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NATIONAL DAM SAFETY PROGRAM. SILVER LAKE DAM (INVENTORY NUMBER --ETC(U)
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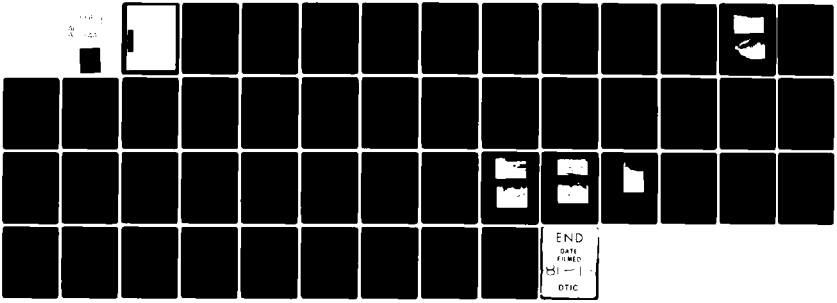

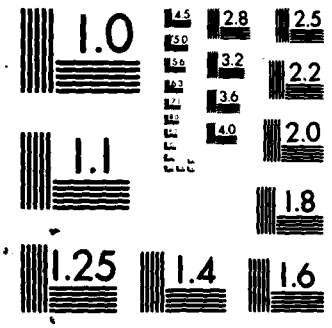

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20. Abstract

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

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

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

POTOMAC RIVER BASIN

NAME OF DAM: SILVER LAKE DAM
LOCATION: ROCKINGHAM COUNTY, VIRGINIA
INVENTORY NUMBER: VA. NO. 16508

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Silver Lake Dam, Inventory Number VA 16508, Potomac River Basin, Rockingham County, Virginia. Phase I Inspection Report.

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

BY

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

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PREFACE

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

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

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

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

Name of Dam: Silver Lake
State: Virginia
County: Rockingham
USGS Quad Sheet: Bridgewater
Coordinates: Lat 38° 25.3' Long 78° 56.4'
Stream: Branch of Cooks Creek
Date of Inspection: April 15, 1980

BRIEF ASSESSMENT OF DAM

Silver Lake Dam is a stone masonry/earth structure approximately 400 ft long and 15 ft high. The principal spillway consists of three corrugated metal pipe arches and a side discharge overflow weir. One arch pipe (50" x 31") is connected to the overflow weir which controls the pool levels. The remaining arch pipes assist in pool level control during above-normal flows. The dam is located on a branch of Cooks Creek about 0.2 miles north of Dayton, Virginia. The reservoir serves as a water supply for both the Town of Dayton and the City of Harrisonburg and is owned and maintained by the City of Harrisonburg, Virginia.

Based on criteria established by the Department of the Army, Office of the Chief of Engineers (OCE), the appropriate Spillway Design Flood (SDF) is the ½ PMF. The spillway will pass less than 10% of the Probable Maximum Flood (PMF) or 20% of the SDF. During the SDF, the dam will be overtopped to a depth of 1.2 ft maximum, at a maximum velocity of 4.8 fps, and will be overtopped for a period of 5 hours.

An evaluation of the stability condition could not be made since there is no design or construction data for this structure.

The visual inspection revealed several problems. The overflow weir is badly deteriorated and there is water flowing from an eroded area at the right abutment. Both of these conditions have the potential of damaging the dam if not corrected.

Due to the lack of information concerning the geometry and stability of the dam, the structural integrity of the spillway, and the possibility of a dam breach by overtopping during the SDF, the spillway is rated seriously inadequate and the dam is assessed "unsafe-non-emergency".

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

It is therefore recommended that within two months of the date of notification of the Governor of the Commonwealth of Virginia, the Owner engage the services of a professional engineering consultant to perform the necessary studies and design work outlined below:

1) A detailed evaluation of the spillway capacity and the effects overtopping has on the dam during the Spillway Design Flood appropriate for this dam.

2) Perform a limited subsurface exploration and stability analysis in order to evaluate the stability of the dam and modify as necessary.

3) The eroded area located at the right abutment should be corrected in order to prevent continual or increased flow of water and associated erosion in the earthen portion of the dam.

4) The earthen portion of the dam section should be protected against erosion which would occur during periods of overtopping.

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

The following routine maintenance and observation functions should be initiated as part of an annual maintenance program:

1) Vegetation should be routinely controlled. The slopes and crest of the structure should be cut at least once a year.

2) All existing small trees or saplings cut to the ground.

3) A staff gage should be installed to monitor water levels.

Prepared by:

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

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

Submitted by:

Original signed by
JAMES A. WALSH

James A. Walsh, P.E.
Chief, Design Branch

Approved:

Original signed by:
Douglas L. Haller

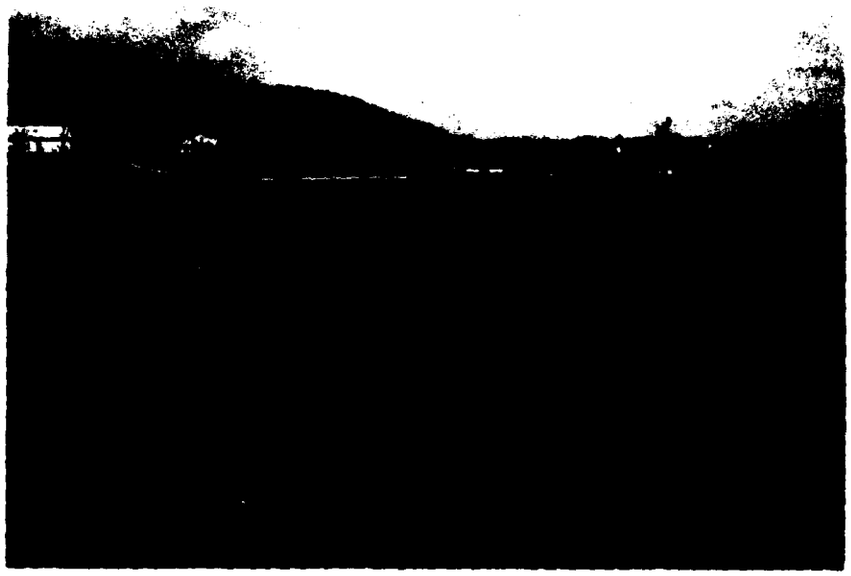
Douglas L. Haller
Colonel, Corps of Engineers
District Engineer

