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MARTIN (DEWARD M) AND ASSOCIATES INC WILLIAMSBURG VA
NATIONAL DAM SAFETY PROGRAM. LAKE MONTCLAIR DAM. INVENTORY NUMB--ETC(U)
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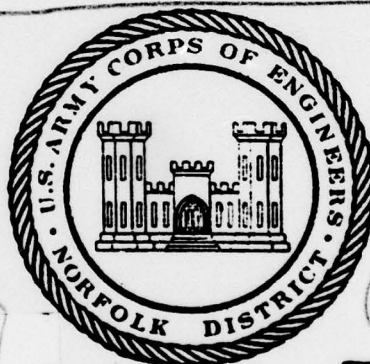
Name Of Dam: LAKE MONTCLAIR DAM
Location: PRINCE WILLIAM COUNTY
Inventory Number: VA. 15302

LEVEL

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

Lake Montclair Dam. Inventory Number:
VA-15302. Prince William County, Virginia.
Phase I Inspection Report.



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DACW65-78-D-0015

PREPARED FOR

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

BY

(DEWARD M.) MARTIN & ASSOCIATES, INC.
WILLIAMSBURG, VIRGINIA

MARCH 1979

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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.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

LAKE MONTCLAIR DAM
PRINCE WILLIAM COUNTY, VIRGINIA
INVENTORY NO. VA 15303

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POTOMAC RIVER BASIN

Name of Dam: Lake Montclair Dam
Location: Prince William County
Inventory Number: VA 15303

PHASE I INSPECTION REPORT

National Dam Safety Program

Prepared for

**NORFOLK DISTRICT CORPS OF ENGINEERS
803 Front Street
Norfolk, Virginia 23510**

by

**Deward M. Martin & Associates, Inc.
January 1979**

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 aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam : Lake Montclair Dam
State : Virginia
County : Prince William
Stream : Powell Creek
Date of Inspection : December 5, 1978

Lake Montclair Dam is an earth embankment 74 feet high and 650 feet long. The dam is in the Montclair Development on Route 234, 2.5 miles west of I-95 at the Dumfries, Virginia Interchange. The dam was built in 1963 with no known design or plans. In 1970, 6.5 feet was added to the top of the dam. During the 1972 Tropical Storm Agnes, the emergency spillway was reported to have 4 feet of water depth and considerable erosion. Maintenance was done as needed by the Second Montclair Corporation, owner of the development.

The emergency spillway will pass 100% of the PMF over a period of 70 hours. The water velocity will reach 11.3 feet per second at a depth of 8.2 feet. The soil in the area of the emergency spillway will erode at this water velocity. Erosion around the end of the abutment along the emergency spillway is a potential danger to the abutment. The box culvert outlet structure has open cracks 2-3 inches wide. The embankment soil has not been thoroughly analyzed for stability. There are no design calculations for the embankment.

It is recommended that immediate action be taken by the owner, at his own expense, to secure services of a Professional Engineer to have soil samples of the embankment, spillway and right abutment taken and analyzed for strength parameters to establish the design and stability of the embankment; improve the emergency spillway and repair the box culvert where deteriorating; establish a warning procedure to alert residents in time of emergency; and install a staff gage to measure flow through the water course.

It is recommended that within two months from date of notification to the Governor of the Commonwealth of Virginia, the owner engage the services of a Professional Consultant to determine by more sophisticated methods and procedures, the required remedial measures.

Within Six months of the date of notification to the Governor, the Professional Consultant's Report of appropriate remedial mitigating measures should have been completed and the owner should have an agreement with the Commonwealth of Virginia to a reasonable time frame in which all remedial measures will be complete.

Submitted By:

Original signed by
JAMES A. WALSH

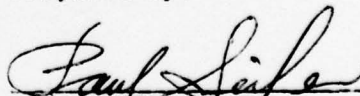
JAMES A. WALSH, P.E.
Chief, Design Branch

Recommended By:

Original signed by
ZANE M. GOODWIN

ZANE M. GOODWIN, P.E.
Chief, Engineering Division

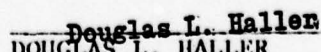
Prepared By:


PAUL SEILER, P.E.

Deward M. Martin & Associates, Inc.

Approved By:

Original signed by:


DOUGLAS L. HALLER
Colonel, Corps of Engineers
District Engineer

APR 3 1979



TOP OF DAM
(Looking North)



DOWNSTREAM FACE

LAKE MONTCLAIR DAM

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MONTCLAIR DAM

SECTION 1. PROJECT INFORMATION

1.1 General:

1.1.1 Authority: Public Law 92-367, 8 Aug 72 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 (Appendix VI, Reference 1). The main responsibility is to expeditiously identify those dams which may be a potential hazard to human life or property.

1.2 Project Description:

1.2.1 Dam and Appurtenances: Montclair Dam is an earth embankment 74 feet high from the top of the dam at elevation 210.5 to the invert of the outlet structure at elevation 136.5 in the toe of the dam. The length of the dam is 650 feet at the top of dam. The slope on the upstream side is 2.9:1 and the slope on the downstream side is 2.3:1. The lake water outlets into a concrete tower (principal spillway) through trash gates into a vertical outflow structure down to a 5-foot x 8-foot box culvert extending to the toe of the dam at the outlet channel. The outlet structure is equipped with a manually operated 24-inch diameter knife gate valve to drain the lake. The gate valve is under repair and is expected to be operational in the spring of 1979. A submersible pump is used to draw water for sprinkling lawns of the golf course. The emergency spillway is located beyond the right abutment at elevation 197. The emergency spillway channel is 150 feet wide.

1.2.2 Location: The Dam is in the Montclair Development, 1.9 miles west of I-95 along Dumfries Road, State Route 234 on Powells Creek.

1.2.3 Size Classification: The dam is classified as intermediate by storage capacity of 5,398 acre-feet and a height of 74 feet.

1.2.4 Hazard Classification: The dam is in a residential development with homes downstream and is given a high hazard classification in accordance to the guidelines of Section 2.1.2 of Recommended Guidelines for Safety Inspection of Dams. The hazard classification used to categorize dams is a function of the location only and unrelated to the stability or probable failure of the dam.

Table 1.1 DAM AND RESERVOIR DATA

ITEM	Elevation * Ft., msl	Area Acres	RESERVOIR		Length Miles
			Capacity Acre Feet	Watershed Inches	
Top of dam	210.5	279	5938	9.9	2.23
Emergency Spillway	197	173	2858	4.8	2.05
Principle Spillway crest	192	85	2188	3.6	1.29
Normal riverbed	130+				

*add 4 ft. to design elev. to get USGS m.s.l. elev.

SECTION 2. ENGINEERING DATA

2.1 Design: There are no plans or specifications available for the original construction of Montclair Dam.

***2.1.1 Geologic Investigations:** There were no known subsurface investigations conducted in conjunction with the original construction of the Montclair Dam. In 1970, however, a subsurface investigation was conducted at the dam site to determine the stability of the dam and the feasibility of raising the crest of the dam.

The subsurface investigation was conducted by Soil Testing Services, Inc. of Washington, D.C. Three soil tests borings were drilled along the crest of the dam and two auger probes were drilled in a proposed borrow area. In order to determine the various soil parameters, routine classification tests were performed on representative samples and consolidated undrained triaxial tests with pore pressure measurements were performed on selected undisturbed samples. Two of the triaxial tests were performed on samples taken from the existing dam soils and the third triaxial test series was performed on the proposed borrow material compacted to approximately 99 percent of Standard Proctor Density (ASTM Specification D-698).

Results of all soil test boring and laboratory testing is enclosed in Appendix IV. In addition, a boring location plan along with a review of the laboratory test results by Soil Testing Services, Inc. are included in Appendix IV.

Briefly, the soils at the site consisted primarily of micaceous sandy clayey silts and sandy silty clays. Results of laboratory consolidated undrained triaxial shear tests with pore pressure measurements revealed the following results:

Boring	Depth Ft.	Range in Natural Density (pcf)	ϕ' Degrees (drained friction)	C' PSF Drained Co- hesion Intercept
1 and 2 (in embankment)	30-37	119.4-121.8	27.5	1,843
1 and 2 (in embankment)	15-17	124.3-129.9	31.0	614
Power Auger (Borrow)	0-15	120.2-121.9	17.0	1,229
Crest of Hill (Borrow)	0-12	117.0-119.5	19.0	614

Previous experience with the drained shear strength values of similar soils from the Piedmont Province gives reason to question the high cohesion intercepts obtained. (Theoretically, the drained cohesion intercept should be zero.)

***2.1.3 Structural Analysis:** Original design calculations were not available. A structural analysis was undertaken in 1970 by Bauer Engineering, Inc. of Chicago, Illinois. The purpose of the analysis was to determine the stability of the existing dam if the crest elevation was increased an additional 6.5 feet.

***2.2 Construction of the Dam:** Mr. F. M. Coffey was the owner of the property now known as Country Club Lake at the time the dam at this location was constructed. In 1963, Mr. Coffey approached the firm of Moore, Kelly & Reddish, Inc., of Orange, Virginia, in order to contract for the construction of an earth dam which would create a lake on his property.

Moore, Kelly & Reddish, following contract signing, proceeded to construct the dam; construction was completed in 1964. According to a statement made by Mr. Goodwin Moore, partner in the firm, the dam was built according to Soil Conservation Service construction procedures and practices.

The following account of construction was provided by Messrs. Coffey and Moore:

According to Mr. Coffey, the base area of the dam was cleared and grubbed and all topsoil stripped, prior to placement of the fill in the valley at the dam site. A core trench of 32-foot bottom width was excavated into the valley bottom as much as 11 feet in depth until rock or hardpan was reached. Clay material was borrowed from the property and transported to the dam site to fill the core trench; the filling operation was performed by pans which brought the clay from the borrow site to the dam site. The fill material was then spread in 8-inch to 11-inch thick layers and was subsequently leveled by bulldozer and compacted by Sheep's-foot rollers to a 6 to 8-inch compacted thickness. The loaded pans were routed across the surface of the core fill so that their rubber tires could aid in the compaction of each layer. Once the core was filled to the existing ground surface, front and back fills of the dam were made in lifts until the 30-inch height above the core was reached. The core was then filled in layers until the 30-inch depth was completely filled and the next lift of front and back fills was raised in layers an additional 30 inches and the core again filled. This procedure was repeated until the top of the dam at elevation 200 was reached.

The trench for the box culvert spillway through the base of the dam had to be blasted into rock. The trench was blasted 3 feet below the bottom of the box culvert slab and refilled with compacted clay to form a cushion so that the culvert would lie on a uniform blanket of earth rather than partly on earth and partly on rock. Four anti-seepage collars were constructed along the length of the culvert and clay backfill was placed and compacted along the sides of the box culvert and across the top.

2.2.1 Toe drains were installed approximately 10 feet back from the toe of the fill. These were built in 24-inch wide trenches dug 5 feet deep with 2 feet of 1-2 inches of crushed stone under 6-inch perforated corrugated metal pipe with 12 inches of the same stone over the pipe. The toe drains extended from the outlet pipe at the toe on the south side. Discharge is along side of the outlet box culvert.

The lake water outlets through a concrete tower structure at the edge of the water behind the embankment. In 1970, the tower was redesigned as a vacuum type syphon, where water travels up through a trash rack and flows down a 6.25-foot x 8-foot vertical box into a 5-foot x 8-foot box culvert extending through the bottom of the dam to the toe to the outlet channel. The syphon action takes place when the lake rises about 8 inches. Velocity is approximately 30 feet per second at the outlet channel. The lake drain is controlled by a 24-inch knife valve in the bottom of the tower structure operated manually from the Tower bridge.

2.3 Operation: The Second Montclair Corporation does not have an established operating procedure, although presently the project manager is located on the development constantly and is responsible for operation. The manual control of the lake drain is expected to be repaired and operable in the spring of 1979. The golf course takes lawn sprinkling water from the lake by use of a submersible pump.

2.4 Evaluation: Design of the dam built in 1963 and records of construction are not available. The information given by Messrs, Coffey and Moore indicates the general construction procedure but does not have soil types or soil tests. The notes on the construction in 1970 indicate the compaction and general procedure used to raise the top of the dam elevation. The soils information taken at that time must be confirmed by additional soil samples and tests of these samples to establish the design of the embankment. The operation procedure is not established and no records are presently kept of operations or observations of the dam.

*Information provided by Law Engineering Associates of Virginia

SECTION 3. VISUAL INSPECTION

3.1 Findings: Appendix V outlines the field observations.

*3.1.1 The major visual observance made during the field inspection was seepage of approximately five gallons/minute along the left side (looking downstream) of the box culvert. This is the location of the toe drain. The riprap along the sides of the culvert has required repair indicative of erosion as confirmed by owner.

*3.1.2 There was no observed bulging at the base of the dam or detrimental settlement along the crest of the dam. There was a gneiss rock outcrop along the left side of the stream approximately 100 feet from the base of the dam.

*3.1.3 There was some erosion of embankment soils along the downstream face of the dam. In several areas, the erosion gullies were as much as 18 inches deep, located about 20 feet up the slope and 30 feet left of the box culvert as well as along the right abutment where the gully is 6-inches deep.

3.1.4 The emergency spillway water flows through a beach and parking area then through a grassed area which is about 400-feet from the lake. At this point, the emergency spillway turns to the left until it is parallel with the axis of the dam. In the turning action, water in excess of the capacity of the channel to direct the water around the left turn will tend to continue in a straight line heading over Spillway Drive. It is reported by the owner that Spillway Drive had water flowing over it to a depth of about 1-foot during Tropical Storm Agnes in 1972. There are about 28 homes downstream in the potential path of the emergency spillway "overflow" below the left turn of the channel.

3.1.5 The lake drain valve is not operable. Repair is expected to be completed by spring of 1979.

3.2 Evaluation: The visual inspection revealed obvious problems of erosion and seepage which needs prompt maintenance. The lake drain valve is being repaired. The emergency spillway requires some improvement to safely carry and direct flood waters.

SECTION 4. OPERATIONAL PROCEDURES

4.1 Procedures and Maintenance: Operational procedure required is done as the need arises through the project manager of the Second Montclair Corporation. Repair of the lake drain control valve is presently underway. No regular log of condition or maintenance has been kept since 1973.

4.2 Warning System: There is no warning system maintained by the Second Montclair Corporation.

4.3 Evaluation: The dam is functioning as a recreational facility and does not require extensive operational procedure, however, regular records should be maintained of monthly observations by the owner, followed by notes of corrective measures taken as a result of previous observation comments.

SECTION 5. HYDRAULIC/HYDROLOGIC

5.1 Design: General hydraulic and hydrologic design data used for analysis is as follows:

- a) Letter from William O. Doll, Consulting Engineer, showing Lake Montclair Dam data summary, dated 5/30/78.
- b) Letter and calculations from Bauer Engineering, Inc., dated, 2/9/70.
- c) Topographic 1" = 200 scale map of spillway area.
- d) Memo from T. McGourin (SCS) to Munkitterick (SCS), dated 6/10/66.
- e) Memo from Sours to Bauer Engineering, dated 4/23/70.
- f) Letter from Dewberrrt, Nealson & Davis to M. Kelly, Assistant Director, D.P.W. Manassas, Virginia, dated 3/11/70.
- g) Letter from Wiley & Wilson, Engineers, to M. Kelly, Assistant Director, D.P.W. Manassas, Virginia, dated 1/10/70.
- h) Memo from Burt Sours to C.J. Deitz, dated 2/6/70.
- i) Letter from Prince William County, M. Kelly, Assistant Director, D.P.W. Manassas to Dewberry, Nealson & Davis, Engineers, dated 2/17/70.
- j) Letter from Graediger & Baker, Hampton Associates, to Bauer Engineering, dated 8/2/71.
- k) Letter from Bauer Engineering to Dewberry, Nealson & Davis, no date.
- l) Letter from Dewberry, Nealson & Davis to Bauer Engineering, dated 8/2/71.
- m) Letter from Dewberry, Nealson & Davis to M. Kelly, Assistant Director, D.P.W. Manassas, dated 9/4/70.
- n) Letter from Graediger & Baker, Hampton Associates, to W. Sturcey, Construction Manager, Country Club Lake, No date.
- o) Letter from Prince William County to Country Club Lake, dated 9/15/70.

p) Letter from Prince William County, M. Kelly, Assistant Director, D.P.W. Manassas to Dewberry, Nealson & Davis, dated 10/22/79.

q) There is a four-foot difference in elevation of the normal water surface as shown on the USGS mapping and the designer's elevations. The designer's elevations were converted to match the USGS mapping. These elevations were then used in all computations.

5.1.1 These data contained original hydrologic assumptions, spillway rating curve, and some details of construction.

5.2 Hydrologic Records: Gaging information from South Fork Quantico Creek, and North Branch Chopawansic Creek both near Independent Hill, Virginia was available. This data was not used to evaluate the performance of the system.

5.3 Flood Experience: No detailed flooding experience is available, however the Agnes flood of 1972 was passed. The maximum depth over the emergency spillway was estimated at 4.0 feet, which corresponds to 5,760 cfs.

5.4 Flood Potential: General - Assuming the pool elevation to be at the principal spillway crest, elevation 192 msl, the PMF and the 100 year flood were developed and routed through the reservoir and spillway.

5.4.1 The PMF, Probable Maximum Flood, was developed from data in Hydrometeorological Report 33 (Reference No. 1). The Probable Maximum Precipitation (PMP) for the Montclair Dam area is 25 inches in 24 hours for a 200 square mile area. This value was modified for the Montclair 11.25 square mile drainage area and inputted to the HEC-I program, Flood Hydrograph Package, which synthesized an inflow hydrograph of the PMF. The $\frac{1}{2}$ PMF inflow hydrograph was constructed by reducing each calculated PMF hydrograph ordinate by one-half.

The inflow hydrographs were constructed utilizing the unit hydrograph concept. The unit hydrograph was developed using a one-hour duration of excess precipitation and Synder's parameters (Reference No. 2). The HEC-I program then distributed excess precipitation in time and amount to produce the inflow hydrographs. The distribution thus derived was modified by revising the percent hourly distribution within the maximum 6 hour precipitation to more closely conform to that used in TP40 for the 100 year rainfall. Results of this analysis are presented in Table 5.1

5.5 Reservoir Regulation: Montclair Dam has an uncontrolled 8-foot x 5-foot box culvert principal spillway with an inlet elevation of 192.0 msl. The emergency spillway is an uncontrolled earthen trapezoidal section with invert at elevation 197.0 msl. The top of the dam elevation is 210.5 msl.

A 24-inch diameter gated orifice is available for draining the reservoir but was not considered for routing purposes.

5.5.1 Reservoir storage capacity above the spillway crest was calculated using contours from USGS quad maps, planimetry areas and converting to volume in acre-feet. The outlet rating curve was computed using an orifice equation for the principal spillway and a critical depth computation for the emergency spillway then combining the curves for total outflow. Routing was started assuming pool elevation at the principal spillway crest and inflow equal to outflow.

5.6 Overtopping Potential: The PMF, $\frac{1}{2}$ PMF, and 100 year flood inflow hydrographs were routed through the reservoir using the modified Puls method option of the HEC-1 computer program with storage-outflow. Results of this routing are shown in Table 5.1.

5.6.1 A tailwater rating curve was not available for this dam. The tailwater elevation observed during field observation was approximately 126.0 msl with an assumed flow of 50 cfs. The 50 cfs was used as the starting base flow when routing the storms through the system.

5.7 Reservoir Emptying Potential: To empty the dam there is a 24-inch outlet pipe with an invert elevation of 133 msl, and a discharge capacity of 101 cfs at normal water surface elevation, 192 msl.

5.7.1 The above information was inputted to the HEC-1 program, with Eleven cfs inflow and a developed storage vs. outflow curve. This analysis indicated that the dam can be emptied in 18 days.

5.7.2 All hydrologic considerations presented in this report are based on present conditions and no allowances have been made for future development of the watershed.

TABLE 5.1 - RESERVOIR PERFORMANCE

	Normal Flow	100 Yr. Storm	Hydrograph	
			1/2 PMF	PMF
Peak Flow, cfs				
Inflow	50	4,589	9,403	18,806
Outflow	50	3,397	8,646	17,702
Maximum Elevation, ft. msl	192	199.8	202.4	205.2
Ungated spillway (El. 192 & 197 msl) ¹				
Depth of flow, ft.	--	2.8 ²	5.4 ²	8.2 ²
Duration, hours	--	20	70	70
Velocity, fps	--	6.2 ²	8.5 ²	11.3 ²
Percent of Peak outflow passed		100	100	100
Non-Overflow Section (El. 210.5 msl)				
Depth of flow, ft.	--	0	0	0
Duration, hours	--	0	0	0
Velocity, fps	--	0	0	0
Tailwater Elevation, ft., msl	126	NA*	NA*	NA*

* Not Available

1. Elev. 192 is the syphon spillway (Principal spillway) and elev. 197 is the chute spillway (Emergency spillway).
2. Refers to the emergency chute spillway.
The figures in the table do not include volume of water going thru the syphon spillway.

SECTION 6. STRUCTURAL STABILITY

***6.1 Geologic Setting of the Dam Site:** The dam is located just west of the Fall Line between the eastern Coastal Plain Geologic Province and the western Piedmont Geologic Province. The underlying bedrock at the site consists of schistose gneiss. This formation is believed to have originated as sedimentary sand and clay deposits in the late Precambrian age. Much later, probably in late Paleozoic times, strong compressive forces buckled the crust and compressed the bedrock into tight folds. Through the years, the pressure has caused the sedimentary deposits to metamorphose into their present state. At unknown time periods during this process, volcanic intrusions entered the formation. As a result, intrusions of quartz and greenstone are found within this geologic setting.

Soils of this formation consist generally of micaceous silts, sandy silts and silty sands. The soils are formed by the chemical and/or mechanical weathering of the underlying parent rock. Normally, the most advanced weathering occurs near the surface, and decreased degrees of weathering are present with increased depth, until the unaltered parent rock is encountered. As a result, the inherent strength characteristics generally tend to increase with increased depth. Due to the weathering process, intact bedrock elevation is often quite erratic.

