to the height of the top of dam and the width of the emergency spillway cut. Attention is called to this in notes on the plan of the dam.

This backhoe investigation is to be followed by a drilling program in operations.

2. Soils to be used for borrow material are classified according to the Unified System and the U. S. Dept. of Agriculture System. The use of this latter system is only to provide a grouping of the soils for correlation of the samples.

Centerline of the Dam

Weathered coarse-grained gneiss occurs below the selected dam centerline.

On the left abutment from the top of the dam to station 4+00 on the dam centerline, shallow residual soil occurs. This soil has from 1.3 to 2.9 feet of red clayey silt over weathered gneiss. This weathered gneiss is thoroughly rotten rock and does not effect backhoe refusal till below 5.0 feet from top of ground.

The flood plain is present from station 4+00 to station 8+65 on the dam centerline. In the area transected by the centerline of the dam a narrow low alluvial terrace occurs from station 4+00 to station 5+25 on the dam centerline. Since the soil on this low terrace is indistinguishable from the remaining alluvial soil in the flood plain, alluvial soil layers are correlated across the flood plain.

The top alluvium layer is a brown-red clayey silt (ML) that extends to a depth that ranges from 1.6 to 5.0 feet. Below this is a layer of mottled gray and yellow-brown silty clay (ML and CL) that ranges in thickness from 1.0 to 6.5 feet. Below this layer is a layer of subrounded cobbles and gravels of undetermined thickness. The top of this layer ranges in

elevation from 694.0 to 690.0. The reach of the backhoe was insufficient to effect complete penetration of the cobble and gravel layer. Deepest penetration was to elevation 685.0.

The right side of the flood plain has a coarser-grained alluvial soil than the left side. On the right side an SM layer overlies the cobbles and gravels.

The right abutment is steep with shallow soil and gneissic rock outcrops occurring from the toe of the abutment to the top of the dam. From the right abutment toe at station 8+65 on the dam centerline to station 9+00 on the dam centerline this right abutment has a 100 percent slope. From the right of station 9+00 to the top of the dam the slope is 50 percent.

Test pits numbered TP 1 through TP 11 were used to investigate the centerline of the dam.

Centerline of the Pipe

The centerline of the proposed pipe crosses the centerline of the dam at station 6+00 on the dam centerline and station 3+00 on the pipe centerline. These centerlines form an 84 degree angle.

Alluvial soil occurs on the pipe centerline. This soil is similar to the alluvium described on the dam centerline. It has the top brown-red ML layer ranging in thickness from 2.0 to 4.5 feet with an underlying ML or CL layer that ranges from absent to 2.0 feet thick. This finer sediment overlies GM cobbles and gravels of undetermined thickness.

Emergency Spillway

The emergency spillway cut is placed on the left abutment. Coarse-grained weathered gneiss underlays the cut.

Shallow to deep residual soil is present in the cut area. The deep soil ranges up to more than 14.2 feet in depth. This was as deep as the backhoe could dig. The soil has from 5.0 to 8.0 feet of plastic bright yellow-red clayey silt (ML or MH) overlying at least 8.0 feet of brown-yellow slightly micaceous, slightly plastic to non-plastic sandy silt (ML or SM).

The shallow residual soil ranges in depth from 2.5 to 5.0 feet in depth. It has this depth of yellow-brown and brown-yellow ML and SM material over weathered gneiss.

Test pits numbered TP 201 through TP 220 were used to investigate the emergency spillway.

AD-A092 812 BAKER (MICHAEL) JR INC BEAVER PA F/G 13/13
NATIONAL DAM SAFETY PROGRAM. BUFFALO RIVER NUMBER 2 JAMES RIVER--ETC(U)
SEP 79 DACW65-78-D-0016
UNCLASSIFIED VA00912 NL

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Borrow Area

The proposed borrow areas are located on both abutments and upstream from the centerline of the dam.

The largest borrow area is on the left abutment to the right of and upstream from the emergency spillway. Deep residual soil of the hayesville series occurs on the beveled peneplaned surfaces in this area. This soil has a B horizon of bright yellow-red clayey silt (ML or MH) that is approximately 7.0 feet in thickness from bottom of topsoil (A horizon) to the bottom of the B_3. Below this the C horizon of yellow-brown silty sand ranges up to 10.0 feet thick. Total thickness of this layer could not be determined due to the length of backhoe reach being less than 14.0 feet.

Upstream from the emergency spillway cut in this borrow area colluvial soil occurs in a long gently sloping draw. This colluvium has present at least 12.0 feet of red, yellow-red and brown-red clayey silt (ML or MH). Olive and yellow-brown mottles are present in some test pits below 8.0 feet.

This is the largest borrow area. It contains approximately 17 acres. An estimated 260,000 cubic yards of material is available in this borrow area.

A small borrow area occurs on the left side of the stream valley upstream from the centerline of the dam. In this area shallower residual and colluvial soil is present. The depth of these soils is approximately 9.0 feet with the plastic ML material extending down to 7.5 feet.

Also on the flood plain edge of this borrow area, alluvial soil occurs. This alluvial soil has 3.6 feet of ML and SM material over cobbles and gravels with water at approximately 4.0 feet.

An estimated 2.0 acres is present in this borrow area with an estimated 20,000 cubic yards of material.

This borrow area is almost entirely within the permanent pool area. It is separated from the larger borrow area by the steep slopes that border the stream valley. In this area there are large rock outcrops present on the slopes.

On the left side of the flood plain approximately 1,500 feet from the centerline of the dam a borrow area is proposed. This area has fairly shallow colluvial soil present that ranges in depth for the plastic ML material from 5.0 to 9.0 feet. This material is brown to brown-red. Also included in this borrow area is some alluvial soil with a water table at approximately 4.0 feet.

An estimated three acres is present in this borrow area with an estimated 25,000 cubic yards of material available.

Another borrow area is located in a draw that opens into the flood plain downstream from the centerline of the dam on the right abutment.

Deep colluvial soil occurs in this draw. This is red ML or MH material that ranges 6.7 to greater than 12.5 feet in depth. At the head of the draw gray salt and pepper colored silty sand (SM) occurs below 6.7 feet of plastic red colluvium.

Approximately 4.0 acres occur in this borrow area with an estimated 35,000 yards of material available.

APPENDIX VIII

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GENERAL REFERENCES

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