Recommended by:

Original Signed by:
Ronald G. Vann

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

Date: JUL 22 1980



Lake

Dam

OVERVIEW PHOTOGRAPHS

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
SILVER LAKE DAM
VA. NO. 16508

SECTION 1 - PROJECT INFORMATION

1.1 General:

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

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

1.2 Project Description:

1.2.1 Dam and Appurtenances: Silver Lake Dam is a stone masonry/earth structure approximately 400 ft long and 15 ft high.* The top of the dam is 15 ft wide and is at elevation 1216 msl. The downstream side is vertical and the upstream face is estimated at about 1 horizontal to 1 vertical (1H:1V) (See Plate No. 2, Appendix I). It is unknown if the dam is keyed into the foundation or if a drainage system exists. There are no foundation drain outlets. The downstream slope is vegetated and the upstream slope includes a thin concrete cover for protection.

The principal spillway consists of three corrugated metal pipe arches at sizes of 19" x 11", 29" x 18" and 50" x 31" respectively, with each pipe running through the dam.

---

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

The 50" x 31" arch pipe empties into a side discharge concrete weir spillway originally used to propel a waterwheel. The side discharge spillway crest elevation is at normal pool (elevation 1215 msl). The 29" x 18" arch pipe discharge is located near the center of the dam with an invert at elevation 1214.5 msl. The 19" x 11" arch pipe is near the right abutment with an invert at elevation 1215 msl (See Plate No. 2, Appendix I).

1.2.2 Location: Silver Lake Dam is located on a branch of Cooks Creek 0.2 miles north of Dayton, Virginia (See Plate No. 1, Appendix I). The impoundment is popularly known as Silver Lake.

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

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

1.2.5 Ownership: The City of Harrisonburg, Virginia owns and operates the dam.

1.2.6 Purpose: Recreation and water supply for both the Town of Dayton and City of Harrisonburg.

1.2.7 Design and Construction History: There was no information available concerning the design and construction of this structure. The impoundment was purchased from the Grove family in 1946. According to Mr. Ruben F. Rhodes (local resident), the structure was constructed no later than the year 1900.

1.2.8 Normal Operational Procedures: The spillways are ungated, therefore, water rising above the crest of the concrete weir and the invert of the pipes is automatically discharged downstream. Normal pool is maintained at elevation 1215 by the crest of the concrete weir. A portion of the normal flow through the reservoir is taken in through the water supply intake in the center of the lake. According to Mr. Ed Loker of the Harrisonburg Water Department, the lake is spring fed with an estimated flow of 4 to 6 million gallons per day (mgd).

1.3 Pertinent Data:

1.3.1 Drainage Areas: The drainage area is 0.3 square miles.

1.3.2 Discharge at Dam Site: Maximum known flood at the dam was not recorded, and the dam has never been overtopped based on our discussions with Mr. Ed Loker.

Principal Spillway Discharges:

Pool Elevation at Crest of Dam (elevation 1216) 34 CFS

1.3.3 Dam and Reservoir Data: See Table 1.1 below:

Table 1.1 - DAM AND RESERVOIR DATA

	Reservoir				
		Storage			
Item	Elevation feet msl	Area Acres	Volume Acre Feet	Watershed Inches	Length Miles
Crest of Dam	1216	12.5	65	3.72	.30
Crest of Overflow Weir and 19" x 11" Arch Pipe	1215	11.0	51	3.19	.28
29" x 18" Arch Pipe	1214.5	10.5	46	2.83	.25
Streambed at Downstream Toe of Dam	1201	-	-	-	-

SECTION 2 - ENGINEERING DATA

2.1 Design: There is no design data available.

2.2 Construction: No construction records are available. According to Mr. Ruben F. Rhodes (local resident), the dam was constructed prior to 1900. Mr. Rhodes stated that he believes the dam is constructed entirely with stone, however, he does not know what was used for mortar. Mr. Rhodes did not observe any phase of the construction.

2.3 Evalutation: There is no information to evaluate foundation conditions and embankment stability.

SECTION 3 - VISUAL INSPECTION

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

3.1.1 General: An inspection was made on 15 April, 1980 and the weather was cloudy and windy, with a temperature of 40°F. The pool and tailwater levels at the time of inspection were 1215 and 1201 msl, respectively, which correspond to normal levels. Ground conditions were damp at the time of the inspection. No previous reports were available.

3.1.2 Dam and Spillway: The downstream slope consists of a 15 ft± high vertical wall constructed with hand-placed limestone blocks. Much of the downstream slope and right abutment was densely vegetated with honeysuckle vines. There was approximately one foot of freeboard at the time of the inspection, therefore, very little of the upstream slope was visible. The upstream slope appeared to be rather steep (1H:1V) and was blanketed in part with concrete above and below pool level to depth of visibility. No seepage was observed through the stone blocks or along the toe of the downstream slope. It could not be determined whether the dam is constructed entirely of stone. A field sketch of the dam is provided as Sheet 1 of Appendix III.

A breach or eroded area was located along the right side of the reservoir, as illustrated on Sheet 2, Appendix III. The erosion appeared to be the result of removal of several limestone blocks. Water was passing through this area flowing at an estimated rate of 50 gpm. The adjacent corrugated metal pipe, which probably served as a spillway, was above pool level and not passing water.

No bedrock was observed at the site. The right abutment is thickly vegetated, but does include several surface exposures of silty clay (CL) material. The mill structure occupies the left abutment. The dam ties into both abutments and no erosion was observed except as mentioned above.