***6.2 Stability Analysis:** As indicated in Section 2, a stability analysis was conducted by Bauer Engineering using data obtained by Soil Testing Services. Since the original stability calculations were not available, the loading assumptions, such as "steady state seepage", used in the analysis, are not known. However, as noted, the factor of safety calculated by Bauer Engineering was 2.24 (Reference Appendix IV). Previous experience with the drained shear strength values of similar soils from the Piedmont Province gives reason to question the high cohesion intercepts obtained. Theoretically, the drained cohesion intercept should be zero. However, a drained cohesion of 611 psf was used in the stability calculation by Bauer. Reducing the cohesion value to the theoretical value of zero for drained loading would result in significantly lower factors of safety. It is therefore imperative that a detailed stability analysis of the embankment be conducted.

6.3 The concrete box culvert outlet structure, extending from the riser structure to the toe of the dam, was inspected by a diver for the owner. The inspection comments are shown in attachment "C" in Appendix IV. There are numerous cracks and seepage noted in the inspector's report. Some cracks are open as much as 2-3 inches (items 18 and 29 of box inspection). The box should be repaired and monitored.

***Information provided By Law Engineering Associates of Virginia.**

SECTION 7. ASSESSMENT AND REMEDIAL MEASURES/RECOMMENDATIONS

7.1 Dam Assessment:

7.1.1 The design calculations, plans and construction records for the original construction are not available. The design for raising the crest of the dam was done in 1970, when soil samples from three borings in the embankment were tested. These borings should be supplemented by sufficient additional borings and soil sample testings to establish the location of the various materials in the embankment and the qualities of these materials.

7.1.2 Seepage and erosion on the downstream slope of the dam was visible, as well as needed repairs to the slope around the wing walls of the outlet box. The report of the inspection of the inside of the outlet box structure indicates repairs to the structure are needed. The alignment and base of the embankment show no obvious indications of movement.

7.1.3 The emergency spillway channel curves to the left about 400 feet below the crest. The crest had 4 feet depth of water during the Tropical Storm Agnes in 1970. This depth of water caused erosion and water over Spillway Drive to a depth of 1 foot. The erosion of the spillway and the curve in the channel endanger the spillway area and safety of the homes along Spillway Drive.

Based on the high risk, intermediate category of this dam, the combined spillways should be capable of passing the PMF, which is 18,806 cfs. If both spillways are considered sound and the pool elevation is at the crest of the dam, the capacity would be 38,000 cfs.

7.1.4 There is no established operating procedure or warning system established. No log is presently maintained of observations of the dam, and/or maintenance work. The lake drain valve is presently being repaired and is to be completed in the spring of 1979.

7.1.5 Remedial Measures and Recommendations: Immediate action needs to be taken by the owner, at his expense, to reduce the potential risk to life and property. The slope around the box culvert outlet and gullies on the slopes should be repaired. The box culvert should be repaired where deteriorating. At the same time the toe drain outlets should be located and extended beyond the toe to drain freely. Riprap around the stilling pond at the outlet should be installed.

The owner should obtain the services of a professional engineer to further evaluate the stability of the dam by taking test borings for soil samples along the top of the dam extending through the core to the base and in the area of the toe along the length of the dam. The soil samples should be analyzed to determine strength parameters for the embankment materials. Observation wells should be installed along the top of the dam and in the downstream slope to monitor the phreatic surface within the dam. In addition to the above, borings of the emergency spillway crest, along the spillway channel and in the natural earth abutment along the channel should be taken to obtain soil samples. These samples should be analyzed for strength parameters of the material in the spillway and natural earth abutment.

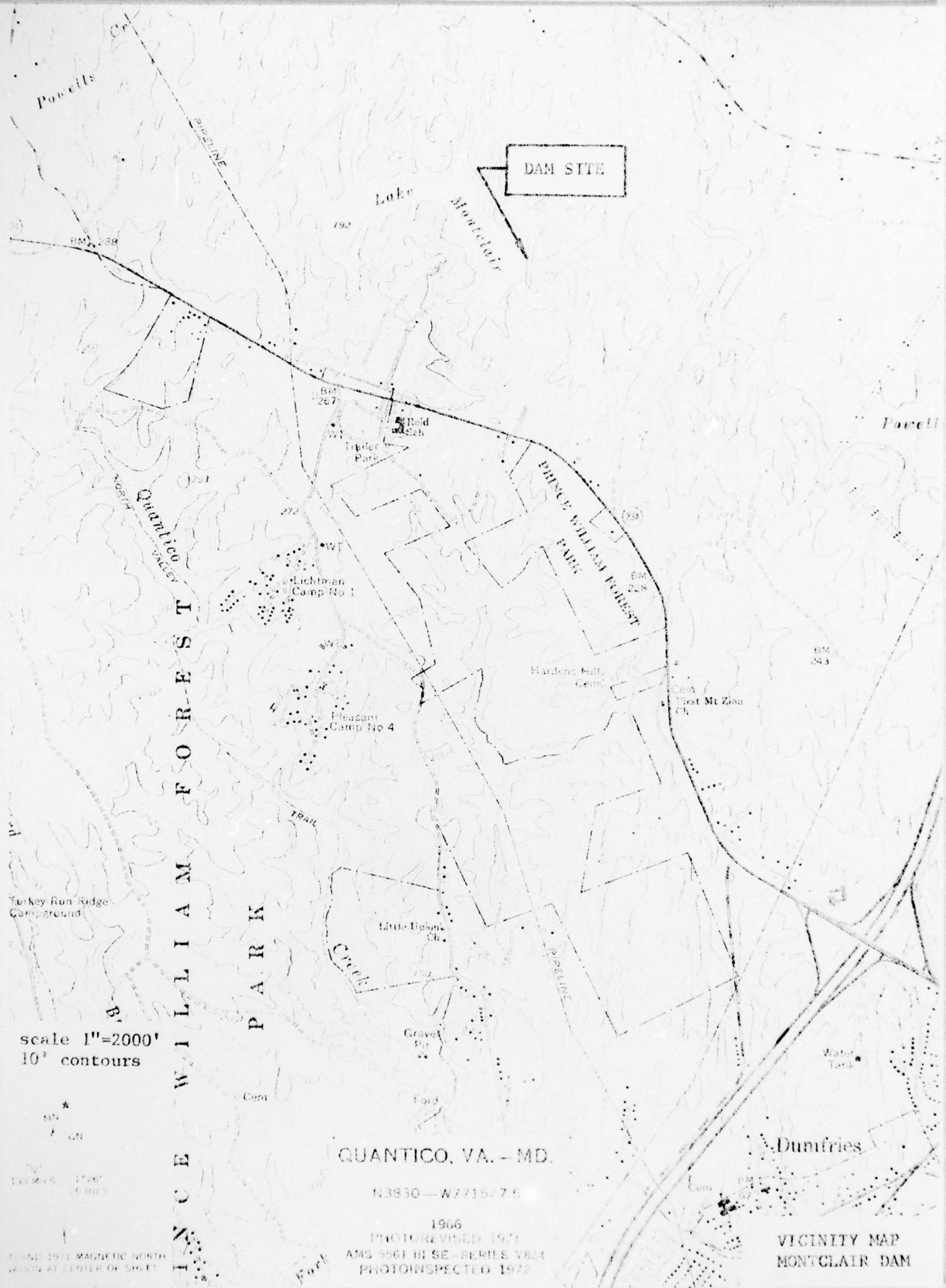
Consideration in view of these soil test results should be given to erosion of the natural earth abutment along the left side of the emergency spillway and to safety of containing flood waters at the crest and along the course of the spillway channel to avoid damage to property and life along Spillway Lane. The emergency spillway should be improved accordingly. A warning procedure needs to be established so that the downstream residents can be alerted in case of an emergency. A staff gage should be installed to permit documentation water level.

APPENDIX I

MAPS



REGIONAL MAP
MONTCLAIR DAM



scale 1"=2000'
10' contours

133 MILES 1"26"
25 MILES

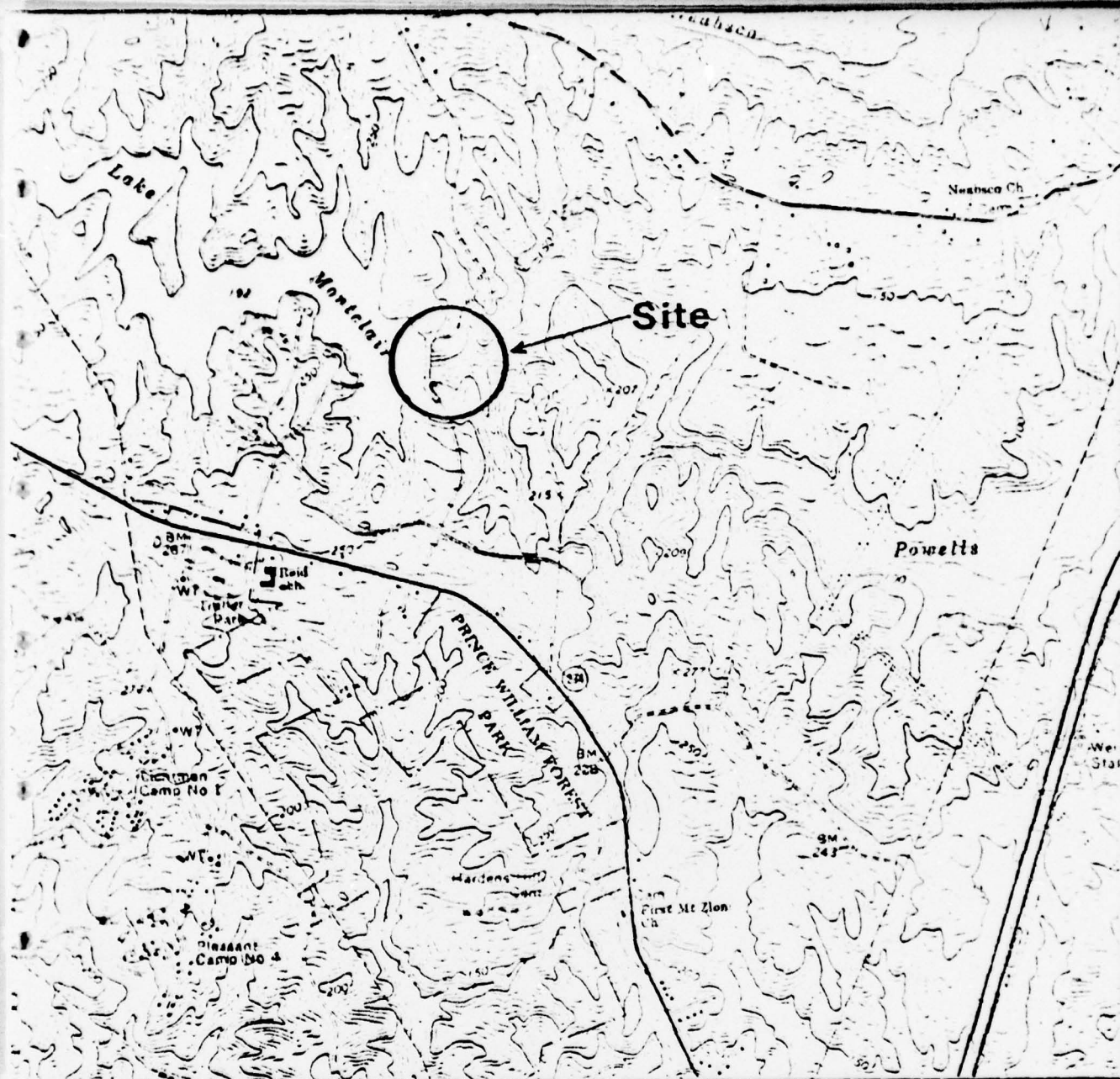
5 AND 1971 MAGNETIC NORTH
VECTOR AT CENTER OF SHEET

QUANTICO, VA. - MD.

N3830-W7715/7.5

1966
PHOTOREVISED 1971
AMS 5561 III SE-SERIES V824
PHOTOINSPECTED 1972

VICINITY MAP
MONTCLAIR DAM



Taken from USGS Quad Map
Quantico, Va.-Md., 1966



Site Location	LAW ENGINEERING SOILS, MATERIALS, AND FOUNDATIONS ENGINEERS 7913 WESTPARK DRIVE, McLEAN, VIRGINIA 22101		
Montclair Dam	SCALE 1" = 2,000.	Drawn: DLR Checked: MJC Date: 12-28-78	Job No. U-8-2270 Dwg. No. 1
Prince William County, Virginia			

APPENDIX II

PLANS



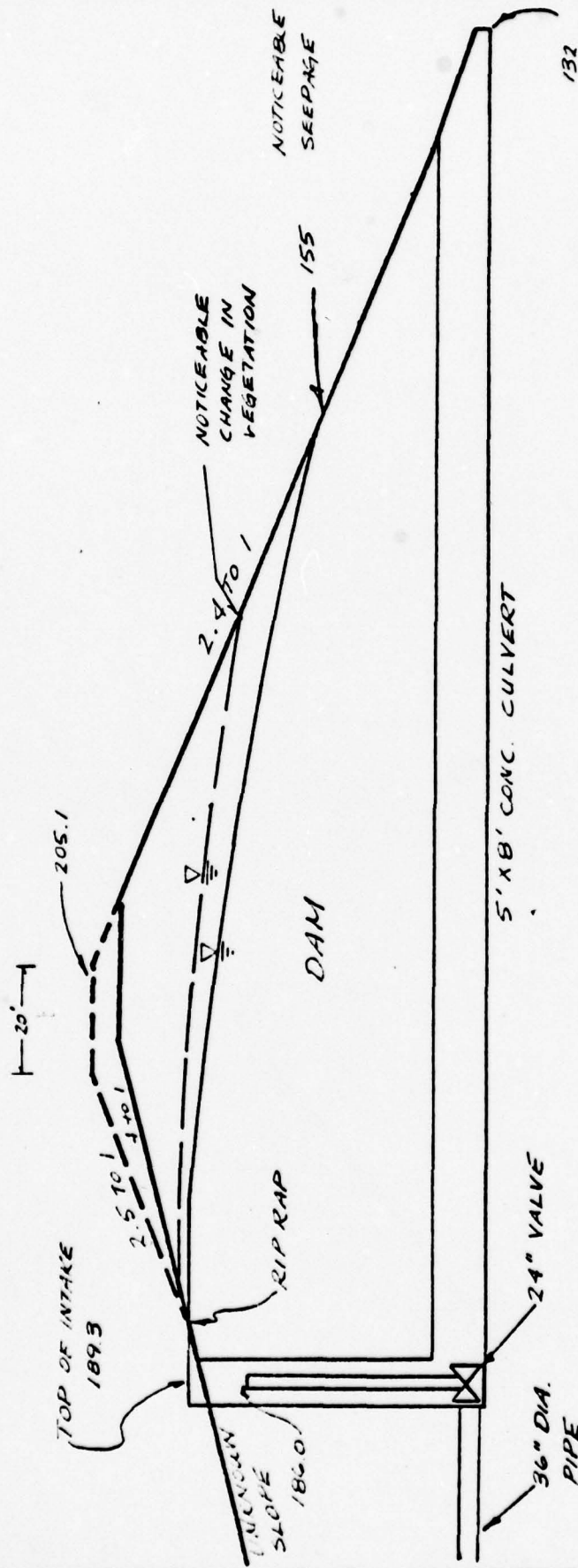
W/L 188

W/L 188



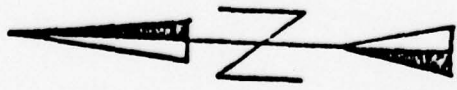
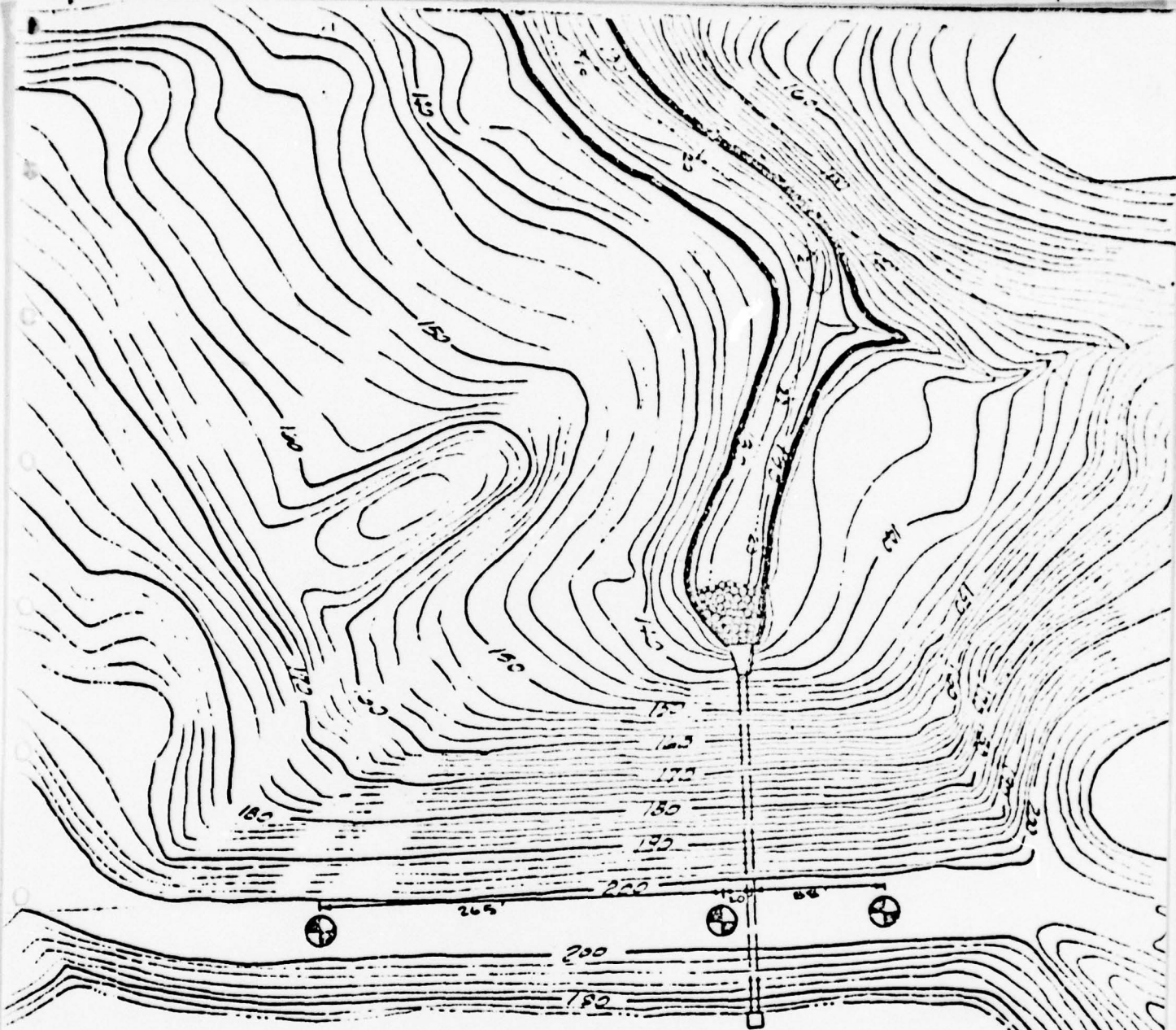
JUNE 18-8-75

AIR SURVEY / 20



--- SECTION CONSTRUCTED IN 1970

Typical Dam Cross-Section		LAW ENGINEERING TESTING COMPANY SOILS, MATERIALS, AND FOUNDATIONS ENGINEERS 7913 WESTPARK DRIVE, MCLEAN, VIRGINIA 22101	
Montclair Dam		SCALE	Drawn: DLR Checked: MJC Date 12-28-78
Prince William County, Virginia		NONE	Job No. WS-227C Dwg No. 3



COUNTRY CLUB LAKE

TEST HOLE LOCATION
AUG. 1970, SCALE 1"=100'

BURTON O. SOURS JR.
CERTIFIED LAND SURVEYOR

SOIL TESTING SERVICES, Inc.

P.O. Box 266, 111 Plingsten Road

Northbrook, Illinois 60062



R. KNAEDINGER
 A. HAFER, JR.
 R. G. LUKAS
 R. C. HALL
 R. C. BROWN, JR.
 R. J. POLLOCK
 R. L. MCCOMBS

Date _____

Bauer Engineering, Inc.
20 N. WACKER DRIVE
CHICAGO, ILL. 60606

STS Job No. _____

Structure _____

Location _____

Attention: Mr. Donald W. Wikan

☐ Gentlemen:

☐ herewith

We are sending _____

_____ sets of prints of

☐ under separate cover

- ☐ Boring Logs and Location Diagram
- ☐ Laboratory Compaction Data
- ☐ Field Compaction Control Data
- ☐ Classification Test Data
- ☐ Consolidation Test Data
- ☐ Triaxial Compression Test Data
- ☐ Sealed Jar Samples
- ☐ Rock Core Samples

- ☐ Caisson Reports
- ☐ Permeability Tests Data
- ☐ Grain Size Analysis Data
- ☐ Atterberg Limits Test Data
- ☐ C.B.R. Test Data
- ☐ Organic Content Test Data
- ☐
- ☐

for the above job.

Yours truly,

SOIL TESTING SERVICES, INC.

GENERAL NOTES

1950 Chicago Building Code Soil Classifications are Used Except Where Noted

DRILLING & SAMPLING SYMBOLS

SS : Split-Spoon—1½" I.D., 2" O.D., except where noted
ST : Shelby Tube—2" O.D., except where noted
PA : Power Auger Sample
DB : Diamond Bit—NX: BX: AX:
CB : Carbide Bit—NX: BX: AX:
OS : Osterberg Sampler—3" Shelby Tube
HS : Housel Sampler
WS : Wash Sample
FT : Fish Tail
RB : Rock Bit
WO : Wash Out

Standard "N" Penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2 inch OD split spoon, except where noted.