The corrugated metal pipe (cmp) arches showed no signs of deterioration. The concrete weir at the waterwheel structure is severely spalled and contains cracked concrete. This structure controls the pool level which is subject to a constant discharge from the reservoir.

3.1.3 Reservoir Area: The reservoir area was freeof debris at the time of inspection and the surrounding area is farm and pasture land. The reservoir is located in a broad valley having very gentle side slopes (approximately 10H:1V to 20H:1V). No sediment buildup was observed and the water was extremely clear. The reservoir is fed by a spring located below pool level near the northwest corner of the reservoir. The spring flow reported by Mr. Ed Loker was a rate of 4 to 6 million gallons per day.

3.1.4 Downstream Area: The downstream channel consists of a 15 ft wide by 2 ft deep channel located in a shallow valley. The valley side slopes range from 10H:1V to 20H:1V and consist of open pasture meandering through the Town of Dayton. Immediately downstream there are two commercial facilties less than 10 ft above the streambed and approximately one-quarter mile downstream there is one home about 8 feet above the streambed.

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

3.2 Evaluation:

3.2.1 Dam and Spillway: Overall, the dam was in fair condition at the time of inspection. Based upon the appearance of the dam and amount of vegetation growing on the embankment at the time of inspection, it would appear that only a limited maintenance program exists for this structure. The area surrounding the reservoir appears to be well maintained. According to Mr. Ed Loker a routine maintenance program does not exist, however, maintenance is performed as required. The structure and right abutment area should be mowed and brush removed at least once a year, but more preferably twice a year. Small trees should not be allowed to grow on the embankment and should be cut to the ground during maintenance.

The eroded area along the right side of the reservoir should be corrected. Although it did not hinder the performance of the dam at the time of the inspection, increased flow and erosion could be detrimental.

The outlet pipes are in good condition. The concrete weir is badly deteriorated and is in need of repair. The structural integrity of the weir structure could precipitate instability of the dam.

A staff gage should be installed.

3.2.2 Downstream Area: There is one commercial facility adjacent to the dam, one commercial facility several hundred feet downstream, and a dwelling one-quarter mile downstream which could be jeopardized during a dam failure.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures: Silver Lake is used for recreational purposes and water supply. The normal pool elevation is maintained by an overflow weir acting as the principal spillway. During periods of normal flows (4 mgd), a portion of the water flow is absorbed by the water supply intake. Water supply is drawn off through a supply line located in the middle of the lake. During periods of above-normal flows, the pool elevation rises above the inverts of the overflow pipes increasing the flow through the dam. Large increases in flows which cannot be absorbed by storage would pass over the dam when the pool rises above elevation 1216 msl.

4.2 Maintenance of Dam and Appurtenances: Maintenance is the responsibility of the City of Harrisonburg, Virginia. Maintenance consists of periodic inspection, debris removal and repair. A routine maintenance program does not exist.

4.3 Warning System: No warning system exists.

4.4 Evaluation: The dam and appurtenances are in fair operating condition. Maintenance of the dam is inadequate. A routine maintenance program should be established and complete records of maintenance and inspections should be maintained for future reference. An emergency operation and warning plan should be developed. It is recommended that a formal emergency procedure be prepared and furnished to all operating personnel. This should include:

a) How to operate the dam during an emergency.

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

SECTION 5 - HYDRAULICS/HYDROLOGIC DATA

5.1 Design: No hydraulic/hydrologic data is available.

5.2 Hydrologic Records: There are no records available.

5.3 Flood Experience: The dam has never been observed in an overtopped condition.

5.4 Flood Potential: 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. The Probable Maximum Flood (PMF), ½ PMF and 100 year flood hydrographs were developed by the SCS method (Reference 4, Appendix IV). Precipitation amounts for the flood hydrographs of the PMF, ½ PMF and 100 year flood are taken from the U. S. Weather Bureau Information (Reference 5 and 6, Appendix IV). Appropriate adjustments for basin size and shape were accounted for. These hydrographs were routed through the reservoir to determine maximum pool elevation.

5.5 Reservoir Regulation: For routing purposes, the pool at the beginning of flood was assumed to be at elevation 1215 msl. Reservoir stage-storage data and stage-discharge data were determined from field measurements and USGS quadrangle sheets. Floods were routed through the reservoir using the outlet pipes discharge up to a pool storage elevation of 1216 msl and combined outlet pipes and non-overflow section discharge for pool elevations above 1216 msl.

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

TABLE 5.1 - RESERVOIR PERFORMANCE

		Hydrograph		
	Normal Flow	100 Year	½ PMF	PMF
Peak Flow, CFS				
Inflow	6	478	1630	3260
Outflow	3	462	1490	3014
Maximum Pool Elevation Ft, msl	-	1216.6	1217.2	1218
Non-Overflow Section (Elev 1216 msl)				
Depth of Flow, ft	-	0.6	1.2	2.0
Duration, Hours	-	4.5	5.0	5.4
Velocity, fps (a)	-	3.2	4.8	6.0
Tailwater Elevation Ft, msl	1201	1206.5	1210	1215

(a) Critical velocity at control section

5.7 Reservoir Emptying Potential: There is no way to lower the reservoir below the outflow weir elevation of 1215 msl.

5.8 Evaluation: U.S. Army, Corps of Engineers guidelines indicate the appropriate Spillway Design Flood (SDF) for a small size, significant hazard dam is the 100 year flood to the ½ PMF. Because of the risk involved, the ½ PMF has been selected as the SDF. The spillway will pass less than 10 percent of the PMF (20% of the SDF). The SDF will overtop the dam a maximum of 1.2 ft , and remain above the dam for 5 hours with a critical velocity of 4.8 fps.

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

SECTION 6 - DAM STABILITY

6.1 Foundation and Abutments: The dam is located in the Valley and Ridge Physiographic Province of Virginia. The impoundment and structure are underlain by the Beekmantown Formation of lower Ordovician Age. This formation is up to 2000 ft thick and consists basically of thick-bedded gray dolomite with some blue limestone interbeds and considerable chert. The impoundment is located on the west limb of the Harrisonburg syncline. Bedrock in the immediate area strikes to the northeast and dips from 15 to 40 degrees to the southeast. No bedrock or faults were observed at the site, and it is not known whether a cutoff trench exists beneath the dam.

Subsurface data is not available for the structure. Based upon brief examination of the surrounding area, it would appear that the dam rests upon a thin stratum of alluvial or stream deposited soils consisting of assorted mixtures of sand, silt and clay materials. Natural permeabilities ranging from low to medium are likely. The underlying residual soils, which are derived from the in-place weathering of limestone and dolomite bedrock, probably consist of silty clays and clays possessing low to very low permeabilities. It is not known whether the dam is keyed into the foundation.

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

6.2 Embankment:

6.2.1 Materials: A portion of the upstream slope is blanketed with a thin concrete cover. The downstream slope includes a vertical, stone or rubble facing which is about three ft thick at the top. The only exposed soil portion of the dam is the crest and the top 1 ft± of the upstream slope. The exposed soil consists of red to brown silty clay to clay materials with variable amounts of sand or rock fragments. These materials probably possess low to very low compacted permeabilities and would classify as CL to CH in accordance with the Unified Soil Classification System. It is not known if the structure consists of a soil embankment with a stone face or whether it is essentially a stone gravity structure with some soil on the upstream slope.

6.2.2 Subdrainage and Seepage: There is no known drainage system. No toe drain outlets were observed and no seepage was observed along the downstream toe. The presence of thick vegetation and scattered debris made visual inspection difficult.

6.2.3 Stability: There are no stability calculations for this structure. The dam is 15 ft high and has a crest width of approximately 15 ft. The upstream slope is approximately 1 horizontal to 1 vertical while the downstream slope is vertical. An accurate check on the stability of this structure cannot be made since there is no design or construction data. However, the performance record of the structure for the past 70 years± would indicate a stable structure up to the time of the inspection.

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

6.3 Evaluation: An accurate check on the stability of this structure cannot be made since there is no design and construction data. The dam cannot be subjected to sudden drawdown conditions since the reservoir cannot be drained. It could not be determined from the visual inspection whether the structure is a soil embankment with a stone face, or a stone (masonry) gravity dam with soil blanket on the upstream slope. Furthermore, foundation conditions are not known. Detrimental effects of overtopping cannot be assessed since the geometry and stability of the dam could not be evaluated. Therefore, it is recommended that the Owner retain the services of a Professional Engineer with expertise in Geotechnical Engineering to perform a limited subsurface investigation and a stability analysis in order to evaluate the safety of the dam. Based upon the performance history of the dam, a detailed analysis would not seem necessary. Since no undue settlement, cracking, or sloughing was noted at the time of inspection, it appears that the embankment is adequate for maximum control storage with water at elevation 1215 msl.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment: The Silver Lake Dam at the time of inspection appeared to be in fair condition. The appropriate SDF for this dam is the ½ PMF. The spillway will pass less than 10 percent of the PMF (20 percent of the SDF) without overtopping, and the dam will be overtopped by 1.2 ft during the SDF. The possibility of a dam breach does exist if overtopping of the dam further damages the concrete weir. The potential for a breach caused by the weir condition results in an increased hazard to the downstream dwelling. There are no design or construction records available for this structure, therefore, an accurate check on its stability cannot be made. Only a limited maintenance program for the structure exists and maintenance is considered inadequate.

Due to the lack of information concerning the geometry and stability of the dam, the structural integrity of the spillway, and the possibility of a dam breach by overtopping during the SDF, the spillway is rated seriously inadequate and the dam is assessed "unsafe-non-emergency".

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

7.2 Recommended Remedial Measures: It is recommended that within two months of the date of notification of the Governor of the Commonwealth of Virginia, that the Owner engage the services of a professional engineering consultant to complete the following:

1) A detailed evaluation of the spillway capacity and the effects overtopping has on the dam during the Spillway Design Flood appropriate for this dam.

2) A limited subsurface investigation and stability analysis should be performed in order to evaluate the stability of the dam and modify as necessary.

3) The concrete weir adjacent to the water wheel should be evaluated for structural soundness and repaired if necessary.

4) The eroded area of the right abutment should be corrected in order to prevent continued or increased flow and associated erosion.

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

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

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

1) How to operate the dam during an emergency.