WATER LEVEL MEASUREMENT SYMBOLS

WL : Water Level
WCI : Wet Cave In
DCI : Dry Cave In
WS : While Sampling
WD : While Drilling
BCR : Before Casing Removal
ACR : After Casing Removal
AE : After Boring

Water levels indicated on the boring logs are the levels measured in the boring at the times indicated. In pervious soils, the indicated elevations are considered reliable ground water levels. In impervious soils, the accurate determination of ground water elevations is not possible in even several days observation, and additional evidence on ground water elevations must be sought.

CLASSIFICATION

COHESIONLESS SOILS

"Trace"	: 1% to 10%	
"Trace to some"	: 10% to 20%	
"Some"	: 20% to 35%	
"And"	: 35% to 50%	
Loose	: 0 to 9 Blows	} or equivalent
Medium Dense	: 10 to 29 Blows	
Dense	: 30 to 59 Blows	
Very Dense	: ≥ 60 Blows	

COHESIVE SOILS

If clay content is sufficient so that clay dominates soil properties, then clay becomes the principle noun with the other major soil constituent as modifier; i.e., silty clay. Other minor soil constituents may be added according to classification breakdown for cohesionless soils; i.e., silty clay, trace to some sand, trace gravel.

Soft	: 0.00 — 0.59 tons/ft ²
Stiff	: 0.60 — 0.99 tons/ft ²
Tough	: 1.00 — 1.99 tons/ft ²
Very tough	: 2.00 — 3.99 tons/ft ²
Hard	: ≥ 4.00 tons/ft ²

GENERAL NOTES

STS

SOIL TESTING SERVICES, INC.
111 PFINGSTEN ROAD
NORTHBROOK ILLINOIS

LOG OF BORING NO. P-1

OWNER				ARCHITECT-ENGINEER Dewberry, Nealon & Davis (Arch.) Bauer Engineering, Inc. (Eng.)						
SITE Country Club Lake Dunfries, Virginia				PROJECT NAME Country Club Lake						
DEPTH ELEVATION	SAMPLE NO.	TYPE SAMPLE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT. 3	UNCONFINED COMPRESSIVE STRENGTH TONS/FT. 2				
						1	2	3	4	5
						PLASTIC LIMIT % WATER CONTENT % LIQUID LIMIT % STANDARD "N" PENETRATION (BLOWS/FT.)				
				SURFACE ELEVATION		10	20	30	40	50
	1	33	-	Silty and sandy clay (mica- ceous), trace gravel - brown to reddish brown & slightly gray - tough (MC) (MB)	105 83 87					
				Sandy silt, trace to some clay, trace gravel - brown - moist - dense (ML-SM)	115					
				Silty clay (micaceous), trace to some sand, trace gravel - brown to reddish brown - very tough (CL)	102					
				Sandy clay, trace gravel and roots - brown with dark gray seams - hard (CL-CH)	113					
				Sandy and clayey silt, trace gravel - brown with dk. gray seams - moist - dense (ML-SM)						
				Clayey silty sand, some gravel brown-moist to wet-very dense						
				End of Boring						
				10' 11" Casing						

*Calibrated Penetrometer

DATE OF BORING	6-29-70
TIME OF BORING	11:00 AM
LOCATION OF BORING	Country Club Lake

SOIL TESTING SERVICES
INC.
111 PRINGSTON ROAD
NORTHBROOK, ILLINOIS

BORING STARTED	6-29-70
BORING COMPLETED	6-29-70
BY	MD
CHECKED BY	MD

LOG OF BORING NO. 1-2

OWNER

ARCHITECT-ENGINEER

(Arch.) Dewberry, Heaton & Davis
(Eng.) Bauer Engineering, Inc.

Country Club Lake
Runfries, Virginia

PROJECT NAME

Country Club Lake

DEPTH ELEVATION	SAMPLE NO.	TYPE SAMPLE	SAMPLE NO. & RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT. 3	UNCONFINED COMPRESSIVE STRENGTH (TONS/FT. 2)				
						1	2	3	4	5
						PLASTIC LIMIT %	WATER CONTENT %		LIQUID LIMIT %	
						X	O		Δ	
						STANDARD "N" PENETRATION (BLOWS/FT.)				
						10	20	30	40	50
				Silty clay (micaceous), trace some sand, trace gravel - red very tough (CL-CH)	1005		20	30	40	50
				Silty clay, trace to some sand, trace gravel - reddish brown and slightly gray - very tough to tough (CL-CH)	91		20	30	40	50
				Clayey and silty very fine sand, trace mica and roots - brown & slightly gray - moist - dense (SC-ML)	113		20	30	40	50
				Clayey and sandy silt, trace to some gravel - rust brown and slightly gray - moist - very dense (ML-CL)	92			30	40	50
				Silty clay (micaceous), trace to some sand, trace gravel - reddish brown & slightly gray - tough (CL-CH)	91			30	40	50
				Silty sand, trace clay and mica - med. dark brown - moist - very dense (SM-ML)						
				Silty clay (micaceous), trace sand, gravel and roots - reddish brown and slightly gray - very tough to hard (CL-CH)	81 82 75					
				Silty clay (micaceous), trace sand and gravel - brown - tough (CL-L)						

LOG OF BORING NO. B-2 (Cont.)

OWNER				ARCHITECT-ENGINEER (Arch.) Dewberry, Nealon & Davis (Eng.) Bauer Engineering, Inc.					
SITE Country Club Lake Dunfries, Virginia				PROJECT NAME Country Club Lake					
DEPTH ELEVATION	SAMPLE NO.	TYPE SAMPLE SAMPLING METHOD RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LOG/FT. 6	UNCONFINED COMPRESSIVE STRENGTH TONS/FT. 2				
					PLASTIC LIMIT % WATER CONTENT % LIQUID LIMIT % STANDARD "N" PENETRATION (BLOWS/FT.)				
SURFACE ELEVATION									
(Cont. from Sheet 1)									
105			Silty clay (micaceous), trace to some sand, trace gravel with pocket of sand - brown - tough (CL)	105					
			Fine to med. gravel & sand, trace silt & clay lumps - gray to gray-brown-moist - very dense (GP)						
End of Boring					*Calibrated Penetrometer				
10' of 4" Casing 45' of 11X Casing									

WATER LEVEL OBSERVATIONS	
DATE	TIME

SOIL TESTING SERVICES
INC.
111 PRINGSTEN ROAD
NORTHBROOK, ILLINOIS

BORING STARTED	
BORING COMPLETED	
FIG. 17	DRILLER: JL
DRILLER: MD	RECORDED: CUC
DATE: 12-20-70	

LOG OF BORING NO. B-3

OWNER				ARCHITECT-ENGINEER (Arch.) Dewberry, Heaton & Davis (Eng.) Bauer Engineering, Inc.						
SITE Country Club Lake Dumfries, Virginia				PROJECT NAME Country Club Lake						
DEPTH ELEVATION	SAMPLE NO.	TYPE SAMPLE	SINGLE DIST RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT. 3	UNCONFINED COMPRESSIVE STRENGTH TONS/FT. 2				
						1	2	3	4	5
SURFACE ELEVATION 100										
100	100	FT		Silty clay (micaceous) trace to some sand and gravel - red and brown - hard (CL-CH)	96					
92				Silty & gravelly sand, trace gravel - tan, white & yellowish brown - moist - very dense (SM)	92					
112				Silty clay, trace to some sand, trace gravel & mica - reddish brown to lt. brown - very tough (CL)	105					
5 FT				Silty clay (micaceous), trace sand and gravel - reddish brown to slightly gray - tough to very tough (CL-CH)	41					
115				Silty & sandy clay, trace gravel - reddish brown to lt. brown - very tough (CL)	115					
Possible rock - 100% water loss										
End of Boring						*Calibrated Penetrometer				
10' of 4" Casing										
35' of MX Casing										

SOIL TESTING SERVICES INC. 111 BRINGSTON ROAD NORTHBROOK, ILLINOIS		BORING STARTED 4-24-70 BORING COMPLETED 6-29-70 Dwg. 17 DRAWN	
---	--	--	--

LOG OF BORING NO. PA-1

OWNER	ARCHITECT-ENGINEER (Arch.) Dewberry, Nealon & Davis (Eng.) Bauer Engineering, Inc.
SITE Country Club Lake Dumfries, Virginia	PROJECT NAME Country Club Lake

DEPTH ELEVATION	SAMPLE NO.	TYPE SAMPLE SAMPLE DATE RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS / FT. 3	UNCONFINED COMPRESSIVE STRENGTH TONS/FT. 2				
					1	2	3	4	5
			PLASTIC LIMIT %		WATER CONTENT %		LIQUID LIMIT %		
STANDARD "N" PENETRATION (BLOWS/FT.)									
					10	20	30	40	50
	PA		Silty clay, trace to some sand, trace gravel - brown (MH)						
	PA								
			End of Boring						

WATER LEVEL OBSERVATIONS	
DATE	TIME

SOIL TESTING SERVICES
INC.
111 PFINGSTEN ROAD
NORTHBROOK, ILLINOIS

BORING STARTED	6-22-70
BORING COMPLETED	6-24-70
DWG. NO.	17
DRAWN BY	MD
APPROVED	CNC

LOG OF BORING NO. FA-2

OWNER		ARCHITECT-ENGINEER (ARCH.) Genserry, Heaton & Davis (Eng.) Bauer Engineering, Inc.	
SITE Country Club Lake Richfield, Virginia		PROJECT NAME Country Club Lake	

DEPTH ELEVATION	SAMPLE NO.	TYPE SAMPLE SAMPLE DIST RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LOG / FT. 6	UNCONFINED COMPRESSIVE STRENGTH TONS/FT. 2				
					1	2	3	4	5
					PLASTIC LIMIT %		WATER CONTENT %		LIQUID LIMIT %
					STANDARD "N" PENETRATION (BLOWS/FT.)				
					10	20	30	40	50
			Silty clay, trace to some sand, trace gravel - reddish brown (MH)						
			End of Boring						

TESTER'S OBSERVATIONS	
WE 07/10	
DATE	TIME
11/11	10:30

SOIL TESTING SERVICES
INC.
111 PFINGSTEN ROAD
NORTHBROOK, ILLINOIS

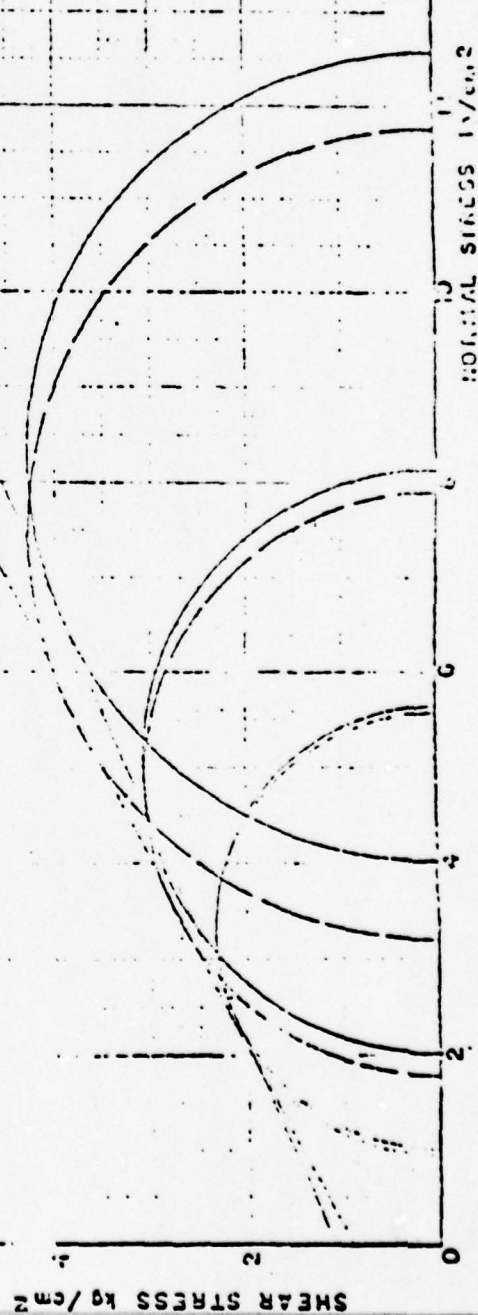
BORING STARTED 6:30 PM	
BORING COMPLETED 8:00 PM	
RIG 17	ENGINEER JL
DRAWN MD	APPROVED GRC
10016	

CONSOLIDATED UNDRAINED T-X SHEAR TEST

TEST NO.	INITIAL SAMPLE		DRY DENSITY pcf	WATER CONTENT %		CHAMBER PRESSURE kg/cm ²	CORRECTION	STRAIN AT MAX. STRESS ($\sigma_1 - \sigma_3$) %	MAX. DEV. STRESS kg/cm ²	FRICTION ANGLE $\bar{\phi}^\circ$	COHESION \bar{c} kg/cm ²
	DIAMETER in.	HEIGHT in.		INITIAL	FINAL						
1	1.85	4.175	101.0	22.0	20.0	3.10	1.0	5.0	5.31	27.5	0.9
2	"	3.975	101.5	22.0	19.5	4.10	2.0	5.0	6.12		
3	"	4.250	99.2	27.7	21.6	6.10	4.0	4.6	8.00		

COUNTRY CLUB LAKE
BAUER ENGINEERING
STS Job No. 13929
Date : 7/17/70

Boring 1 B 2
Sample 7 B 8
Depth 30'-37'
LL: PL: PI:



CONSOLIDATED UNDRAINED T-X SHEAR TEST

TEST NO.	INITIAL SAMPLE		DRY DENSITY pcf	WATER CONTENT %		CHAMBER PRESSURE kg/cm ²	HORIZONTAL STRESS kg/cm ²	STRAIN AT MAX STRESS ($\sigma_1 - \sigma_2$) %	MAX DEV STRESS kg/cm ²	FRICTION ANGLE $\bar{\phi}^\circ$	COHESION \bar{c} kg/cm ²
	DEPTH in.	HEIGHT in.		INITIAL	FINAL						
1	1.85	3.85	105.4	19.5	20.5	3.10	1.0	4.9	2.59	31.0	0.3
2	"	4.03	106.5	21.6	22.0	4.10	2.0	3.6	3.81		
3	"	3.85	102.1	20.9	21.8	6.10	4.0	6.54	6.73		

COUNTRY CLUB LAKE
BAUER ENGINEERING

STS Job No. 13929

Date: 7/14/70

Boring 1 & 2

Sample 4

Depth 15'-17'

LL = 37.2 FL = 230 PI = 142

$\bar{\phi} = 31.0^\circ$

$\bar{\phi} = 25.0^\circ$

NORMAL STRESS σ_2 /cm²

1

2

3

4

5

6

7

8

9

10

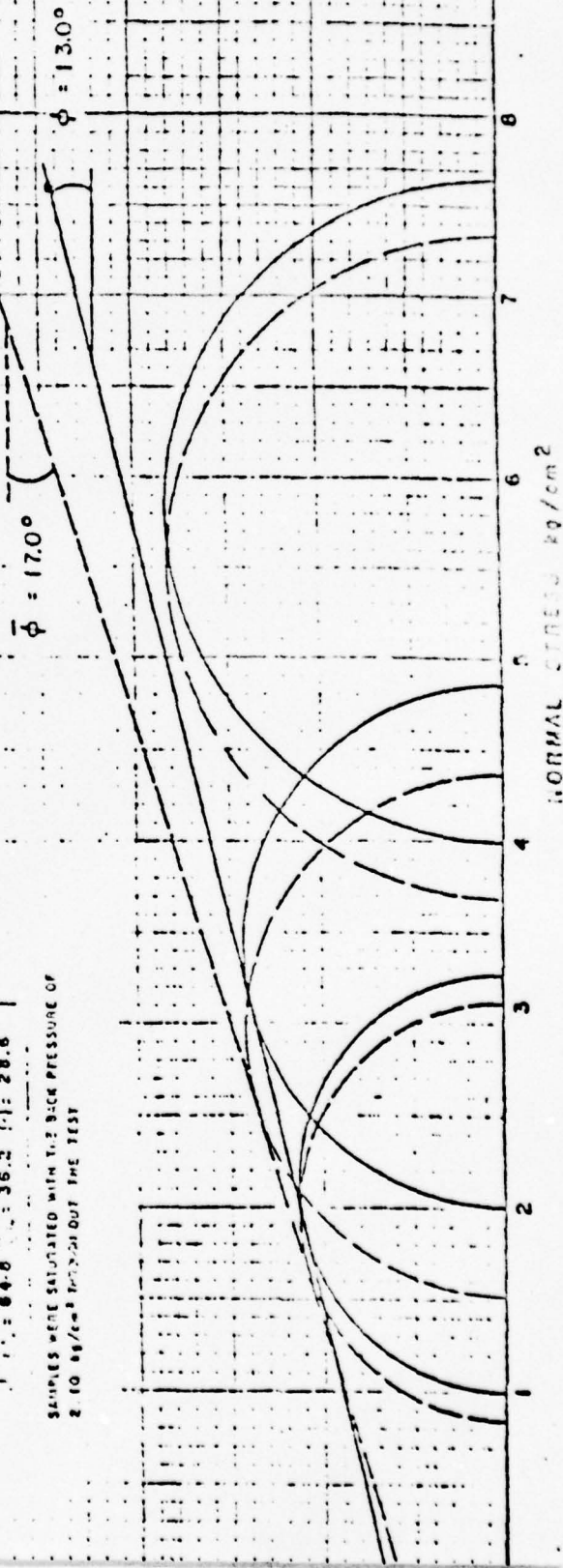
CONSOLIDATED UNDRAINED T-X SHEAR TEST

TEST NO.	INITIAL SAMPLE		DRY DENSITY pcf	WATER CONTENT %		CHAMBER PRESSURE kg/cm ²	CONSOLIDATION PRESSURE kg/cm ²	STRAIN AT MAX STRESS ($\sigma_1 - \sigma_3$) %	MAX DEV STRESS kg/cm ²	FRICTION ANGLE ϕ°	COHESION C kg/cm ²
	DIAMETER in.	HEIGHT in.		INITIAL	FINAL						
1	1.98	4.40	94.5	26.5	27.2	3.10	1.00	8.5	2.28	17.0	0.6
2	1.98	4.11	95.5	26.7	27.6	4.10	2.00	9.3	2.84		
3	1.99	4.30	95.8	26.2	27.2	6.10	4.00	15.7	3.63		

CORNER/CLUT THE
 SOIL ENGINEERING
 015 JAY NO. 13022
 DATE: 7/28/70

DESIGN: POWER AUGER
 SAMPLES REMOVED IN THE STANDARD
 PROCTOR
 FILL: 0'-15'
 P: 64.0 S: 36.2 I: 28.6

SAMPLES WERE SATURATED WITH THE BACK PRESSURE OF
 2.10 kg/cm² THROUGHOUT THE TEST

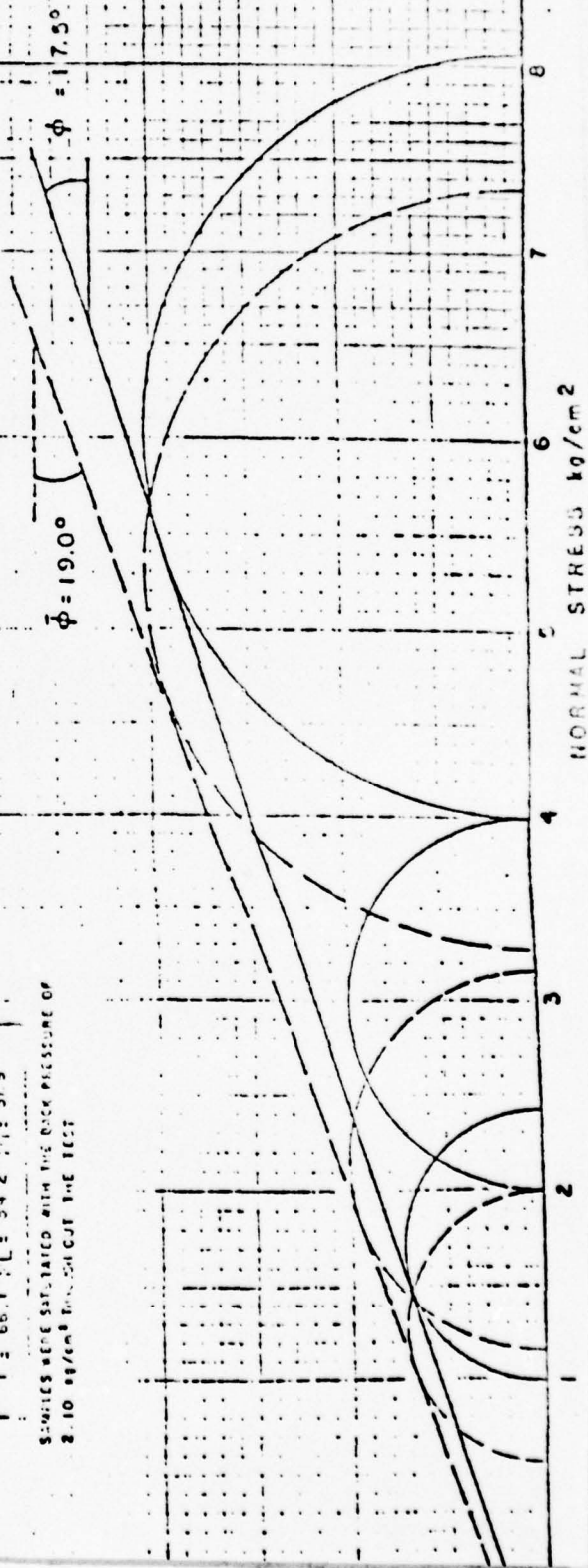


CONSOLIDATED UNDRAINED T-X SHEAR TEST

TEST NO.	INITIAL SAMPLE		DRY DENSITY pcf	WATER CONTENT %		CHARACTER PRESSURE kg/cm ²	CORRELATION HUBB PRESSURE kg/cm ²	STRAIN AT MAX. ($\sigma_1 - \sigma_3$) %	MAX. DEV STRESS kg/cm ²	FRICTION ANGLE $\bar{\phi}^\circ$	COMPRESSION \bar{C} kg/cm ²
	DIAMETER in.	HEIGHT in.		INITIAL	FINAL						
1	1.95	4.315	94.8	20.0	23.4	3.10	1.00	2.9	1.41		
2	1.96	4.10	94.5	21.8	25.0	4.10	2.00	18.6	2.00	19.0	0.3
3	1.98	4.15	96.0	21.0	24.5	6.10	4.00	16, 6	4.06		

113 JOE RD 13329
253 : 7/28/70

TO THE CREST OF HILL
SLOPE REMOVED IN THE STANDARD
FUNCTION
D 112 0' - 12'
1 = 66.1 FL = 34.2 PLE 31.9
ISOMES WERE SATURATED WITH THE ROCK PRESSURE OF
2 TO 88/688 TO CALCULATE THE TEST



SOIL TESTING SERVICES, Inc.