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

7.3 Required Maintenance and Observation:

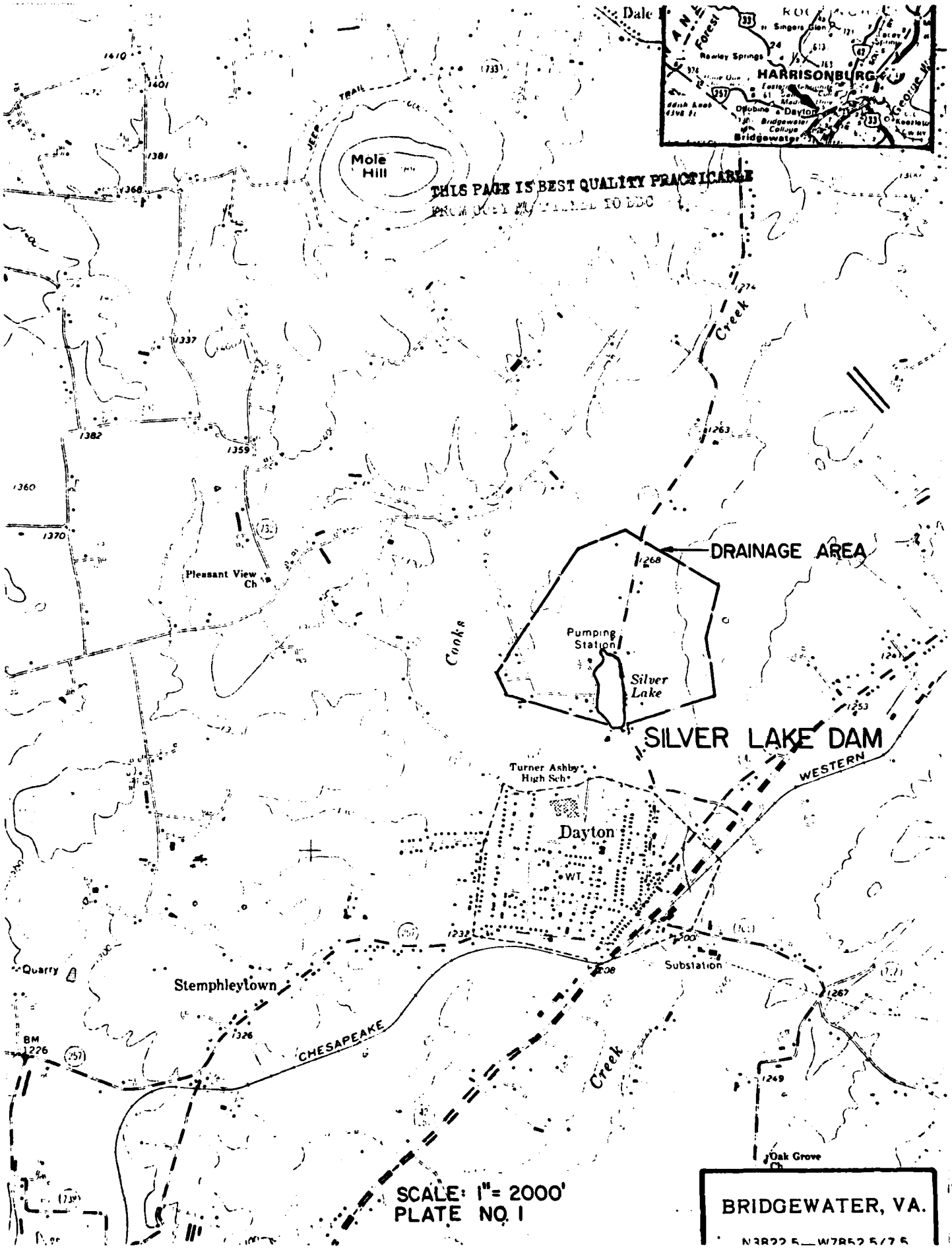
7.3.1 The grass and weeds on the embankment should be cut at least once and preferably twice a year. It is recommended that a routine maintenance program be established in the early summer and fall.

7.3.2 All small trees and saplings present on the embankment should be cut to ground level yearly during maintenance operations.

7.3.3 A staff gage should be installed to monitor water levels.

APPENDIX I

MAPS AND DRAWINGS



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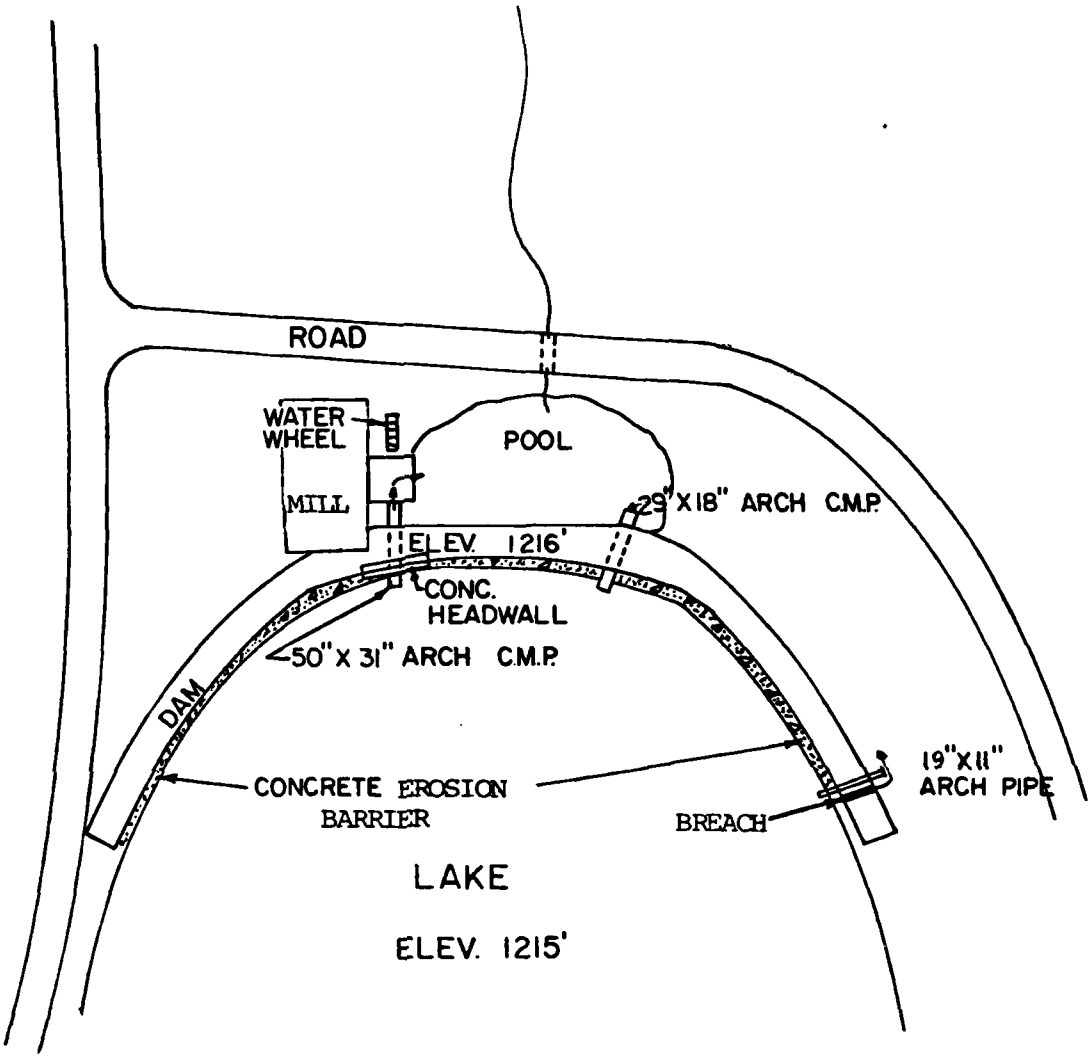
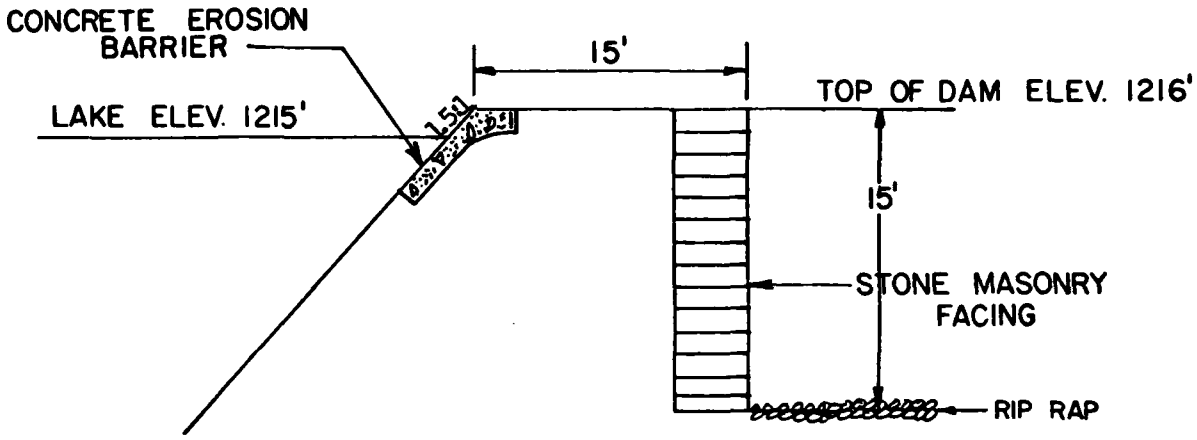