111 Pfingsten Road
Northbrook, Illinois

S.T.S. Job No. 13929

Date 7/14/70

LABORATORY COMPACTION CONTROL REPORT

Job Name and Location COUNTRY CLUB LAKE

Architect or Engineer BAUER ENGINEERING

Contractor _____

A. Description of Soil: SILTY CLAY, TR. TO SOME SAND, TR. GRAVEL - REDISH BROWN

Material Mark BORROW MATERIAL Unified Classification MH AASHO Classification _____

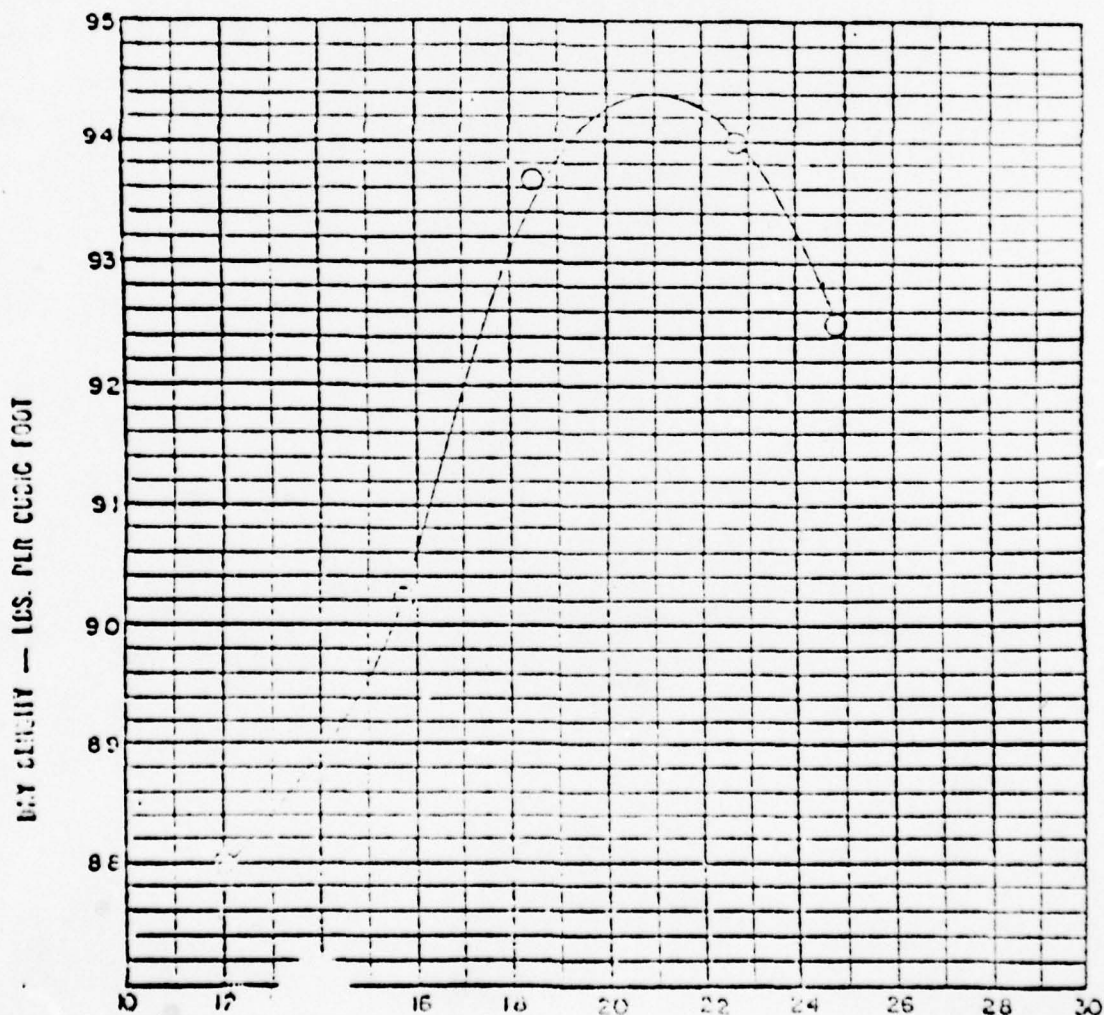
Source of Material BORING 2, CREST OF HILL DEPTH 0' - 12'

Natural Water Content 36.8 % Natural Dry Density _____ PCF Specific Gravity 2.70

Liquid Limit 66.1 % Plastic Limit 34.2 % Plasticity Index 31.9

B. Test Procedure Used: ASTM D-698

C. Test Results: Maximum Dry Density 94.4 PCF Optimum Water Content 21.0 %



SOIL TESTING SERVICES, Inc.

111 Pfingsten Road
Northbrook, Illinois

S.T.S. Job No. 13929

Date 7/14/70

LABORATORY COMPACTION CONTROL REPORT

Job Name and Location COUNTRY CLUB LAKE

Architect or Engineer BAUER ENGINEERING

Contractor _____

A. Description of Soil: SILTY CLAY, TR. TO SOME SAND, TR. GRAVEL - REDISH BROWN

Material Mark BORROW MATERIAL Unified Classification MH AASHTO Classification _____

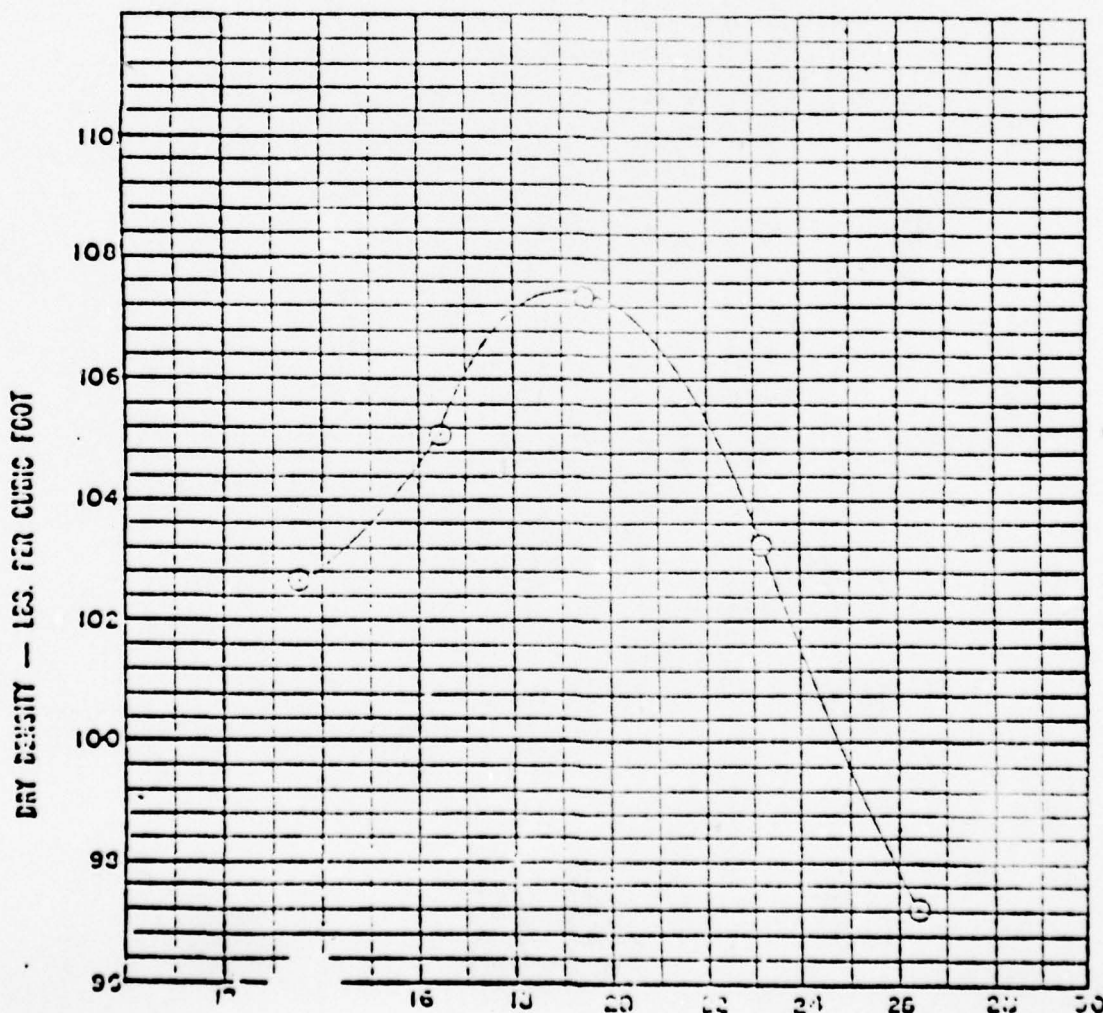
Source of Material BORING 2, CREST OF HILL DEPTH: 0' - 12'

Natural Water Content 36.8 % Natural Dry Density _____ PCF Specific Gravity 2.70

Liquid Limit 66.1 % Plastic Limit 34.2 % Plasticity Index 31.9

B. Test Procedure Used: ASTM D 1557 - 66 T

C. Test Results: Maximum Dry Density 107.5 PCF Optimum Water Content 19.0 %



SOIL TESTING SERVICES, Inc.

111 Pfingsten Road
Northbrook, Illinois

S.T.S. Job No. 13929

Date 7/14/70

LABORATORY COMPACTION CONTROL REPORT

Job Name and Location COUNTRY CLUB LAKE

Architect or Engineer BAUER ENGINEERING

Contractor _____

A. Description of Soil: SILTY CLAY, TR. TO SOME SAND, TR. GRAVEL - BROWN

Material Mark BORROW MATERIAL Unified Classification MH AASHTO Classification _____

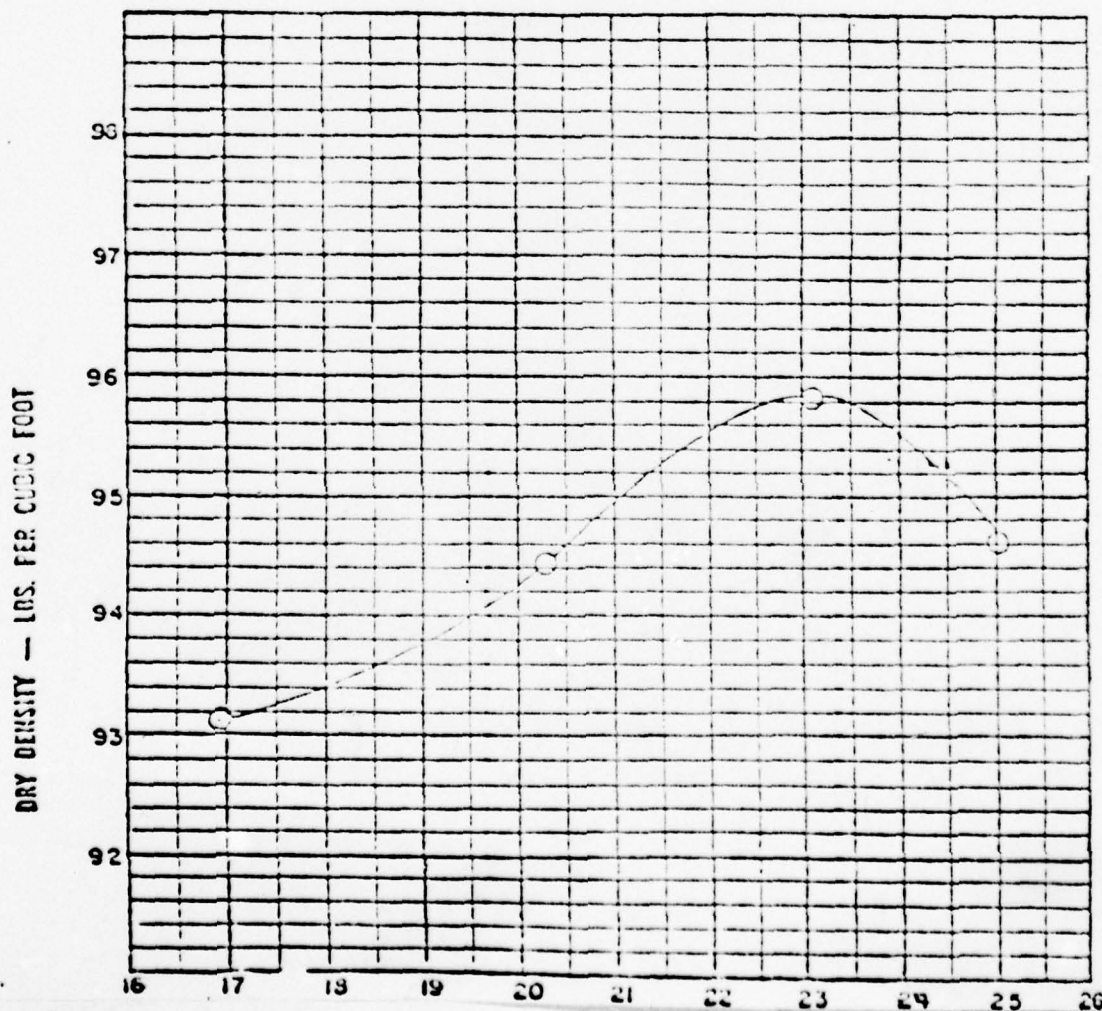
Source of Material BORING 1 DEPTH 0' - 15'

Natural Water Content 28.1 % Natural Dry Density _____ PCF Specific Gravity 2.70

Liquid Limit 64.8 % Plastic Limit 36.2 % Plasticity Index 28.6

B. Test Procedure Used: ASTM D-698

C. Test Results: Maximum Dry Density 95.9 PCF Optimum Water Content 23.0 %



SOIL TESTING SERVICES, Inc.

111 Pfingsten Road
Northbrook, Illinois

S.T.S. Job No. 13929

Date 7/14/70

LABORATORY COMPACTION CONTROL REPORT

Job Name and Location COUNTRY CLUB LAKE

Architect or Engineer BAUER ENGINEERING

Contractor

A. Description of Soil: SILTY CLAY, TR. TO SOME SAND, TR. GRAVEL - BROWN

Material Mark BORROW MATERIAL Unified Classification M H AASHO Classification

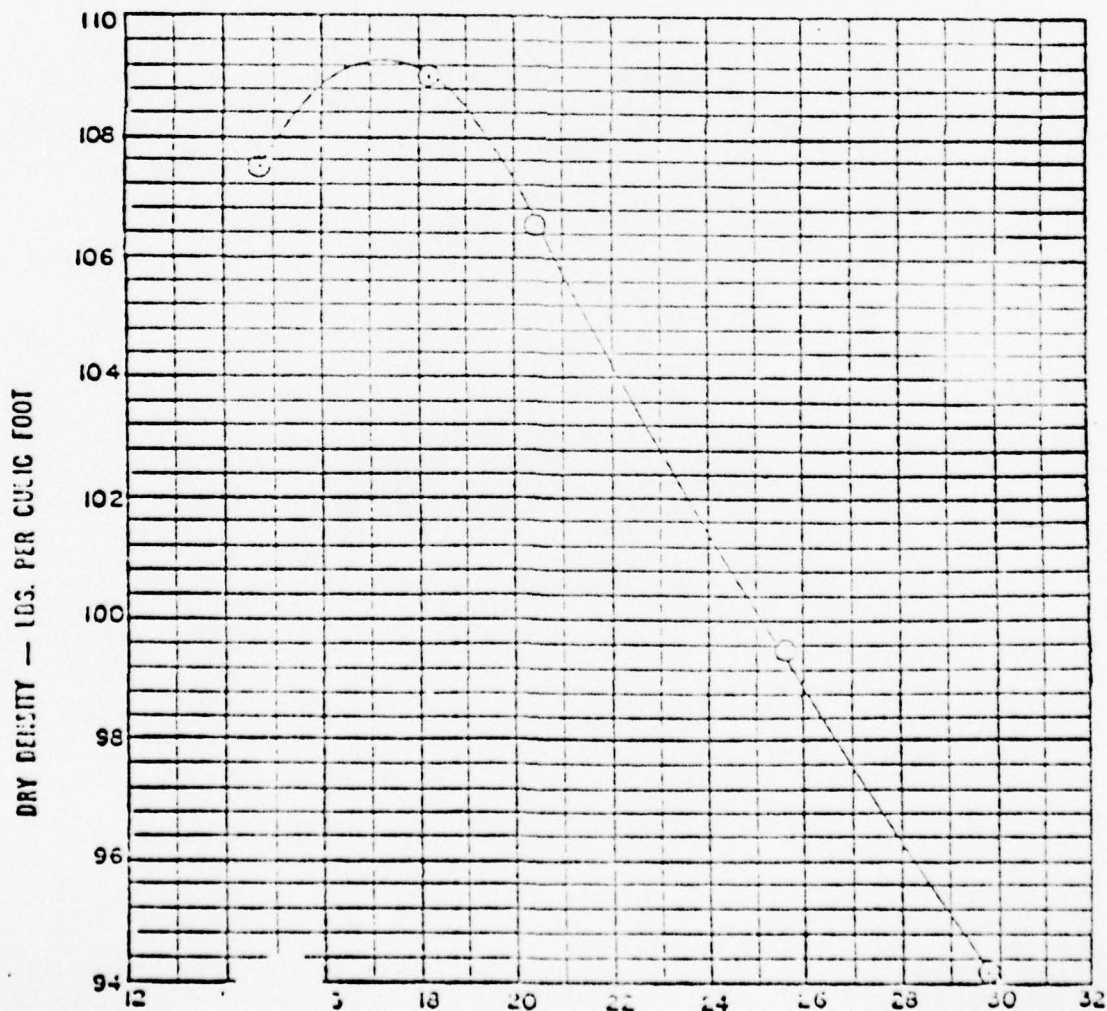
Source of Material BORING - 1, DEPTH: 0' - 15'

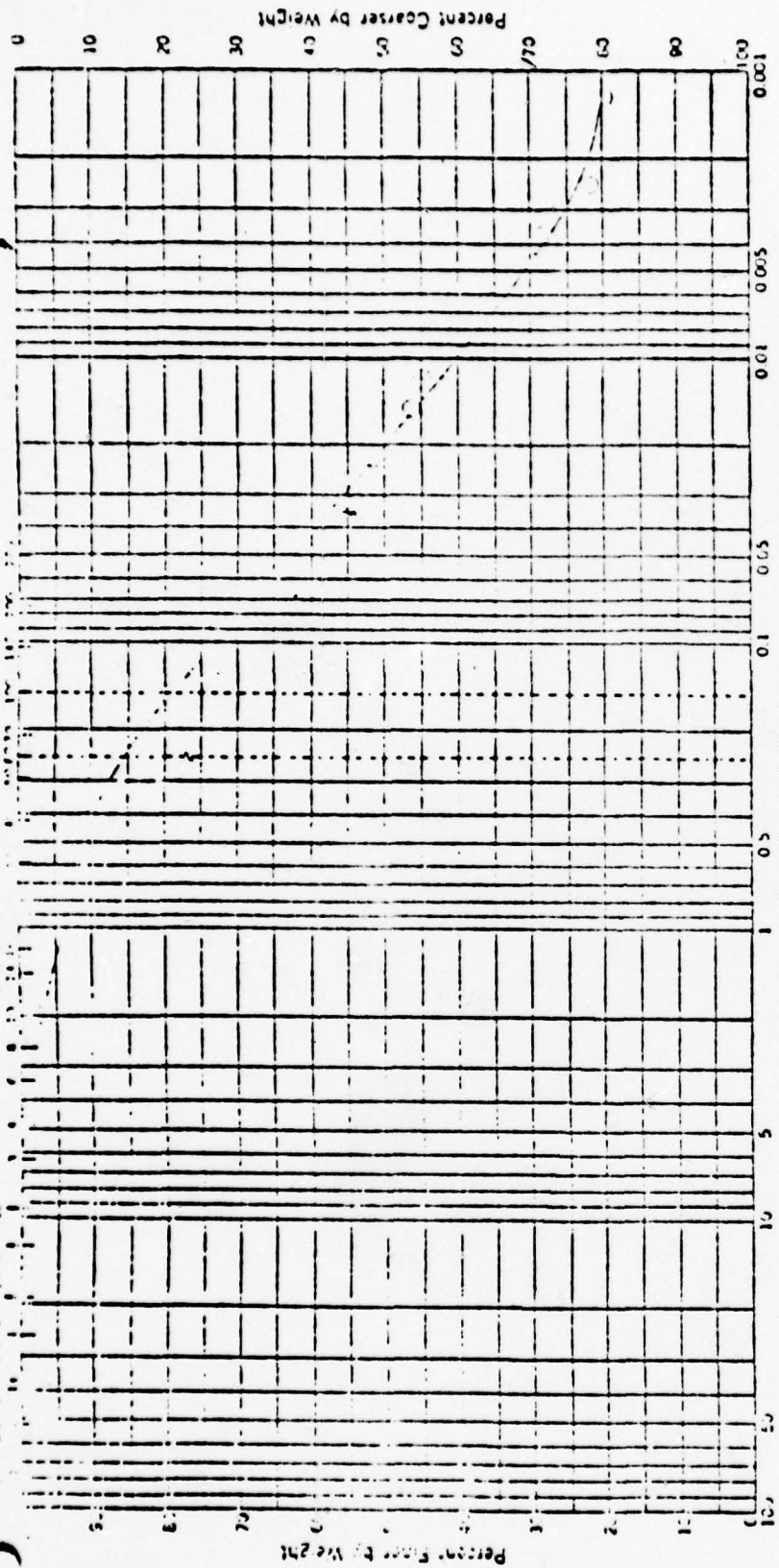
Natural Water Content 28.1 % Natural Dry Density PCF Specific Gravity 2.70

Liquid Limit 64.8 % Plastic Limit 36.2 % Plasticity Index 28.6

B. Test Procedure Used: ASTM 1557 - 66 T

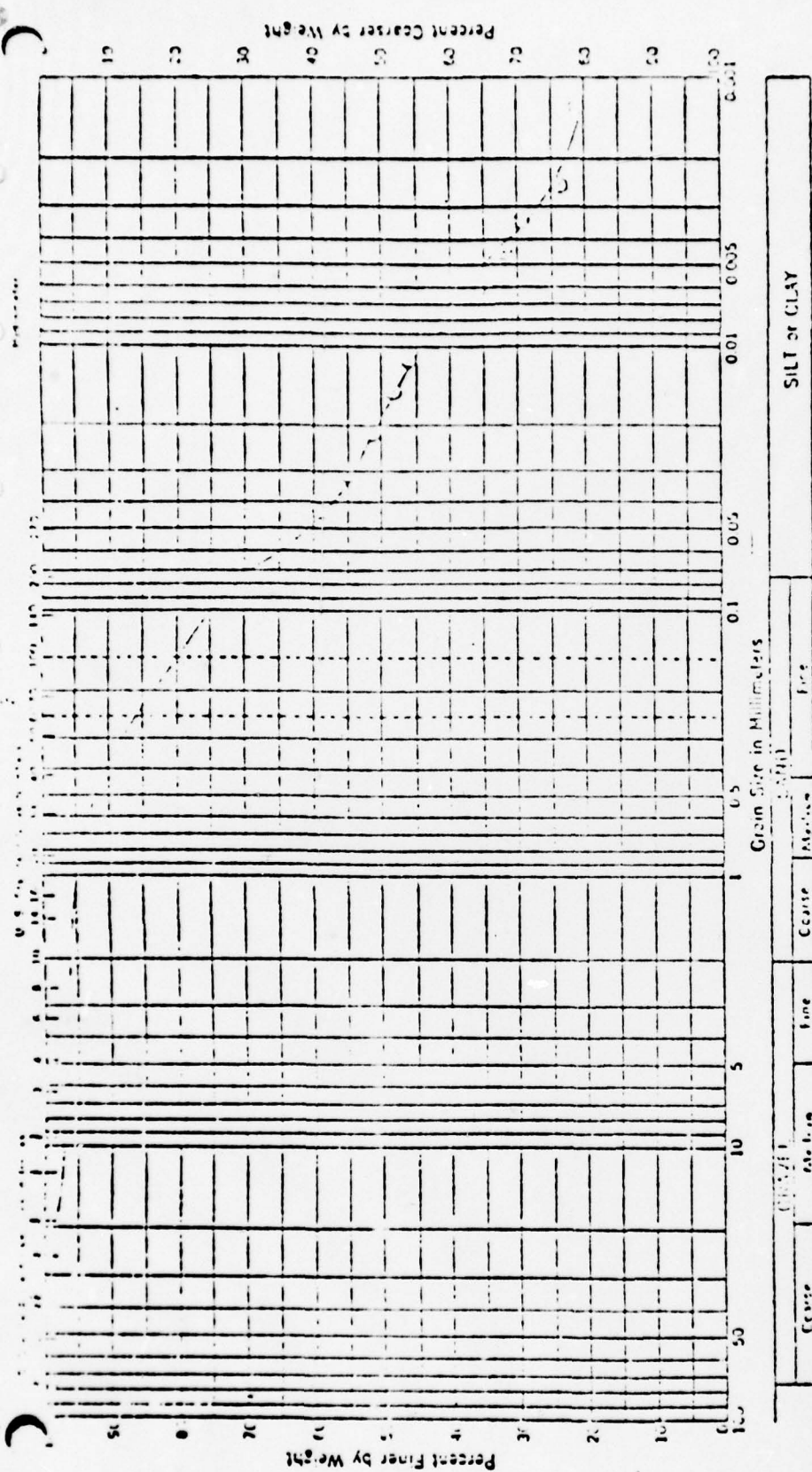
C. Test Results: Maximum Dry Density 109.2 PCF Optimum Water Content 17.2 %



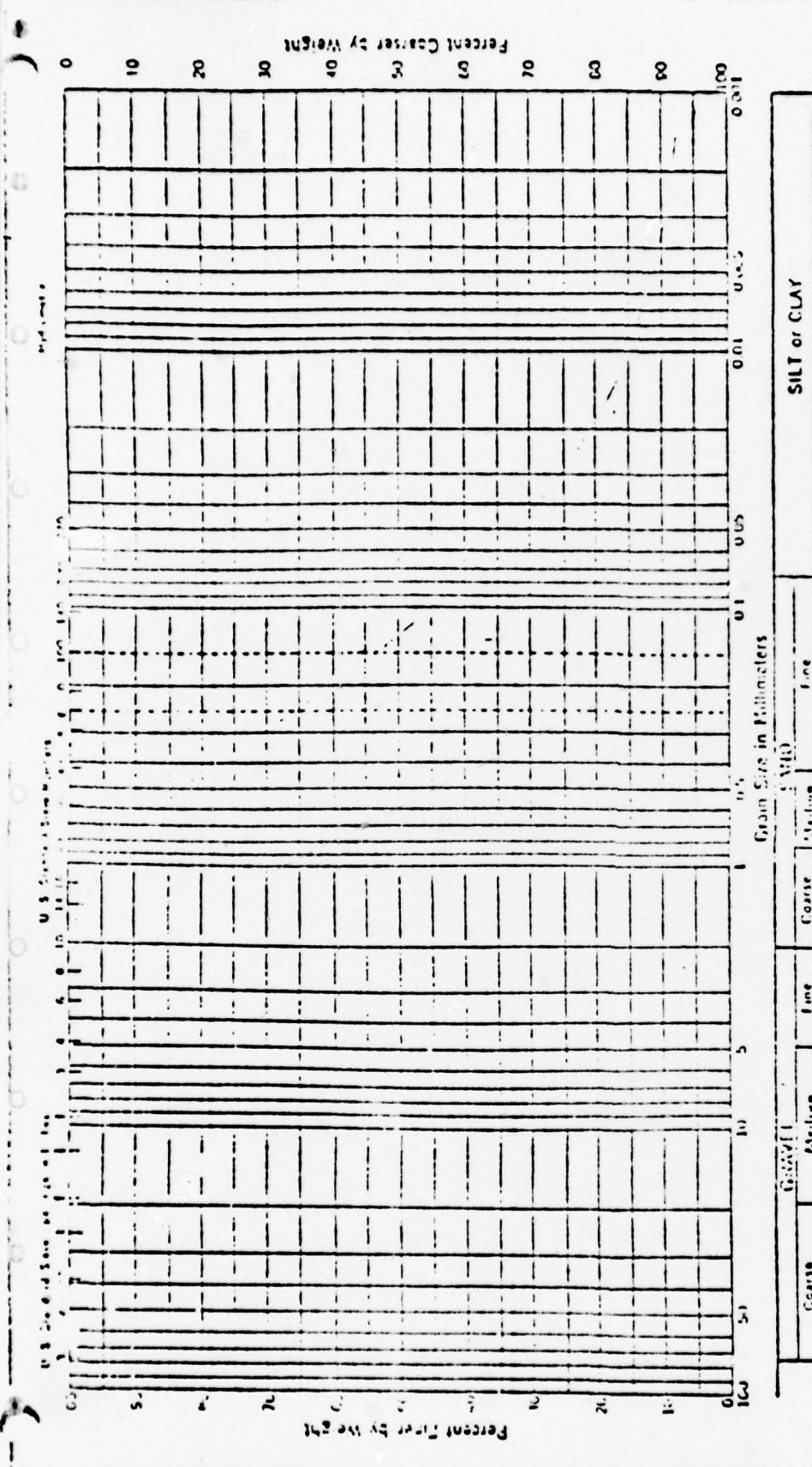


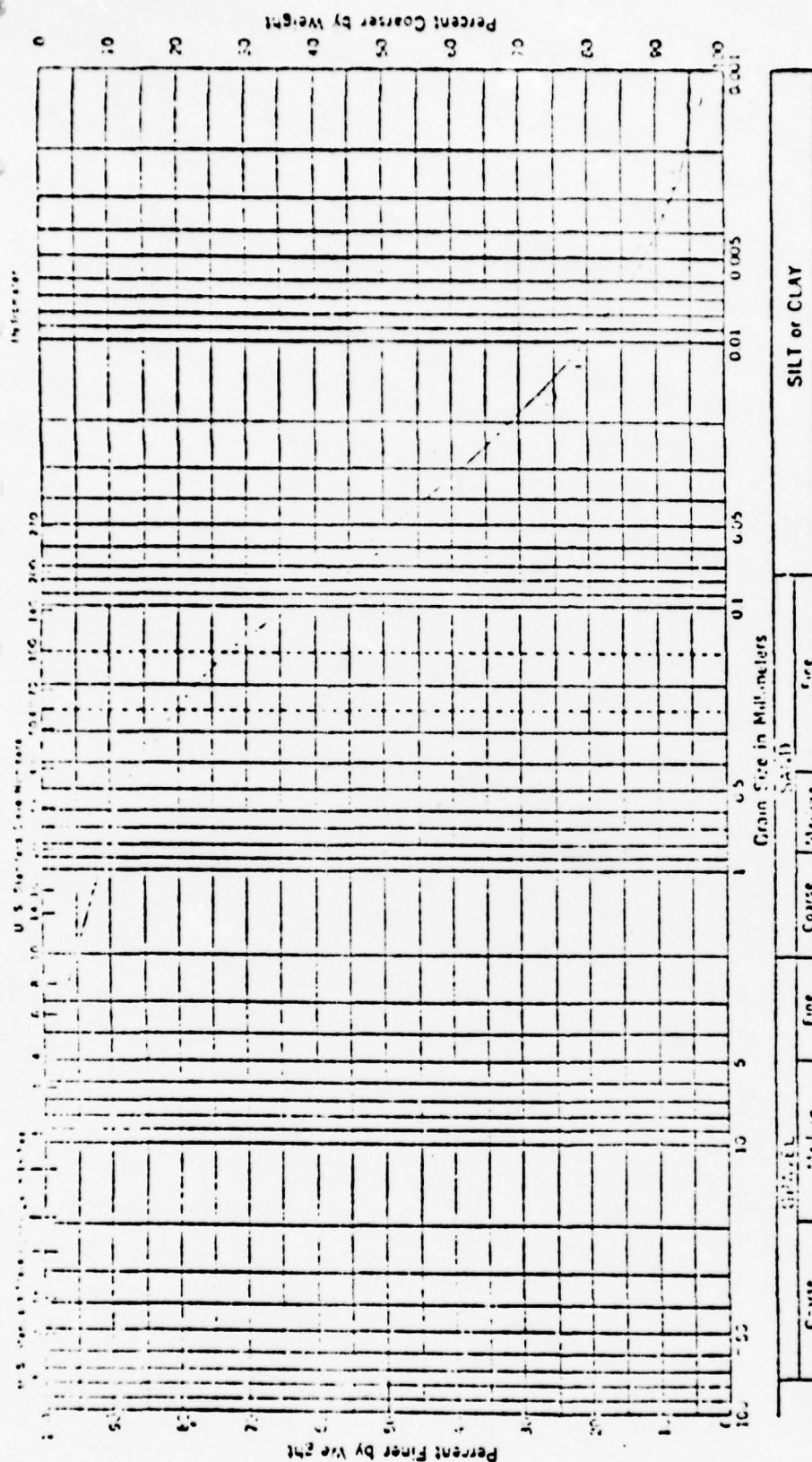
Grain Size in Millimeters			SILT or CLAY	
Coarse	Medium	Fine		

SAMPLE NO.	CLASSIFICATION				COUNTRY CLUB LAKE	
	W.C.	LL	PL	PI	BAUER ENGINEERING	
	39.5	64.0	40.5	23.5	POWER BORING : 2	
					CREST OF HILL	
					DEPTH : 12' - 15'	
					SOIL TESTING SERVICES, INC.	
					111 KINGSTON ROAD	
					NORTHBROOK ILLINOIS	
					DRAWN	APPROVED
					S 2	C H C
					DATE	JOB NO.
					7/14/70	13920



SILE NO.	CLASSIFICATION				COUNTRY CLUB LAKE BAUER ENGINEERING BORING 2 CREST OF HILL DEPTH 0'-12'			
	W.C.	LL	PL	PI	SOIL TESTING SERVICES, INC. 111 PRINGSTON ROAD NORTHWOOD MA 01905			
	36.0	65.1	34.2	31.9	DESIGN APPROVED DATE 7/14/70			
					S Z C H C 7/14/70 103920 A			

[illegible]



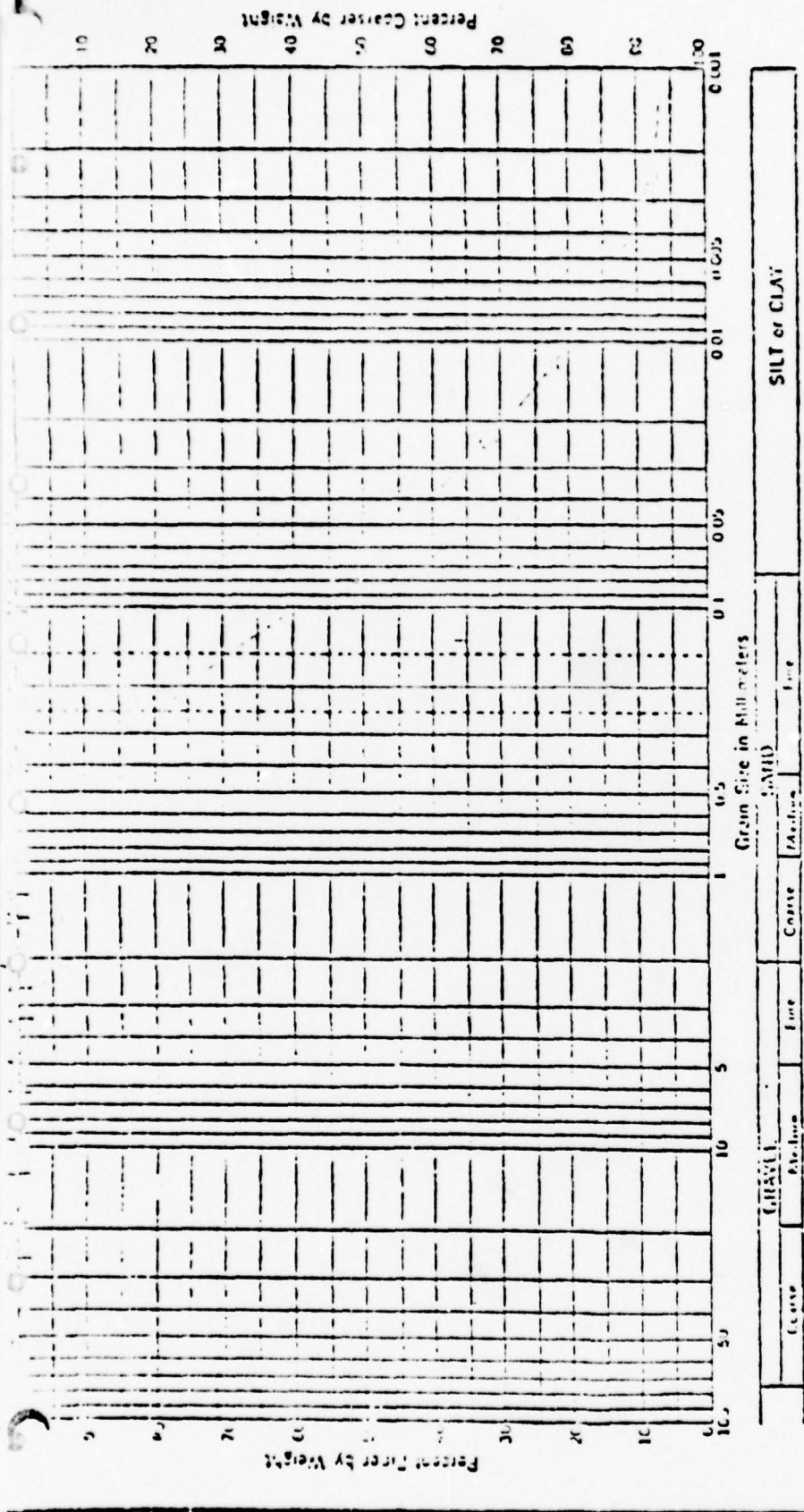
SAMPLE NO.	W.C.	LL	PL	PI	CLASSIFICATION
	19.5	37.2	23.0	14.2	Sandy silt, fr. to some clay-brown with black seams (ML-CL)

COUNTRY CLUB LAKE
BAUER ENGINEERING

BORING : 1
SAMPLE : 4
DEPTH : 15'-17'

SOIL TESTING SERVICES, INC.
111 PINGSTEN ROAD
NORTHBROOK ILLINOIS

DRAWN	APPROVED	DATE	JOB NO.
5 2	C H C	7/28/70	13929

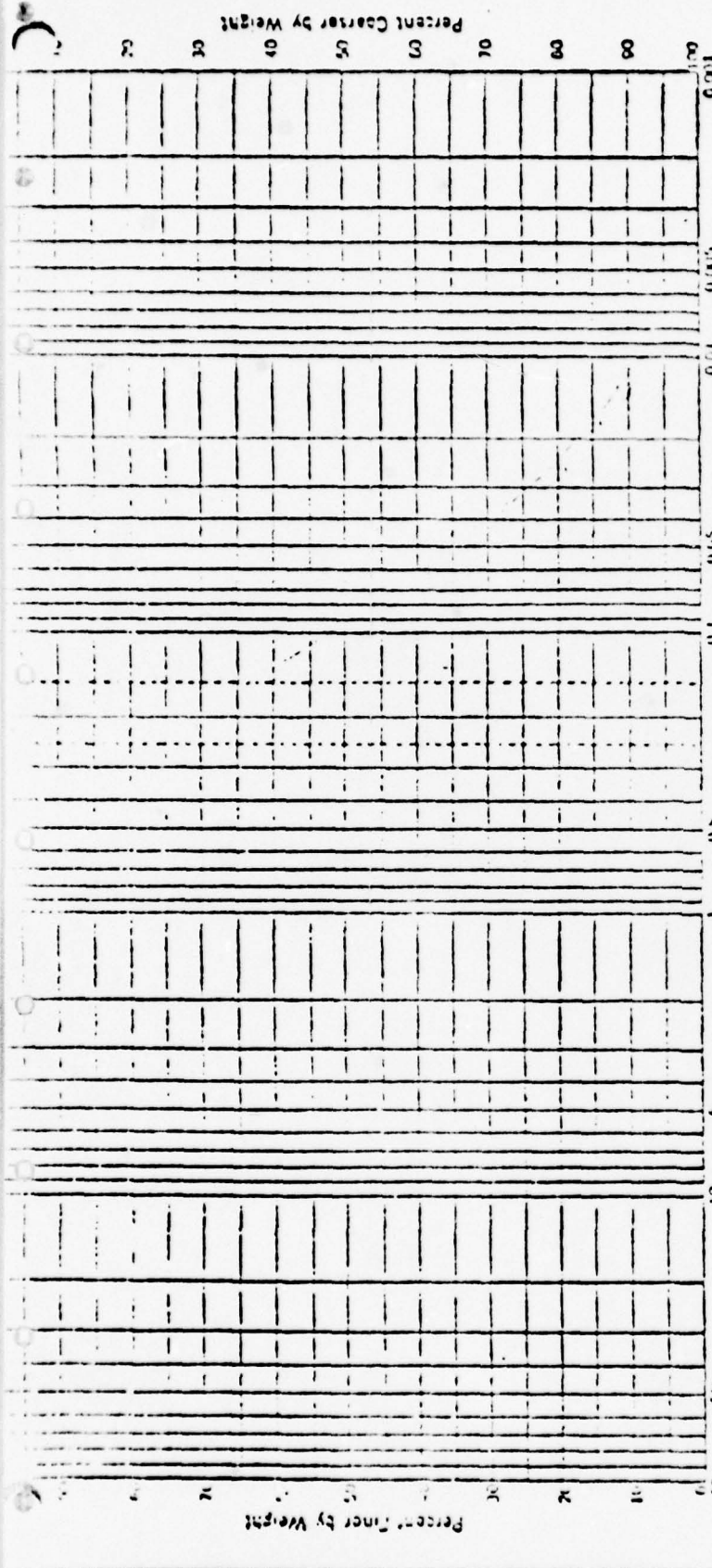


SAMPLE NO.	CLASSIFICATION				GRAVEL		FINE		SAND		FINE		SILT or CLAY
	V.C.	LL	I.P.	PI	Coarse	Fine	Coarse	Fine	Coarse	Fine	Coarse	Fine	
	28.5	48.8	31.2	17.6	Clayey silt & sand, 1% gravel - rust brn. &								
					slightly grey (ML-CL)								

COUNTRY CLUB LAKE
CAUER ENGINEERING
BORING : 2
SAMPLE : 6
DEPTH : 25'- 27'

SOIL TESTING SERVICES, INC.
111 BINGHAM ROAD
NORTHROCK
ILLINOIS

DATE	APPROVED	DATE	JOINED
5 2	C H C	7/20/70	13929



Grain Size in Millimeters			SILT or CLAY		
Coarse	Medium	Fine	Coarse	Medium	Fine

SAMPLE NO.	CLASSIFICATION				COUNTRY CLUB LAKE				
	V.C.	FI	PL	PI	BAUER ENGINEERING				
	MOIST		NONE		BORING : 2				
					SAMPLE : 8-2				
					DEPTH : 35'-37'				
SOIL TESTING SERVICES, INC.								SOIL TESTING SERVICES, INC.	
NORTH BOSTON ROAD								NORTH BOSTON ROAD	
ILLINOIS								ILLINOIS	
DRAWN				APPROVED		DATE		JOB NO.	
S 2				C H C		7/20/70		13929	

**Graedinger
Parker & Associates
Hampton**

CONNECTICUT AVENUE, N.W.