PLAN

SILVER LAKE DAM

FIELD SKETCH

PLATE NO. 2



TYPICAL SECTION

SILVER LAKE DAM

FIELD SKETCH

PLATE NO. 3

APPENDIX II

PHOTOGRAPHS

Downstream Channel

(Note Dwelling on Stream Bank)

Photograph No. 1

Intake Structure and Upstream Face of Dam

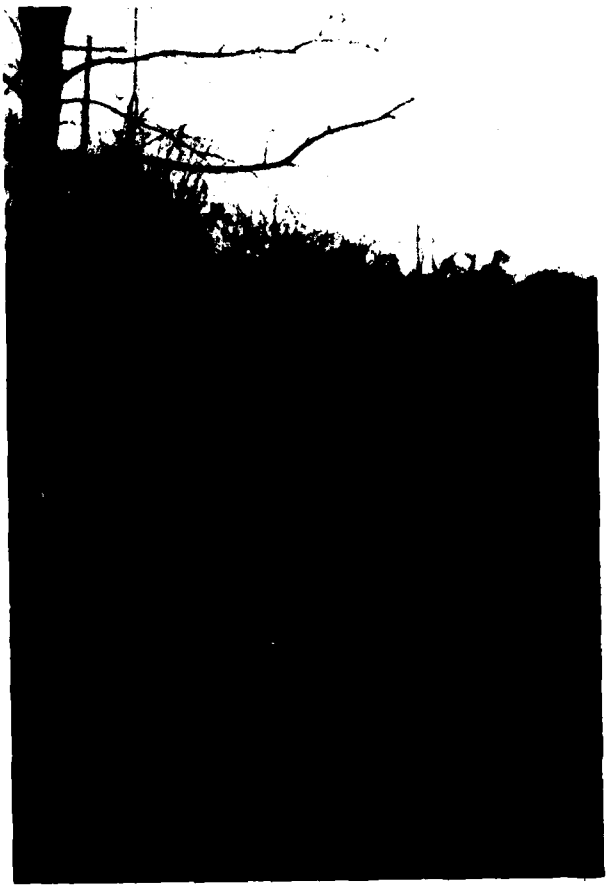
Photograph No. 2

Outlet Pipe (18" X 29") and Plunge Pool

Photograph No. 3

Outlet Weir and Abandoned Water Wheel
(Note Structural Cracks in Weir)

Photograph No. 4



Downstream Face of Dam

to the Right of Stone Masonary Wall

Photograph No. 5

APPENDIX III

FIELD OBSERVATIONS

Check List
Visual Inspection
Phase I

Name Dam Silver Lake County Rockingham State Virginia Coordinators Lat. 38°-25.3' Long. 78°-56.4'

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

Pool Elevation at Time of Inspection 1215 msl Tailwater at Time of Inspection 1201 msl

Inspection Personnel:

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

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

State Water Control Board
Hugh M. Gildea, P.E.

City of Harrisonburg, Virginia
Mr. Ed Loker, Water Department

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	The slopes, crest and abutment contacts were inspected and no cracks were noted. The downstream slope was rather densely vegetated with honeysuckle vines.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	No unusual movements or cracking were noted on the dam or beyond the embankment toe.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	The crest of the dam appears to be constructed with silty clay soils (CL), with traces of fine sand. The structure includes a 3 ft± wide limestone rock vertical facing on the downstream side and a steep (1.5H:1V±) concrete covered upstream slope. The downstream slope and right abutment were heavily vegetated with honeysuckle, therefore it was difficult to observe any erosion. A breach or eroded area was located along the right side of the reservoir, consisting of a narrow channel approximately 1 to 2 ft square. Flow through this area was estimated at 50 gpm±. The adjacent corrugated metal pipe which served as a spillway, was above pool level and not passing water. The erosion appeared to be the result of removal of several limestone blocks. The mill is located on the left abutment.	
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	The vertical and horizontal alignment of the dam appeared to be good.	
RIPRAP FAILURES	No riprap exists. The upstream slope includes a concrete blanket. Repair work was performed 15 years ago±.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	No rock is exposed in either abutment. The mill structure occupies the left abutment. The right abutment is thickly vegetated, but does include several surface exposures of silty clay (CL) materials. The dam ties into both areasand no erosion was observed.	
ANY NOTICEABLE SEEPAGE	No seepage was observed through the stone facing on the downstream slope.	
STAFF GAGE AND RECORDER	None observed.	
DRAINS	None observed.	