WASHINGTON, D.C. 20036

PHONE 202 - 466-2922

V. P. GRAEDINGER, P.E.
J. A. PARKER, JR., P.E.
J. HAMPTON, Ph.D., P.E.

August 6, 1970

R. DORRIS, JR., P.E.
J. G. LUKAS, P.E.
J. C. HALL, P.E.

Bauer Engineering, Inc.
20 North Wacker Drive
Chicago, Illinois 60606

Attention: Mr. Donald W. Wikan STS Job No. 13929

Reference: Subsurface investigations for proposed reconstruction of
Country Club Lake Dam in Dumfries, Virginia

Gentlemen:

The subsurface investigation at the site of the existing Country Club Lake Dam in Dumfries, Virginia has been completed. Three borings were performed along the dam axis to investigate the present condition of the dam relative to dam stability and two power auger borings were performed at proposed borrow locations to obtain representative samples of borrow materials. The logs of the borings are included with this report. All samples obtained were sealed in the field and brought back to the laboratory for further examination, testing, and classification in accordance with the Unified Soil Classification System.

It is our understanding that the existing dam has a maximum height of approximately 60 feet and minimum 2½:1 side slopes. It is proposed to raise the height of the dam approximately six more feet placed on 2:1 side slopes. The primary purpose of this investigation and report is to determine the condition and composition of the existing dam, to determine the soil parameters to be used in the stability analysis for this proposed additional height, and to make recommendations regarding the construction of the proposed additional dam height.

In order to determine the various soil parameters, routine classification tests were performed on representative samples and special consolidated undrained triaxial tests with pore pressure measurements were performed on selected samples. Two of the triaxial test series were performed on samples taken from the existing dam soils and the third triaxial test series was performed on the proposed borrow material compacted to approximately 99% of Standard Proctor Density (ASTM Specification D-698). Results of all the testing are included in the Appendix of this report.

The borings performed revealed the existing dam soils to consist primarily of tough to very tough micaceous silty and sandy clay or medium dense to dense micaceous clayey sandy silt extending to the original natural underlying soil which consisted of a very dense clayey and silty sand to the end of the borings. This clayey sand grades into the parent bedrock.

Unconfined compressive strength test values in the existing dam soils generally varied from 1.5 to over 4 tons per square foot (tsf) with natural water contents in the more clayey soils generally in the 25 to 35% range and natural water contents in the more sandy soils in the 15 to 25% range. Liquid limits in the more clayey soils are generally in the 40 to more than 60 range whereas liquid limits in the more sandy and silty soils are generally less than 40. Much of the material plots below the A line on the Unified Soil Classification System Chart indicating a considerable degree of elasticity and resilience in the soil.

The consolidated undrained triaxial test series with pore pressure measurements performed on representative samples from the existing dam indicated consolidated undrained friction angles in the range of 23° to 25° with cohesion values varying from .3 to more than 1 kilogram per square centimeter. The effective stress friction angle varied in the range of 27° to 31° with a slightly lower cohesion value intercepts. Since all of these friction angles are greater than the existing side slopes of the dam, the existing dam is stable. If these soil parameters are put through a standard slope circle stability analysis, a fairly high factor of safety should result.

With regard to the proposed additional six feet of material to be placed on top of the existing dam at a 2:1 slope, we recommend that the proposed borrow material be compacted to a minimum of 98% of standard Proctor (ASTM-D-698). To achieve this, the fill should be placed in loose lifts of not more than 9 inches in thickness and where necessary the natural water content should be lowered by disk and aeration to get within 4% of the optimum water content for compaction. The compaction test results included in the appendix indicate the optimum water content for compaction of the borrow material is in the range of 21 to 23%. With natural water contents running from 28 to more than 35%, some reduction of the water content will be necessary to achieve the recommended degree of compaction.

The triaxial test series performed on the borrow material indicated a total stress consolidated undrained friction angle of 17.5° with a cohesion of approximately .3 kilograms per square centimeter. This is considerably lower than the existing dam material. However, considering the shallow depth of new fill this should be adequate.

Bauer Engineering, Inc.
STS Job No. 13929
August 6, 1970
Page 3

Considering the high water content of the proposed borrow material and also considering the relatively low friction angle and cohesion values for the compacted material, close inspection and testing during construction will be necessary to make certain that the best possible results are obtained. As mentioned previously, because the natural water content is in certain cases more than 10% above the optimum for compaction, a certain amount of diskings and aeration will probably be required in order to achieve the desired compaction.

The information and recommendations in this report have been presented as an aid to the design engineer to facilitate achieving a safe economical dam reconstruction. Since the investigation was limited in scope, variations in soils conditions from those indicated at the boring locations may occur. However, it is our opinion that the extent of the investigation has been sufficient to give a reasonable representation of the existing conditions and proposed constructed condition and that if the reconstruction is performed as recommended, the dam will be safe with regard to stability.

If there are any questions with regard to the information presented in this report, or if we can be of service to you in any way, please do not hesitate to contact us.

Very truly yours,

SOIL TESTING SERVICES, INC.

Clyde N. Baker, Jr.

Clyde N. Baker, Jr.
Registered Professional Engineer

Dixon O'Brien, Jr.

Dixon O'Brien, Jr.
Registered Professional Engineer
Virginia #3983

CNB:seh

cc: Country Club Lake
P.O. Box 124
Dumfries, Virginia 22026

Attention: Mr. William H. Sturcey
Construction Manager

**Gnaedinger
Baker & Associates
Hampton**

1250 CONNECTICUT AVENUE, N.W. • WASHINGTON, D.C. 20036 • PHONE 202 - 466-2992

JOHN P. GNAEDINGER, P.E.
CLYDE N. BAKER, JR., P.E.
LON HAMPTON, PH.D., P.E.

DIXON, CARRIE, JR., P.E.
ROBERT G. LUKAS, P.E.
HAROLD C. HALL, P.E.

October 14, 1970

Mr. William Sturcey
Construction Manager
Country Club Lake
Dumfries, Virginia

STS Job No. 13929-A

Reference: Proposed Dam Reconstruction, Country Club Lake, Dumfries, Va.

Dear Mr. Sturcey:

This is a letter report transmitting the results of laboratory tests recently conducted to evaluate proposed borrow materials. A total of four compaction tests were conducted, one on borrow material from a site adjacent to the dam, two on proposed borrow from future cuts, and one on soil used in a road fill. The results of these tests can be summarized as follows:

<u>Sample Description</u>	<u>Optimum Moisture, %</u>	<u>Optimum Density, pcf</u>	<u>Natural Moisture, %</u>
1. Borrow site adjacent to the dam	23.9	94.0	31.6
2. Test pit #1, area of proposed cut	19.0	102.5	25.9
3. Test pit #2, area of proposed cut	17.5	105.9	19.6
4. Road fill	13.0	116.5	-

Test No. 1 was made to recheck optimum dry density of the borrow being used in the field. A decision was made to conduct this test when difficulty was encountered in meeting the compaction criterion for fill placed on the dam. A specific gravity test was also conducted on this sample and a value of 2.84 was obtained.

Tests Nos. 2 and 3 were made to assess the feasibility of using soil from a proposed cut as fill for the dam. Both samples tested proved suitable. However, the data from Test No. 3 was most representative of the soils at the site of the proposed cut. It's natural moisture content is significantly above the optimum moisture content. Therefore, if borrow is taken from this area it will require significant aeration, prior to compaction, to dry the soil to, or below, it's optimum moisture content. The soil from Test pit No. 1 (Test No. 2) appeared to be highly over-consolidated and break up into hard slabs. When this material is encountered, it will have to be broken down prior to compaction.

Test No. 4 was taken on a road fill above a culvert. The data obtained, is being used, in conjunction with nuclear moisture-density measurements, to ascertain the degree of compaction of this fill.

Compaction control operations have been in progress on the earthwork operations on a continuous basis and a final report and a summary of all tests performed will be submitted at the completion of the work.

If there are any questions with regard to this letter, or if we can be of any further service to you, please do not hesitate to contact us.

Very truly yours,

GNAEDINGER, DAKER, HAMPTON & ASSOCIATES

Delon Hampton
Delon Hampton

Registered Professional Engineer
Washington, D.C. #5991

Dixon O'Brien, Jr.
Dixon O'Brien, Jr.
Registered Professional Engineer
Virginia #3983

Clyde N. Baker, Jr.
Clyde N. Baker, Jr.
Chief Engineer

DH:jp

Baker & Associates
Hampton

CONNECTICUT AVENUE, N.W. • WASHINGTON, D.C. 20036 • PHONE 202 - 466-2000

DR. P. CRADINGER, P.E.
MR. N. BAKER, JR., P.E.
LOU HAMPTON, PH.D., P.E.

MR. D. BRIEN, JR., P.E.
MR. T. S. LUKAS, P.E.
MR. D. C. HALL, P.E.

October 20, 1970

Mr. William Sturcey
Construction Manager
Country Club Lake
Dumfries, Virginia

Re: Proposed Dam reconstruction, Country Club Lake, Dumfries, Virginia

Dear Mr. Sturcey:

We have completed continuous inspection of the earthwork operations occurring on the reconstruction of the Country Club Lake Dam, Dumfries, Virginia. The Dam revision work consisted of widening the Dam on the lakeside and raising the existing Dam with 6 ft. 2 inches of clay fill and 4 inches of topsoil to attain an ultimate elevation of 206.5.

The earthwork operations on the project began on October 21, 1970, and all clay fill that was placed and compacted to the completion of the project on October 14, 1970 was approved as being installed in accordance with the specifications. Topsoil is to be placed at a later date.

The widening of the Dam was accomplished by cutting two shelves in the 2.5:1 slope on the lakeside to permit equipment to operate. The borrow material consisted of a clayey silt soil containing a trace of sand, which had a reddish brown to reddish yellow color. A nuclear density gauge was employed throughout the project to provide rapid compaction and moisture content results. As was discussed in earlier reports, the fill material used to reconstruct the Dam had a moisture content considerably above optimum so that considerable discing and scarifying of the soil had to be performed to aerate the material so that compaction to the recommended minimum of 98% standard proctor density could be achieved.

Initially, a 14 ton rubber-tired roller, a sheepfoot roller and the loaded scrapers were used to obtain the compaction. With this equipment, it was generally possible to readily obtain compaction to 94 to 95% of standard

proctor density but, considerable compactive effort was necessary to achieve the required 98% degree density. Because of the slowness of the work a 15 ton vibratory roller was brought to the site, which proved very satisfactory in achieving the compaction of the fill. As shown on the enclosed test results, compaction to the required degree of density was eventually obtained on each lift installed.

If there are any questions with regard to any of the information submitted in this report, or if we can be of further service to you in any way, please do not hesitate to contact us.

Very truly yours,

GNAEDINGER, BAKER, HAMPTON & ASSOCIATES

Robert Gillengerten
Field Technician

Dixon O'Brien, Jr./cc
Dixon O'Brien, Jr.
Registered Professional Engineer
Virginia #3983

Delon Hampton (cc)

Delon Hampton
Registered Professional Engineer
Washington, D.C. #5991

DOB:jp

COMPACTION REPORT

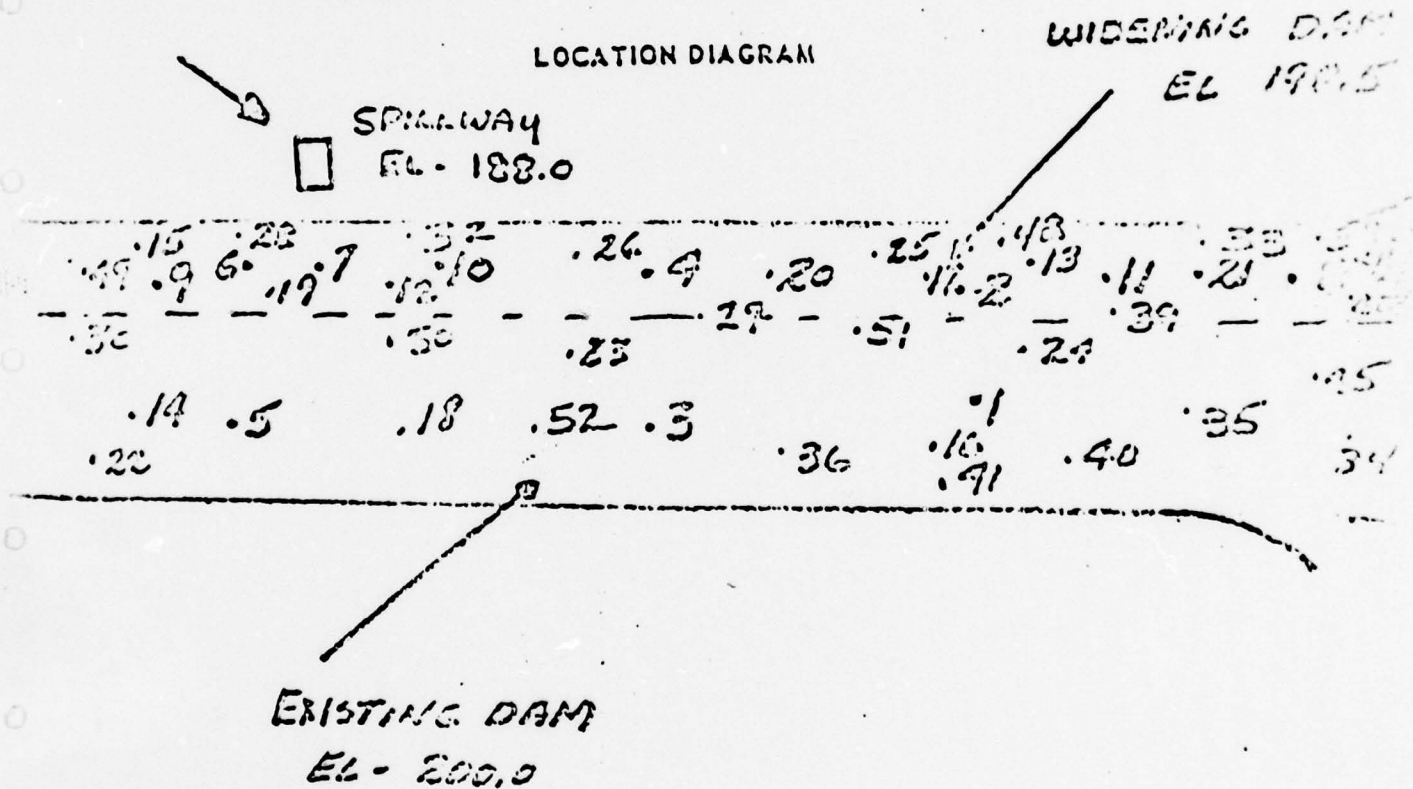
Job Name and Location COUNTRY CLUB LAKE, DUMFRIES VA

Architect or Engineer _____

Contractor F. E. LYONS

TESTS 1 → 52

LOCATION DIAGRAM



THIS ELEVATION OF DAM IS WHERE COMPACTION TESTS HAVE STARTED.

SOIL TESTING SERVICES, Inc.

111 Pfingston Road
Northbrook, Illinois

STS Job No. 12225

COMPACTION REPORT

Job Name and Location CONCRETE CURB SIDE, DUFFERIN, IL

Architect or Engineer _____

Contractor E. E. LUCAS

LOCATION DIAGRAM

TESTS #52 - 104

SPILLWAY

78	.54	.96	.94	.55	.77	.83	.62	.20	.60	.76	.58	.102	.92	.87	.84	.75
							.61		.101	.93		.75		.73		.88
	.81	.71		.82	.72	.85	.105		.101		.105	.100				
53	.95	.80	.70	.103	.56	.69	.98	.63		.68	.57					.67

SOIL TESTING SERVICES, Inc.

111 Pfingston Road
Northbrook, Illinois

STS Job No. 15727

COMPACTION REPORT

Job Name and Location COUNTRY CLUB LAKE, NORTHBROOK, ILL.

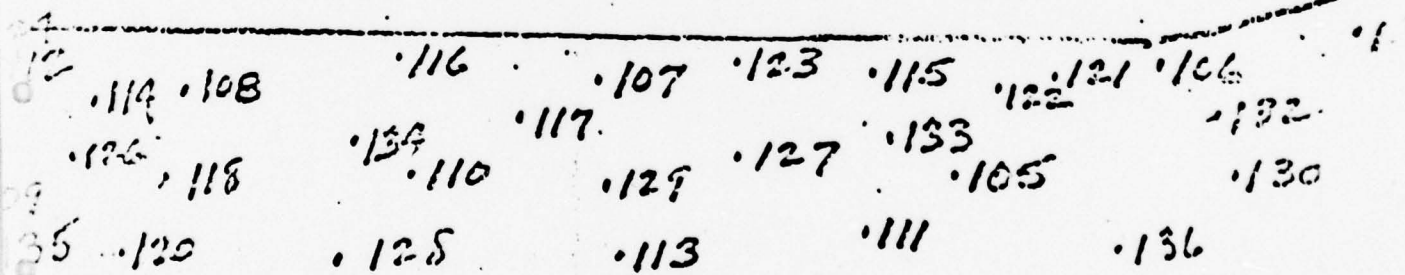
Architect or Engineer _____

Contractor F. E. GRIFFIN

LOCATION DIAGRAM

TESTS 105 → 136

SPILLWAY →





SOIL TESTING SERVICES, Inc.

111 Plington Road
Northbrook, Illinois

S.T.S. Job No. 12904

FIELD COMPACTION SUMMARY

Job Name and Location COUNTRY CLUB LAKE, DUMFRIES, MD

Architect or Engineer _____

Contractor E. F. LYONS

Method of Field Density Measurement

☐ Sand Cone Method

☒ Nuclear Method

DATUM _____

DATE	LOCATION	LIFT NO. OR ELEV.	N.T.L. MARK	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN-PLACE DRY DENSITY	PERCENT COMPACTION	COMMENTS
7-25	SAN DAMIAN	200.0	1	95	22.0	92	97	OK
"	"	198.5	"	"	31.5	80	85	OK
"	"	200.0	"	"	22.0	97	100	OK
"	"	198.5	"	"	31.0	83	87	OK
"	"	200.0	"	"	22.5	94	100	OK
"	"	198.5	"	"	24.0	88	93	OK
"	"	"	"	"	26.0	81	91	"
"	"	"	"	"	36.6	75	82	"
9-21	"	"	"	"	33.0	79	84	"
"	"	"	"	"	24.0	85	90	"
"	"	"	"	"	27.8	82	89	"
9-25	"	"	"	"	26.5	87	92	"
"	"	"	"	"	21.5	87	92	"
"	"	"	"	"	21.0	89	95	"
"	"	"	"	"	26.0	88	93	"
"	"	"	"	"	28.0	96	100	OK
"	"	"	"	"	21.0	88	93	OK
"	"	"	"	"	19.5	96	100	OK
"	"	"	"	"	25.0	88	98	OK
"	"	"	"	"	22.5	93	98	OK
"	"	"	"	"	19.5	93	100	OK
9-30	"	342	"	"	22.3	91	100	OK
"	"	"	"	"	21.0	97	98	OK
"	"	"	"	"	21.6	91	94	OK
"	"	"	"	"	21.2	92	93	OK
"	"	"	"	"	23	95	98	OK



SOIL TESTING SERVICES, Inc.

111 Pfingsten Road
Northbrook, Illinois

Northbrook Phone: 273-5570

S.T.S. Job No. 15257

FIELD COMPACTION SUMMARY

Job Name and Location COUNTRY CLUB LAKE, RIVERVIEW, VA

Architect or Engineer _____

Contractor E. E. LYNCH

Method of Field Density Measurement

☐ Sand Cone Method

☒ Nuclear Method

DATUM _____

TEST NO.	DATE	LOCATION	LIFT NO. OR ELEV.	MTL. MARK	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN-PLACE DRY DENSITY	PERCENT COMPACTION	COMMENTS
27	7-30	SEE DIAGRAM	3 ^{1/2}	1	95	25	88	95	RECORDED
28	"	"	4 ^{1/2}	"	"	25	85	90	"
29	"	"	"	"	"	25	82	93	"
30	"	"	"	"	"	23	91	97	"
31	"	"	"	"	"	22.5	94	99	OK
32	"	"	"	"	"	24.5	90	96	RECORDED
33	"	"	"	"	"	27.5	83	95	OK
34	"	"	"	"	"	30	82	93	RECORDED
35	"	"	"	"	"	26	95	100	OK
36	"	"	"	"	"	26	96	100	OK
37	"	"	"	"	"	27	90	99	OK
38	"	"	"	"	"	27	92	100	OK
39	"	"	"	"	"	26	91	97	OK
40	10-1	"	"	"	"	29	91	97	RECORDED
41	"	"	"	"	"	29	91	97	"
42	"	"	5 ^{1/2}	"	"	24	95	100	OK
43	"	"	"	"	"	28	90	96	RECORDED
44	"	"	"	"	"	27	88	93	"
45	"	"	"	"	"	26	93	95	OK
46	"	"	"	"	"	27	92	95	OK
47	"	"	"	"	"	25.5	93	98	RECORDED
48	"	"	"	"	"	26	96	100	OK
49	"	"	6 ^{1/2}	"	"	27	87	95	RECORDED
50	"	"	"	"	"	27	87	95	"
51	"	"	"	"	"	27	90	95	OK
52	"	"	"	"	"	28	89	95	RECORDED



SOIL TESTING SERVICES, Inc.

111 Pfingsten Road
Northbrook, Illinois

S.T.S. Job No. 15227

FIELD COMPACTION SUMMARY

Job Name and Location COUNTRY CLUB LAKE, DUFFERIN, ILL.

Architect or Engineer _____

Contractor F.E. LUCAS

Method of Field Density Measurement

☐ Sand Cone Method
☒ Nuclear Method
☐ _____

DATUM _____

TEST NO.	DATE	LOCATION	LIFT NO. OR ELEV.	MTL. MARK	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN-PLACE DRY DENSITY	PERCENT COMPACTION	COMMENTS
1	4-5	SEE DUFFERIN	6 1/2	1	95	20	92	95	
2	"	"	"	"	"	20	91.5	95.5	
3	"	"	"	"	"	24	87	95	Re-sampled
4	"	"	"	"	"	25	89	95	"
5	"	"	"	"	"	24	92	95	"
6	"	"	"	"	"	20	93.5	98.5	"
7	"	"	"	"	"	26	92	95	"
8	"	"	"	"	"	20	93.5	98.5	"
9	"	"	"	"	"	20	88	93	Re-sampled
10	"	"	"	"	"	23	87	92	"
11	"	"	"	"	"	24	92	95	"
12	"	"	"	"	"	24	92	95	Re-sampled
13	"	"	"	"	"	23	91.5	95.5	"
14	"	"	7 1/2	"	"	20	89	95	Re-sampled
15	10-6	"	"	"	"	22	96	110	"
16	"	"	"	"	"	23	93	95	"
17	"	"	"	"	"	25	92	95	"
18	"	"	"	"	"	22	90	95	"
19	"	"	"	"	"	21	93	95	"
20	"	"	"	"	"	24	92	95	"
21	"	"	"	"	"	22	94	95	"
22	"	"	"	"	"	15	93	95	"
23	"	"	"	"	"	18	93	95	"
24	"	"	"	"	"	23	91	95.5	Re-sampled
25	"	"	"	"	"	22	93	95	"
26	"	"	"	"	"	20	92	95	"



SOIL TESTING SERVICES, Inc.

111 Pfingsten Road
Northbrook, Illinois

S.T.S. Job No. 15-201

FIELD COMPACTION SUMMARY

Job Name and Location COUNTRY CLUB LINKS, DUFFERIN, ILL.

Architect or Engineer _____

Contractor F.L. LYONS

Method of Field Density Measurement

☐ Sand Cone Method
☒ Nuclear Method
☐ _____

DATUM _____

DATE	LOCATION	LIFT NO. OR ELEV.	INTL. MARK	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN-PLACE DRY DENSITY	PERCENT COMPACTION	COMMENTS
11-6	SEE DRAWING	72	1	95	21	92	95	"
"	"	"	"	"	19	95	100	"
"	"	72 1/2	"	"	21	93	95	"
"	"	"	"	"	21	92	95	"
"	"	"	"	"	20.5	88	93	"
"	"	"	"	"	25.5	85	95	"
"	"	"	"	"	23.5	88	90	"
"	"	"	"	"	25	88	90	"
11-7	"	"	"	"	22	91	97	"
"	"	"	"	"	22	91	97	"
"	"	"	"	"	26	91	88	"
"	"	"	"	"	30	88	93	"
"	"	"	"	"	30	88	93	"
"	"	"	"	"	23	91	96	"
"	"	"	"	"	26	97	100	"
"	"	"	"	"	25	89	94	"
"	"	"	"	"	29	97	97.5	"
"	"	"	"	"	29	95	90	"
"	"	"	"	"	23	94	99	"
"	"	"	"	"	21	96	100	"
"	"	"	"	"	29	97	100	"
"	"	"	"	"	22	91	97	"
"	"	"	"	"	33	83	92	"
11-8	"	95	"	"	21.5	89	94	"
"	"	"	"	"	20	91	95	"
"	"	"	"	"	22	90	95	"



SOIL TESTING SERVICES, Inc.

111 Pfingsten Road
Northbrook, Illinois

Northbrook Phone: 273-1520

S.T.S. Job No. 1520

FIELD COMPACTION SUMMARY

Job Name and Location COUNTRY CLUB 2025, DUFFERIN, ILL.

Architect or Engineer _____

Contractor F.E. LIONS

Method of Field Density Measurement

☐ Sand Cone Method

☒ Nuclear Method

DATUM _____

TEST NO.	DATE	LOCATION	LIFT NO. OR ELEV.	MTL. MARK	MAXIMUM LAB DRY DENSITY	WATER CONTENT	IN-PLACE DRY DENSITY	PERCENT COMPACTION	COMMENTS
106	10-8	SEC DITCH	9.5	1	95	22	96	95	100%
107	10-9	"	"	"	"	23	95	100	OK
108	"	"	"	"	"	21	95	100	"
109	"	"	"	"	"	20	93	98	"
110	"	"	"	"	"	22	93	98	"
111	"	"	"	"	"	24	94	99	"
112	"	"	"	"	"	23	94	99	"
113	"	"	10.5	"	"	27	91	97	100%
114	"	"	"	"	"	22	96	100	OK
115	"	"	"	"	"	24	91	97	100%
116	"	"	"	"	"	24.5	91	95	OK
117	"	"	"	"	"	22	93	95	OK
118	"	"	"	"	"	22	95	100	OK
119	"	"	"	"	"	23.5	95	100	"
120	"	"	"	"	"	20	99	95	"
121	"	"	"	"	"	21	95	95	"
122	10-17	"	"	"	"	21	93	98	"
123	"	"	11.5	"	"	27	85	93	100%
124	"	"	"	"	"	25	85	92	"
125	"	"	"	"	"	26	85	93	"
126	"	"	"	"	"	25	93	98	"
127	"	"	"	"	"	27	93	95	"
128	"	"	"	"	"	25	91	95	"
129	"	"	"	"	"	24.5	90	99	"
130	"	"	"	"	"	25.5	90	99	"
131	"	"	"	"	"	25.5	90	99	"

NOTES: Definition shown: The ...

SPECIFICATIONS

For

Dam Improvement

COUNTRY CLUB LAKE

Virginia

September 1970

150.007

APPROVED

PUBLIC WORKS DEPARTMENT
PRINCE WILLIAM COUNTY, VA.

DATE 15 SEP. 1970

BY D. W. [Signature]

APPROVED AS PER LETTER FROM M. KELLY
DATED 15 SEP. 1970

Bauer Engineering, Inc.
20 North Wacker Drive
Chicago, Illinois 60606

[Handwritten signature]

COUNTRY CLUB LAKE

VIRGINIA

EARTH EXCAVATION, GRADING AND EMBANKMENT

SCOPE

The work to be performed under this section consists of furnishing all labor, materials and equipment to complete all earth excavation and embankment, removal and satisfactory disposition of all unsuitable materials. The work shall include stripping the borrow area, stripping the existing dam, scarifying and reworking the existing embankment, excavating to the lines and grades designated by the Owner in the borrow areas and placing the embankment material as specified. Embankment shall be placed as shown on the plans and as specified. Drainage of ground and surface water shall be adequately handled so as not to interfere with or damage the work.

PREPARATION FOR WORK

All topsoil, vegetation and debris shall be removed from the existing dam. Topsoil and overburden shall be stripped and stockpiled from the designated borrow areas as directed by the Owner. The existing dam shall be scarified to a depth of not less than eight inches in the areas to receive embankment material.

FINAL GRADES

The Contractor shall excavate designated borrow areas as directed by the Owner and use the excavated material to construct the embankments as shown on the plans and as specified, such construction shall be made to the slopes shown and degrees of compaction specified.

CONSTRUCTION

Excavated materials shall be used to construct the embankments as shown on the plans and cross sections. The material used shall be placed in the locations indicated. Embankment materials shall not contain vegetative materials, organic materials, or rocks over 6 inches in greatest dimension.

No embankment shall be placed upon frozen earth, and no frozen material shall be placed in any embankment.

Topsoil shall be placed in areas shown on the plans.

The embankment shall be constructed in uniform layers not to exceed 8 inches thick, measured loose. Each lift shall extend the full width of the area being filled before starting the next lift. Each layer shall be uniform in thickness and shall be spread in approximately horizontal layers and compacted as specified before the next layer is started.

Materials too wet to compact shall be dried prior to compaction; and moisture shall be added to materials too dry prior to compaction. The moisture content shall be controlled by the Contractor such that compaction is obtained between optimum and + 4% (as determined by ASTM D-698).

In order to achieve the strength necessary to provide stable slopes, the material shall be compacted to not less than 98% of maximum dry density as determined by the ASTM D-698 (Standard Proctor).

DISPOSAL OF EXCAVATED MATERIAL

All excavated material not suitable for refilling or graded fill shall be spread at a location within the site designated by the Prince William County Inspector. All such material shall be spread and graded to permit drainage.

PAYMENT

All work performed under this section will be paid for at the contract price per cubic yard for DAM EMBANKMENT and shall include topsoil, embankment material, labor, tools and equipment used in connection with the item of work, performed as specified.

RIPRAP AND FILTER MATERIAL

SCOPE

Included shall be furnishing and placing material for the riprap and filter.

MATERIAL

Filter material and Riprap shall meet all quality requirements for coarse aggregate, size 57 plus Fine Aggregate, Grading A, of the Virginia Department of Highways Standard Specifications. Approximate gradations are shown on the plans.

PAYMENT AND MEASUREMENT

Volumes of filter and riprap materials shall be computed to the neat lines shown on the drawings.

Payment will be made at the contract unit price per cubic yard for FILTER MATERIAL and RIPRAP.

SEEDING, FERTILIZING AND MULCHING

The Contractor shall provide all labor, materials and equipment necessary, and shall apply seed, fertilizer and mulch on all areas of new embankment or new excavating above the elevation of the water surface not covered with dumped rock. Areas covered with topsoil as specified and areas on which the grass was disturbed by the Contractor's operations are classified as areas to be covered under this item. Materials shall be first class, and the quality and source of supply shall be subject to approval by the Engineer.

Seed, fertilizer, limestone and mulch shall conform to Section 529 of the Virginia Department of Highways Standard Specifications. The seed shall be delivered to the job in bags, mixed, labeled and tested. Materials shall be applied as follows:

Fertilizer Mix (10-6-4)	500 lb per acre
Agricultural ground limestone	4,000 lb per acre
Final seed mix	150 lb per acre
Coated mulch	6,000 lb per acre
Temporary seed-oats (spring)	80 lb per acre
(autumn)	112 lb per acre

Final seed mix shall consist of the following, by weight:

Kentucky Blue-grass	25%
Alta Fescue	45%
Timothy	10%
Perennial Ryegrass	10%
Red Top	10%

Bituminous material for mulch shall be approved by the Engineer.

Final seeding will be permitted only during the regular planting seasons, which are in the spring from February 15th to June 1st, and the fall from August 1st to October 1st. No seeding shall be done during high winds, when the ground surface is too wet, or when, in the opinion of the Engineer, soil and weather conditions are unfavorable for seeding.

Temporary seeding shall be done at all other times soon after completion of earthwork in any area.

Seeding shall consist of the following operations:

1. Discing
2. Harrowing
3. Seeding
4. Brushing
5. Rolling

Each operation shall follow the preceding one in as short a time as is practical to do so.

1. DISCING: This operation shall be accomplished with a disc harrow, the discs of which are set at a slight angle. The discing shall be performed both lengthwise and crosswise whenever practicable to do so. Should the area become crusted or hardened prior to harrowing, then it shall again be disced.
2. HARROWING: Just prior to sowing seed, the surface of the area shall be thoroughly smoothed by means of a harrow. The harrow used shall be either a Meeker Smoothing Harrow or a 3-Section Meeker Discing Machine. Harrowing shall be first crosswise and then lengthwise where practical to do so.
3. SEEDING: The small grass seeds shall be properly mixed and sown at the rate of one hundred and fifty (150) pounds per acre. The seeding shall be accomplished with a wheel-barrow grass seeder similar and equal to the ten (10) foot Thompson Grass Seeder. Wherever practical, the sowing operations shall be conducted in two (2) directions at right angles to each other. The seeder shall be calibrated to give the proper rate of distribution.
4. BRUSHING: Immediately following the sowing, the seed shall be lightly brushed into the soil by means of an approved chain drag.

5. ROLLING: Immediately after brushing, the seeded areas shall be rolled with a tractor-drawn type roller known as the "Farm Roller" or "Golf Roller."

The methods of mulching shall conform to the Standard Specification.

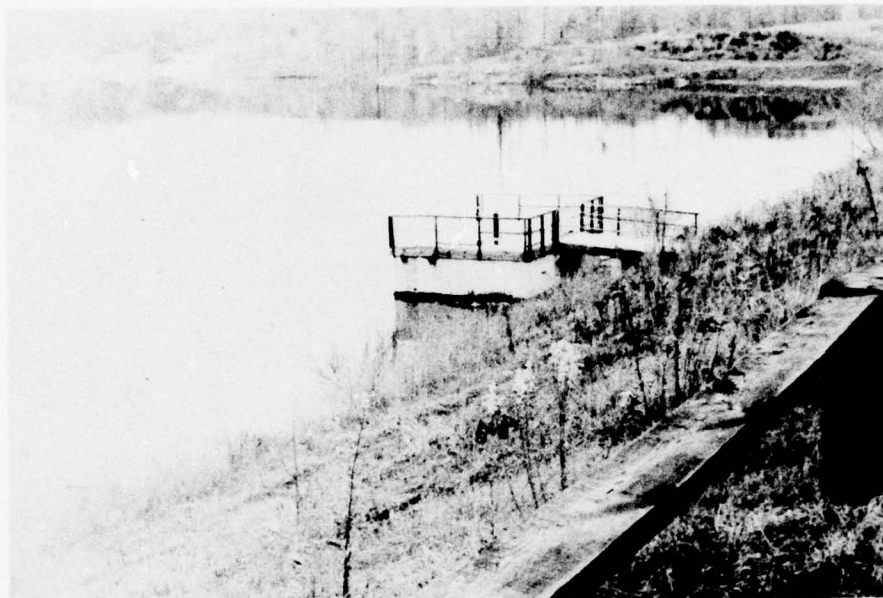
The Contractor shall maintain the seeded areas until the stand of final grass is at least 2 inches average blade height. Seeded areas that do not grow shall be re-seeded until there is a growth of new grass.

MEASUREMENT AND PAYMENT

Seeding, fertilizing and mulching will be measured over the actual area covered as specified. Payment will be made at the Contract unit price per acre for SEEDING, FERTILIZING AND MULCHING performed as specified, and shall include full compensation for all costs incidental to this item of work.

APPENDIX III

PHOTOGRAPHS



PHOTOGRAPH NO. 1
Principal Intake Structure



PHOTOGRAPH NO. 2
Discharging Box Culvert



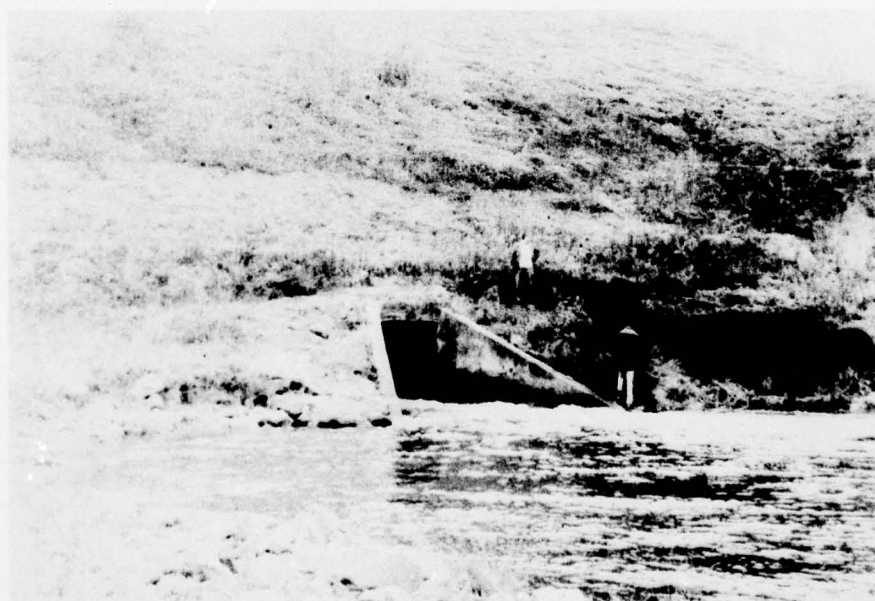
PHOTOGRAPH NO. 3
Discharge Channel



PHOTOGRAPH NO. 4
Face of Dam



PHOTOGRAPH NO. 5
Emergency Spillway



PHOTOGRAPH NO. 6
Wing Wall Discharge Box

REFERENCE IV
GEOLOGICAL INVESTIGATION DATA .
AND
BOX INVESTIGATION DATA

BAUER ENGINEERING, INC.
CONSULTING ENGINEERS LAND AND WATER RESOURCES
20 NORTH WACKER DRIVE
CHICAGO, ILLINOIS 60606

TELEPHONE
641-0210

August 25, 1970



Mr. Lawrence Rehfield
Dewberry, Nealon & Davis
8411 Arlington Boulevard
Fairfax, Virginia 22030

Re: Country Club Lake Stability
Certification 150.006

Dear Mr. Rehfield:

A complete soils investigation was made recently to determine the structural integrity of the existing dam at Country Club Lake, Virginia. The structural analysis included the proposed 6.5 feet of additional height.

The "Swedish Slip Circle" method was used. Soil parameters gained from undisturbed samples taken from within the existing dam and tested for triaxial shear were used in the analysis. ($\phi = 31^\circ$, $C = 615$ lbs/ft. as determined by Soil Testing Services, Washington D. C.).

The structural analysis shows the existing dam, together with the proposed additional 6.5 feet of fill to be extremely safe. The computed factor of safety is 2.24. Dams are usually designed for a factor of safety of 1.5.

We therefore certify that this dam as proposed is structurally safe.

Very truly yours,

D. W. Wikand P.E.
Chief Engineer

W. J. Bauer
President

8/31/70

DWW:mb

RECEIVED

AUG 2 1978



Reference: Country Club Lake Dam

Dear Dr. Bauer:

While performing engineering work in connection with the installation of a new valve to replace the broken gate at the base of the tower of the Country Club Lake dam, it has come to our attention that the tower itself has cracked away from the spillway structure through the dam. We have enclosed a crude photograph showing this condition. We are calling it to your attention because we do not know whether or not this condition would endanger the placing of the proposed hood on top of the tower as designed by your office. It is conceivable that the additional weight of the hood could further aggravate the condition.

I would be very interested in your comments on this situation. If we can provide further information or clarification, please do not hesitate to call.

Very truly yours,

Richard N. Davis

RND:bj

Enclosure - Photograph

cc: Mr. David P. Rhame w/encl.

Enclosure #11 to WOD letter of 5/8/78

File cc

11



September 4, 1970

Mr. Michael H. Kelly, P.E.
Assistant Director, Operations Division
Department of Public Works
Prince William County
433 Lee Avenue
Manassas, Virginia 22110

Reference: Country Club Lake Dam

Dear Mr. Kelly:

During the past months, since the Board of Supervisors approved the final plans for Country Club Lake, Section 2, Stage 1, the developers of this subdivision and their consultants have worked diligently to meet all the County's requirements. The developer agreed that all buildings shall be sited above the level of any flood due to a breached dam. As you know, Bauer Engineering, Inc., has made detailed studies of the dam and the associated hydraulics. In addition, Mr. Williams of our office made a field inspection of the dam and reported the results of his observations. Furthermore, we have obtained statements from the dam's previous owner, Mr. Coffey, and the dam's builder, Moore, Kelly & Reddish, to the effect that the dam was constructed with proper methods, materials and supervision.

Your office had concluded that it is difficult to ascertain the structural quality of the dam since it apparently was constructed without professionally designed plans and without a professional engineer's supervision.

During the past summer, a meeting was held at the Public Works Office at which time Dr. Bauer, who is registered in the State of Virginia, met with Public Works representatives, the Country Club Lake developer, and a representative of Dewberry, Nealon & Davis. As a result of this meeting, it was agreed that the crest of the dam would be raised to Elevation 206.5 so that

CC
Elev 206.5


Mr. Michael H. Kelly, P.E.
September 4, 1970
Page 2

the dam would have sufficient freeboard to resist overtopping by the maximum probable flood. Subsequent to this meeting, Bauer Engineering was commissioned to engineer the dam modification involved in raising the crest. They arranged for a soils investigation of the dam to be performed by the firm of Gnadinger, Baker, Hampton and Associates, 1250 Connecticut Avenue, N.W., Washington, D.C. The developers of Country Club Lake requested that the soils investigation be enlarged to determine the structural integrity of the existing dam. As a result of the soil tests and structural analysis performed by Bauer Engineering and their soil consultants, a report has been prepared; a copy of this report is enclosed.

In summary, the soil tests indicate that the existing dam was properly constructed and is in excellent condition. A certification to this effect, prepared by Bauer Engineering, Inc., is also enclosed. In view of this new information, the developers of Country Club Lake have furnished proof of the adequacy of the existing dam, together with the proposed modifications to prevent over-topping. They feel now that the quality of construction of the existing dam has been established and that any restriction against siting of lots as shown on the approved plat, located downstream from the dam should be eliminated.

In the event you should have any questions in regard to the enclosures, I will be happy to meet with you to go over them in detail.

Very truly yours,


Lawrence Rehfield
Chief Engineer

LR/sb

Enclosures

cc: Mr. Charles J. Deitz

Enclosure #12 to WOD letter of 5/8/78

Baker & Associates
Hampton

100 CONNECTICUT AVENUE, N.W. • WASHINGTON, D.C. 20036 • PHONE 202 - 466-2992

DR. P. GNALDINGER, P.E.
DR. H. BAKER, JR., P.E.
DR. HAMILTON, PH.D., P.E.