EMERGENCY SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	None	-
APPROACH CHANNEL	None	-
DISCHARGE CHANNEL	Mill race structure is deteriorating from weathering of concrete	-
BRIDGE AND PIERS	None	-

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Corrugated metal pipe arches	Good condition
INTAKE STRUCTURE	19" x 11" CMP arch pipe. Severe seepage and erosion to the right of the pipe	Should repair seepage area before erosion is too severe.
OUTLET STRUCTURE	Three corrugated metal arches; 50" x 31", 29" x 18" and 19" x 11". Discharge weir at waterwheel contains severly spalled concrete with some cracking	Weir needs repair
OUTLET CHANNEL	Riprap plunge pool in good condition; some debris	No effect on drain performance
EMERGENCY GATE	None	-

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Very gentle grassed slopes surround the reservoir and the surrounding area is farm and pastureland. The reservoir was free of debris.	
SEDIMENTATION	None. The reservoir is spring fed, therefore very little sediment enters the reservoir. The water is very clear. According to Mr. Ed Loker the spring flows at a rate of 4 to 6 million gallons per day.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	N = .035; riprap and grass. Low road culvert immediately downstream of plunge pool.	Condition is sufficient as not to hinder dam discharge.
SLOPES	Gentle to moderate, grassed slopes bound the downstream channel. The downstream channel consists of a 15 ft wide by 2 ft deep channel located in a shallow valley. The valley side slopes range from 10H:1V to 20H:1V and consist of open pasture extending through the Town of Dayton.	-
APPROXIMATE NO. OF HOMES AND POPULATION	Two commercial structures - one at dam and one immediately downstream. One dwelling in floodplain, 1/4 mile downstream. The two structures immediately downstream are 10 ft± above the streambed. The farthest dwelling is about 8 ft above the streambed.	-