DR. O'BRIEN, JR., P.E.
DR. G. LUKAS, P.E.
DR. C. HALL, P.E.

October 20, 1970

Mr. William Sturcey
Construction Manager
Country Club Lake
Dumfries, Virginia

Re: Proposed Dam reconstruction, Country Club Lake, Dumfries, Virginia

Dear Mr. Sturcey:

We have completed continuous inspection of the earthwork operations occurring on the reconstruction of the Country Club Lake Dam, Dumfries, Virginia. The Dam revision work consisted of widening the Dam on the lakeside and raising the existing Dam with 6 ft. 2 inches of clay fill and 4 inches of topsoil to attain an ultimate elevation of 206.5.

The earthwork operations on the project began on October 21, 1970, and all clay fill that was placed and compacted to the completion of the project on October 14, 1970 was approved as being installed in accordance with the specifications. Topsoil is to be placed at a later date.

The widening of the Dam was accomplished by cutting two shelves in the 2.5:1 slope on the lakeside to permit equipment to operate. The borrow material consisted of a clayey silt soil containing a trace of sand, which had a reddish brown to reddish yellow color. A nuclear density gauge was employed throughout the project to provide rapid compaction and moisture content results. As was discussed in earlier reports, the fill material used to reconstruct the Dam had a moisture content considerably above optimum so that considerable discing and scarifying of the soil had to be performed to aerate the material so that compaction to the recommended minimum of 98% standard proctor density could be achieved.

Initially, a 14 ton rubber-tired roller, a sheepsfoot roller and the loaded scrapers were used to obtain the compaction. With this equipment, it was generally possible to readily obtain compaction to 94 to 95% of standard

Enclosure #13 to WOD letter of 5/8/78

proctor density but, considerable compactive effort was necessary to achieve the required 98% degree density. Because of the slowness of the work a 15 ton vibratory roller was brought to the site, which proved very satisfactory in achieving the compaction of the fill. As shown on the enclosed test results, compaction to the required degree of density was eventually obtained on each lift installed.

If there are any questions with regard to any of the information submitted in this report, or if we can be of further service to you in any way, please do not hesitate to contact us.

Very truly yours,

GHAEDINGER, BAKER, HAMPTON & ASSOCIATES

Robert Gillengerten

Robert Gillengerten
Field Technician

Dixon O'Brien, Jr.

Dixon O'Brien, Jr.
Registered Professional Engineer
Virginia #3983

Delon Hampton (K2)

Delon Hampton
Registered Professional Engineer
Washington, D.C. #5991

DOB:jp

COMMONWEALTH OF VIRGINIA
PRINCE WILLIAM COUNTY
400 LEE AVENUE
MANASSAS, VIRGINIA 22110

DEPARTMENT OF PUBLIC WORKS
OPERATIONS DIVISION
568-5171, EXT. 211

15 September 1970

TO: Engineering Inspection
Owner
Engineer

FROM: M.H. Kelly
Assistant Director

RE: Plan and Profile
and Specifications
DAM MODIFICATION
Country Club Lake

APPROVAL DATE: 15 September 1970

The above referenced plan and profile and specifications have been approved by the Prince William County Board of Supervisors through the Department of Public Works, subject to compliance with the following requirements during construction:

- (1) In the written Specifications under DISPOSAL OF EXCAVATED MATERIAL, unsuitable material as mentioned therein shall be disposed of in the location and in a manner subject to the approval of the County Engineering Inspection Division, and a permanent grass cover shall be established thereon to prevent erosion.
- (2) It is understood that embankment construction shall utilize borrow materials from the sources described in the letter of 6 August 1970 to Bauer Engineering from Mr. Baker and Mr. O'Brien, Professional Engineers, of Cnaedinger-Baker-Hampton & Associates, Consulting Soil and Foundation Engineers, that placement of embankment shall be done with due regard to the findings set forth in the said letter, and that full-time inspection of the placement of the fill will be provided by Cnaedinger-Baker-Hampton & Associates as set forth in the letter of 10 September 1970 to M.H. Kelly from Dr. Delon Hampton, P.E.
- (3) Results of moisture-density compaction tests on embankment shall be made available to the County Engineering Inspection Division as requested during construction.

ML/

Enclosure #14



AD-A073 630

MARTIN (DEWARD M) AND ASSOCIATES INC WILLIAMSBURG VA
NATIONAL DAM SAFETY PROGRAM. LAKE MONTCLAIR DAM. INVENTORY NUMB--ETC(U)
MAR 79 P SEILER

F/G 13/2

DACW65-78-D-0015

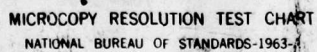
NL

UNCLASSIFIED

2 OF 2

AD
A073630





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

MANASSAS WILLIAM COUNTY

9258 LEE AVENUE
MANASSAS, VIRGINIA 22110

DEPARTMENT OF PUBLIC WORKS
OPERATIONS DIVISION
368-9171, EXT. 211

22 October 1970

Mr. Lawrence Rehfield, P.E.
Chief Engineer
Dewberry, Nealen & Davis
Consulting Engineers
8411 Arlington Blvd.
Fairfax, Virginia 22030

[Handwritten signature]
10/30/70

RE: COUNTRY CLUB LAKE DAM

Dear Mr. Rehfield:

Regarding the earth dam, briefly, the structural integrity has been certified by Dr. Bauer as "extremely safe", construction is in progress on raising the crest of the dam to an elevation that will protect against overtopping by the maximum probable flood as designed by Dr. Bauer, and his plans for improvements to the inlet hood are in hand. Further, Your staff has made an on-site inspection of the dam and found no indications of incipient failure, and improvements to the outlet conduit at discharge (stilling basin) are planned as designed by your office. Other questions regarding negative pressures on the conduit, paving part of the spillway as opposed to erosion of same as a safety factor, have been answered. The weir dam forming a pond below the outlet conduit is substantially underway.

The last matter of interest is the surveillance program originally recommended as a safeguard by Dr. Bauer.

When this program proposal is formally submitted to us, it should include the name of the owner (officers of the corporation), address, representative in charge of the program, and details of the program. We would also like to receive a statement of satisfactory completion of construction, when accomplished, on the raising of the embankment from Gnaedinger, Baker, Hampton, who are inspecting this work per Dr. Hampton's letter to me of 10 September.

We consider the continuing surveillance program of considerable importance as a safety measure. This is certainly in the best interest of the developer since reviews and approvals, etc., by the County in no way relieve the owner of a dam from his responsibilities and liabilities incident upon the ownership and operation of a dam. Even though the County assumes no legal liability through plan approval, we are naturally desirous of safeguarding the public to the greatest degree possible. It has been raised as a query

Lake Montclair
Virginia Dam Inspection
July 17, 1978

Inspection Team: J. Reeve, M. Horton, P. Heynen
Job #47444SE



All stationing upstream; all directions facing downstream.

Inside outfall structure which is a 5'x8' concrete box with beveled corners. Assume station 0+00 at toe of dam. The following items were found within the structure:

- 1) 0+30 - 3-1/2' above invert construction joint showing seepage indicated by efflorescence. Typical flexural mid-height horizontal crack this section.
- 2) 0+38.5 - Vertical crack on left wall from base to bevel at top. Considerable efflorescence in lower portion.
- 3) 0+44 - Water level in channel is zero.
- 4) 0+49.5 - Vertical crack on left hand wall extending into the bottom bevel.
- 5) 0+54.5 - Circumferential crack through both walls and all the way around structure.
- 6) 0+60 - Construction joint, ragged and leaking 2 1/2 - 3 feet up.
- 7) 0+68.5 - Crack in lower left hand wall.
- 8) 0+71 - Crack extending up right wall through bevel and terminates. Excessive efflorescence and leakage through this joint extending to other side.
- 9) 0+74 - Crack extending up right wall 4 feet and continuing as a fine line crack up to the bevel.
- 10) 0+82 - Crack extending through roof and down through bevel on right side veering down station for 2 feet and continuing to the base.
- 11) 0+90 - Construction joint showing substantial leakage on left side, continuing up and around the roof and down the right side. 6' up on left wall is considerable amount of concrete patching at the joint. Joint is irregular. Concrete sounds hollow.
- 12) 0+93 - Vertical crack on left wall extending through bevel and disappears in ceiling. Reappears on right wall. Crack shows considerable leakage and some deterioration of concrete at the base of the right side.

Attachment "C."

-2-

- 13) 1+00 - Right hand wall has a 6" x 18" piece of wood embedded in it.
- 14) 1+01 - Crack on right wall, minimum of 1/8" at base and showing efflorescence. Crack on left wall, again wide at bottom, sloping diagonally up to bevel and terminates at top. Evidence of substantial leakage.
- 15) 1+20 - Construction joint opened at top. There is bleeding of the last pour over the wall of the first section placed. Joints very poor showing exposed aggregate butting earlier pour. Joint is cracked open and showing leakage on both sides.

Grade changed to sharper slope.
- 16) 1+25 - Exposed foot long reinforcing bar in ceiling. Initial cover was 1/4".
- 17) 1+32 - Crack from bottom of bevel on left side to bottom of bevel on right side, in the ceiling. Crack does extend slightly down the sidewall (midway).
- 18) 1+35 - Substantial wide open crack 2-1/2' - 3' longitudinally (full height right side) indicating movement, perhaps this section.
- 19) 132+0 - 6' to 8' wall section (both sides) and roof is cracked in three locations. One crack is 1/4" to 5/16" wide in the bevel area and appears to go thru the base. This crack definitely shows settlement. Crack on right side extends down thru bevel.
- 20) 1+50 - Construction joint slightly opened, apparently patched on right wall. Slight leakage. Crack appears to extend thru base slab.
- 21) 1+60 - 7' long bulge in ceiling, probably from form work dropping. Some transverse cracking in slab area, but no flexural cracking parallel to structure. Substantial amounts of cracking in this area with two cracks 2' apart extending vertically down the left wall, stopping about 1' from base. Also substantial leakage. One sizable crack on right wall with severe leak. Cement has washed out of joints. Some efflorescence showing at crack in bevel area. Up station is one very poor cold joint on right wall apparently patched.
- 22) 1+65 - Lots of honey combing with patching in wall area. Definitely cold joint indications. Fine hair line cracks stepping down both walls.
- 23) 1+76 - one minor crack transversely thru ceiling and down both bevels.

Attachment "C".

-3-

- 24) 1+80 - Construction joint - leaking and spalling at edge surfaces. Joint has been tarred over partially and possibly indicates some settlement between sections. Top surface has 1/8" to 1/4" vertical difference. Downstream base slab is 1/2" to 3/4" lower. Both sides of walls have been tarred over indicating some attempt to correct it. Leading edge of downstream base slab is spalling and worn. One foot down station the concrete appears to be restored to the proper grade.
- 25) 1+88 - 3/16" to 1/4" crack thru ceiling and down both walls to bevel. Aggregate exposed both sides of crack in lower portion. Cannot follow crack beyond lower bevels.
- 26) 1+88 - Substantial cracks, wide open at the ceiling and continuing down both walls with lower portion showing concrete deterioration.
- 27) 1+92 - Cracks with leakage 6' up. Cracks do not extend down right wall.
- 28) 2+10 - Construction joint substantial deterioration thru side walls and bottom bevels. Efflorescence present. Joint apparently surface patched to correct pour irregularities.
- 29) 2+26 - End of tunnel. Cold joint between shaft walls and tunnel is large enough to put entire hand into. (2" wide x 8" deep). Can see what apparently is aggregate backfill thru crack. Heavy seepage 6 inches above channel. Water flowing through joint between shaft wall and tunnel. Overhead joint in very poor condition with substantial amounts of concrete missing.

Outer face of shaft in the tunnel in poor condition and in need of repair. No substantial leakage at this time of year.

Inlet shaft is 6-1/2' x 8'. Right side wall showing seepage 20' up.

30. Adjacent to Concrete Outlet Box Culvert

Outside the outlet channel at the edge of concrete spillway is possibly up to three feet of erosion below the bottom edge of concrete apron.

31. Downstream Side of Embankment

- A. Most of the riprap at toe of dam adjacent to the outlet appears to have eroded away or wasn't in existence previously. There is only a scattering of riprap.

Attachment "C".

-4-

- B. Water depth at concrete outlet/apron is 1 foot deep at time of investigation.
- C. No apparent toe seeps on right side of channel outlet above outlet pool elevation.
- D. At left side of outlet channel:
 - 1. 15 feet left of centerline of channel, a 6-7 inch steel drain pipe flowing 1/4 to 1/4 full. There is a 6 foot vertical slope above the pipe outlet.
 - 2. 25 feet left of centerline of channel is a perforated corrugated metal pipe probably used for a toe drain. There is no apparent flow from the submerged outlet but through the perforations there is seepage, but not monitorable at this time. There is considerable sloughing around the underdrain.
- E. At the left abutment there is a 3 foot wide by 2 foot deep gully proceeding up the slope from the toe.
- F. Two gullies on left side of the dam embankment are approximately 10-15 feet above outlet pool elevation. Picture of gully showing M. Horton in it measures 5.5 feet wide by 3 feet deep. These two gullies are possibly in the natural slope and should be checked by survey.
- G. Downstream embankment except at toe and gully left side of dam looks in good condition.

32) Top of Dam

Roadway on top of dam appears to be in good shape, with no sign of trespassing.

33) Upstream Side of Embankment

- A. Walking upstream toe, top of riprap at left side of dam is 191.5+. Riprap is graded material, 2 inches to 12 inches, sparsely laid.
- B. Upstream embankment looks in good condition. Trees in embankment should be cleared.

APPENDIX V
FIELD OBSERVATIONS

Ref. Inv. Dams Pg 720 Report 1/5/74 VA 15303 NAD VA 153-08

NEAREST TOWN: Georgetown Village
LAKE: Powell's Creek
H. CREST: 900

OWNER: Second Montclair Corp.
CONSTRUCTED BY: Moore, Kelly & Reddish
Checked List:
Visual Inspection
Phase I

Name Dam Montclair Dam

County Prince William

State Virginia

Coordinators

Lat. 3836.7

Long. 7720.6

Date(s) Inspection 12/5/78

Weather

Overcast
No rain

Temperature 50°

188.5 Design dwg.

Pool Elevation at Time of Inspection 192.0 M.S.L.

Tailwater at Time of Inspection 126 M.S.L.

Inspection Personnel:

John S. Jones

Don Weaks

Jack Hyden

Forest Fister

Neal Horst

Jim Reeve

Paul Seiler

Recorder

REMARKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	1. Erosion at Junction of Dam embankment and right abutment with natural ground (looking downstream).	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	No visible misalignment.	
RIPRAP FAILURES	Riprap at principle spillway (box culvert) outlet not serving purpose, not much riprap remaining.	

REMARKS

REMARKS OR DISCUSSION

OBSERVATIONS

VIEWER'S DESCRIPTION OF

ABUTMENT

Left abutment shows erosion and some water today - unknown if from seepage or rainfall of previous night.

JUNCTION OF REANNUENT
AND ABUTMENT, SPILLWAY
AND DRY

Right abutment shows 6" deep gully.

ANY NOTICEABLE SEEPAGE

1. 130' down slope from crest very wet and soggy, trickling water for a width of 40' next to right abutment.
2. Change in ground cover vegetation on line 80' down slope from crest. This is also a line of seepage.
3. Gully 2' deep down slope near left abutment.

STAFF GAGE AND REORDER

None.

STAINS

None visible, reported by owner to be covered.

REMARKS

MONITORING SYSTEMS None available.

MODIFICATIONS 1972 raised dam 6'±

HIGH POOL RECORDS None available.

POST CONSTRUCTION ENGINEERING
STUDIES AND REPORTS None.

PRIOR ACCIDENTS OR FAILURE OF DAM
DESCRIPTION
REPORTS No failure, emergency spillway
had 2-3' water during 1972 and
Spillway Lane had water on it
6-12" deep.

MAINTENANCE
OPERATION
RECORDS November 1970 to May 1973 periodic
inspection made of drains, slopes
intake valve. No periodic record
kept since 1973.

CULVERT WORKS

NATURE AND EXTENT OF DAMAGE	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CULVERT	Box culvert outlet. No cracks in concrete visible.	
INTAKE STRUCTURE	See ungated spillway.	
OUTLET STRUCTURE	Structure-no visible defects. Earth around wing walls of outlet eroded, patched over with concrete and under washed. Sizable flow of water at stream level from underground and adjacent to culvert. Estimated five gallons/minute. Left side slope of channel eroded. 2' gully at tree line. 2' gully eroded 30' from toe of dam.	
OUTLET CHANNEL		
EMERGENCY GATE	Lake drain valve not operable due to repairs to valve plate. Closed for 1 year to be operating spring of 1979.	

LOCATED SPILLWAY

STRUCTURE IDENTIFICATION	OBSERVATIONS	REMARKS
OUTLET WEIR	<p>Outlet structure at water's edge accessible from back of embankment. There is 18" opening for lake water to flow into structure and drops 55' to outlet box culvert. Note: at 10:40 a.m. a great volume of water suddenly released through box into discharge channel(Box culvert 2/3 full.). Exit Vel. estimated to be 30'/sec.</p>	
APPROACH CHANNEL	<p>See note above, Concrete Weir.</p>	
DISCHARGE CHANNEL	<p>Channel filled with white water, high velocity, turbulent. Channel filled to top and great flow to 3-cell box about 2500' downstream.</p>	<p>Emergency spillway elevation 197MSL Trapezoidal section 150' wide, earth banks.</p>
BRIDGE AND PIERS	<p>Small golf-cart bridge out for several years about 1000' below dam. To be replaced with steel bridge. 3-cell box culvert 1/4 mile downstream. 3-pipe low water crossing submerged - 1 mile downstream.</p>	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	Inlet elevation 184.75, valve under repairs. Not operating.	
APPROACH CHANNEL	Submerged on lake bottom.	
DISCHARGE CHANNEL	See ungated notes.	
BRIDGE AND PIERS	See ungated notes.	
GATES AND OPERATION EQUIPMENT	Valve not operating.	

INSTRUMENTATION

VISUAL EVALUATION NON-INSTRUMENTATION SURVEYS	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER		

STATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
STOPS	Wooded.	
SODDENATION	Diver reported minimal silting at 36" intake pipe 250' in lake from Dam in August 1978.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
<p>CONDITION (CHARACTERISTICS, PEAKS, ETC.)</p> <p>Left side rock with trees. Right side some rock, channel turns to left where emergency spillway enters.</p>		
<p>SLOPES</p> <p>Wooded for 800', then grass.</p>		
<p>APPROXIMATE NO. OF HOMES AND POPULATION</p> <p>Eight (8) homes below dam on downstream channel.</p>		

CHECK LIST
 ENGINEERING DATA
 DESIGN, CONSTRUCTION, OPERATION

REMARKS	
AN OF DAM	Montclair Dam, see appendix.
REGIONAL VICINITY MAP	See Appendix.
CONSTRUCTION HISTORY	Construction started by original owner of land development, no information available. 1972 top of dam raised 6' +
PIECAL SECTIONS OF DAM	See appendix.
HYDROLOGIC/HYDRAULIC DATA	None available, have data used in 1972.
DETAILS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RACINGS - IDEAL/RESERVOIR RECORDS	See appendix.

1968

REMAINS

DESIGN REPORTS None.

EOLOGY REPORTS See Appendix.

DESIGN COMPUTATIONS
HYDROLOGY & HYDRAULICS
ANALYSIS
SEepage STUDIES

None available of original construction.
None available.
See Appendix.
None available.

MATERIALS INVESTIGATIONS
CORE RECORDS
LABORATORY
FIELD

None available.

POST-CONSTRUCTION SURVEYS OF DAM See Appendix.

SOURCE OF BORROW Not known.

PLAN IN REPORT SHOWS CONTOURS, AND DAM, APPENDIX.

SECTIONS
None.

DETAILS
None.

PERMANENT EQUIPMENT
LANDS & DETAILS
None.

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Wooded/ 11.25 Sq. mi.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 192 MSL 133 Acre ac. ft.

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): Same as above.

ELEVATION MAXIMUM DESIGN POOL: 192 MSL

ELEVATION TOP DAM: Elevation 210.5 MSL

CREST: Emergency Spillway

- a. Elevation 197 MSL
- b. Type Uncontrolled earthen trapizoidal
- c. Width 150
- d. Length 300'+
- e. Location Spillover Beyond south end of dam.
- f. Number and Type of Gates None.

OUTLET WORKS: _____

- a. Type Over weir on riser structure
- b. Location At water edge 1/4 length of dam from south abutment.
- c. Entrance inverts 192
- d. Exit inverts 126
- e. Emergency draindown facilities 24" diameter gated orifice.

HYDROMETEOROLOGICAL GAGES: None.

- a. Type _____
- b. Location _____
- c. Records _____

MAXIMUM NON-DAMAGING DISCHARGE: _____

APPENDIX VI
REFERENCES

REFERENCES

- Reference No. 1:** Riedel, J.T.; Appleby, J.F.; and Schloemer, R.W.; Hydrometeorological Report No. 33, "Seasonal Variation of the Probable Maximum Precipitation East of the 105th Meridian for Areas from 10 to 200 to 100 Square Miles and Durations of 6, 12, 24 and 48 hours"; U.S. Department of Commerce, Weather Bureau, Hydrologic Services Division, 1956.
- Reference No. 2:** Synder, "F.F. Synthetic Unit-graphs", Transactions of the American Geophys. Union, Vol. 19, pp 497-545, 1938.

MONTCLAIR DAM

List of Data Available

Furnished by:

Second Montclair Corporation

1. Plan - Contour sheet scale 1" = 200'; 5' contour interval.
2. Plan - Country Club Lake (Montclair Lake) 1" = 100' contour interval - 2'.
3. Plan - Development layout and contours - March 5, 1975.
4. Plan - Elevation and sections - principal spillway modifications. Prepared by Bauer Engineering Inc., of Chicago, Illinois.
5. Plan - Country Club Lake overflow spillway knife gate plans.
6. General information and history in form of correspondence dated June 1978.