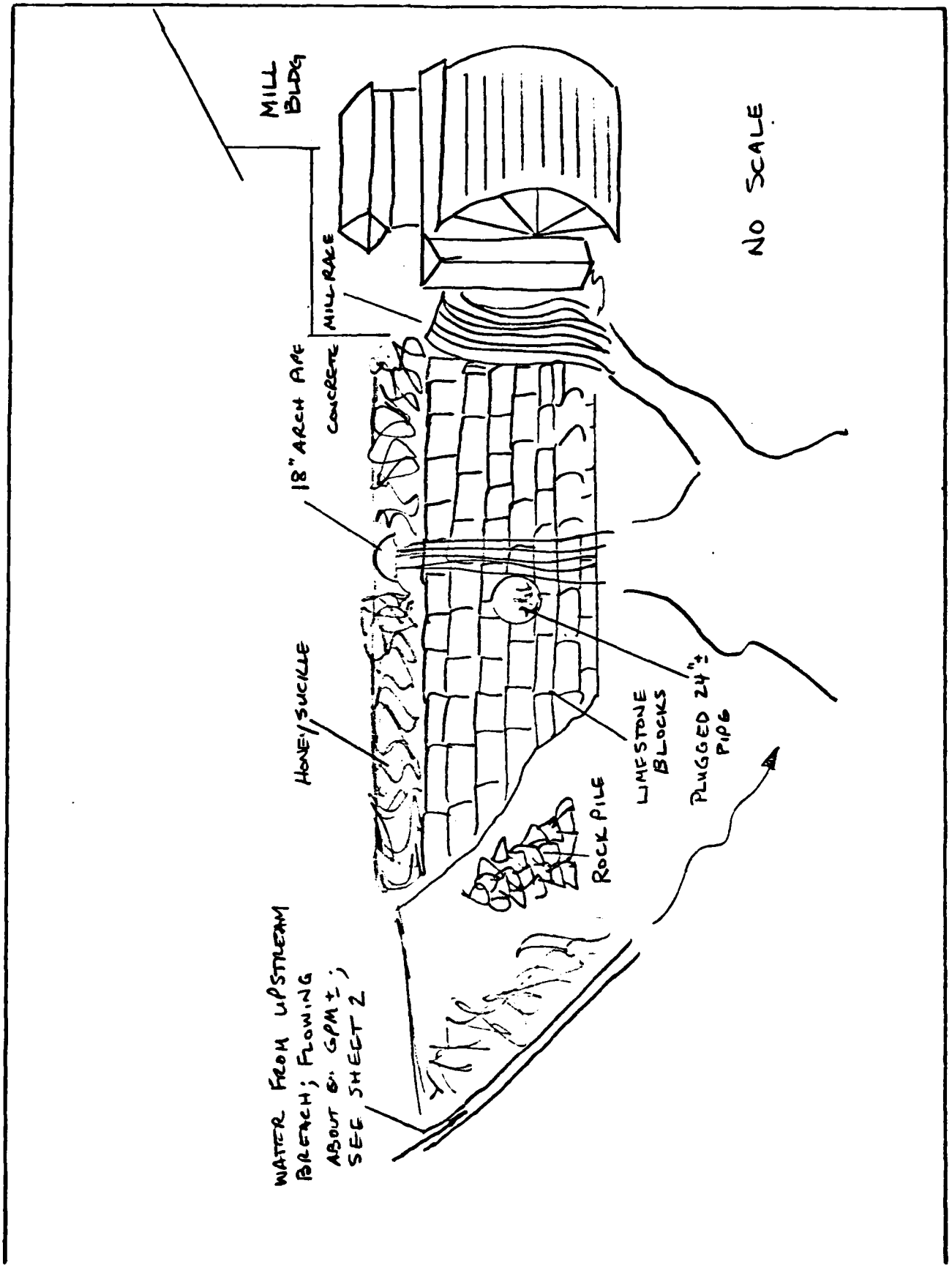
INSTRUMENTATION

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

BY SW DATE 4/15/80 **SCHNABEL ENGINEERING ASSOCIATES** SHEET NO. 1 OF 2

CHKD. BY ..... DATE ..... **CONSULTING ENGINEERS** JOB NO. V80103

SUBJECT FIELD SKETCH — SILVER LAKE DAM



BY SW DATE 4/15/80 **SCHNABEL ENGINEERING ASSOCIATES**

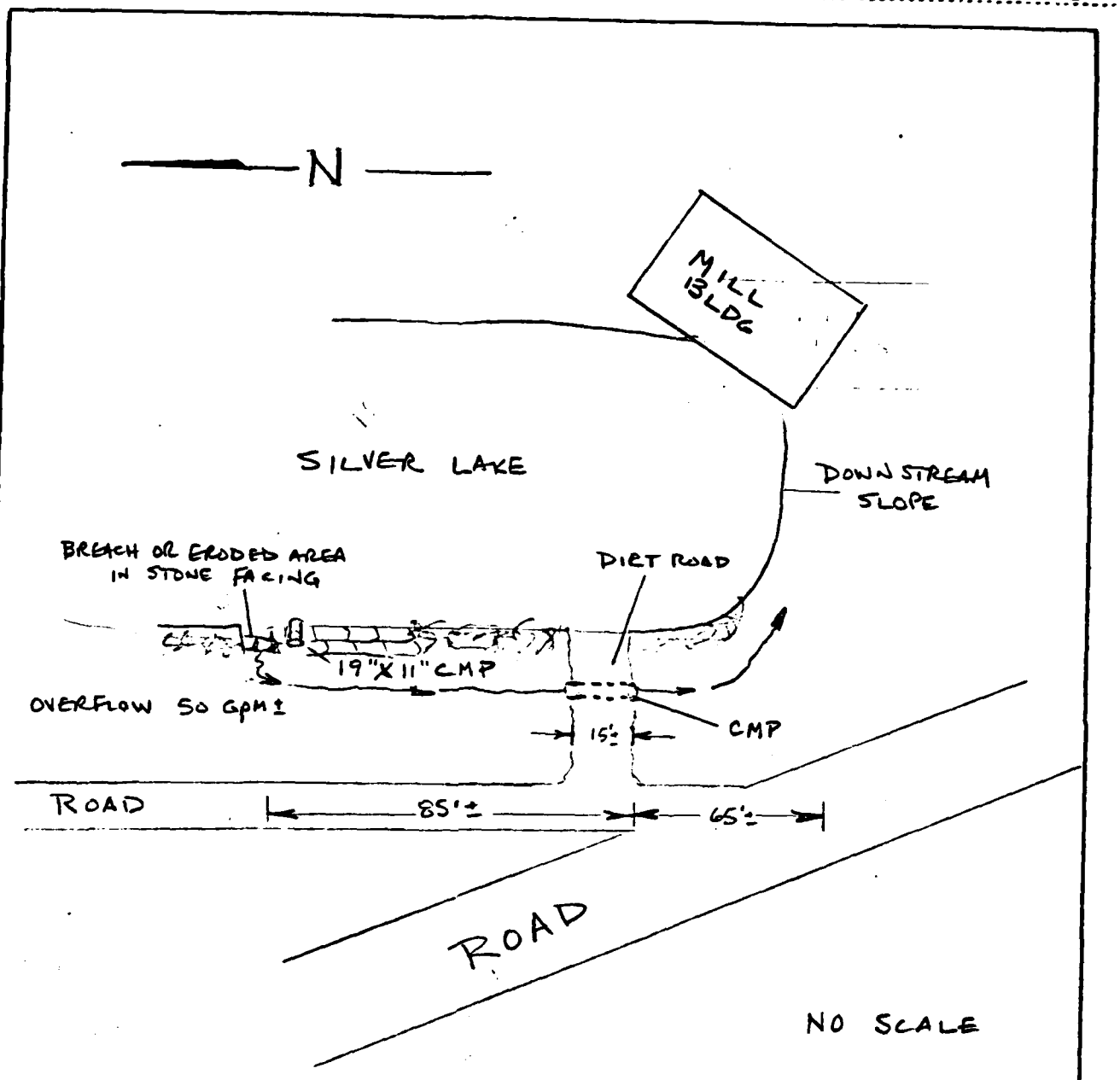
CHKD. BY ..... DATE .....

CONSULTING ENGINEERS

SHEET NO. 2 OF 2

JOB NO. V80103

SUBJECT FIELD SKETCH – BREACH ALONG RIGHT SIDE OF RESERVOIR



APPENDIX IV - REFERENCES

1. Recommended Guidelines for Safety Inspection of Dams, Department of Army, Office of the Chief of Engineers, 46 pp.
2. Design of Small Dams, U. S. Department of Interior, Bureau of Reclamation, 1974, 816 pp.
3. Geology and Mineral Resources of Rockingham County, Bulletin 76, William B. Brent, Virginia, Division of Mineral Resources, 1960, 174 pp.
4. Section 4, Hydrology, Part 1 Watershed Planning, SCS National Engineering Handbook, Soil Conservation Service, U. S. Department of Agriculture, 1964.
5. Hydrometerological Report No. 33, U. S. Department of Commerce, Weather Bureau, U. S. Department of Army, Corps of Engineers, Washington, D.C., April 1956.
6. Technical Paper No. 40, U. S. Department of Commerce, Weather Bureau, Washington, D. C., May 1961.

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