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NATIONAL DAM SAFETY PROGRAM. OLD VIBURNUM TAILINGS DAM (MO 3034--ETC(U)
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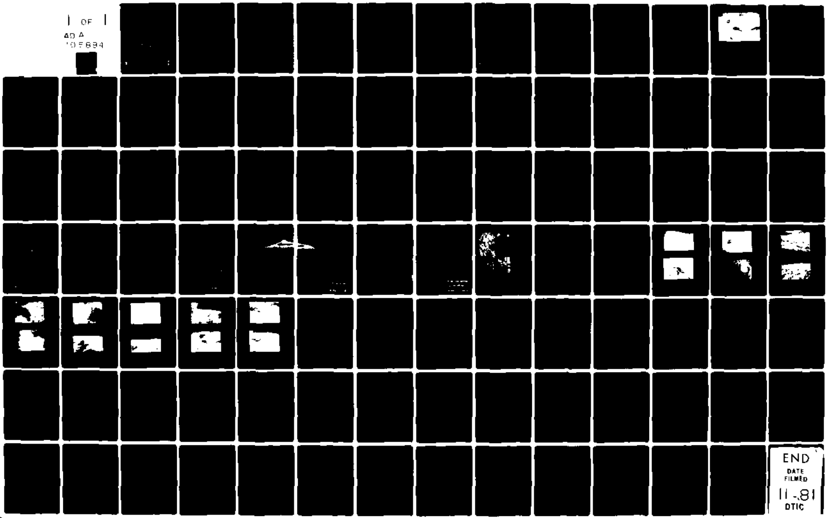

MISSISSIPPI-KASKASKIA-ST. LOUIS BASIN

OLD VIBURNUM TAILINGS DAM
IRON COUNTY, MISSOURI
MO 30342

PHASE 1 INSPECTION REPORT NATIONAL DAM SAFETY ~~INSPECTION~~ Program

United States Army
Corps of Engineers
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St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

APRIL 1981

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This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD, NORTH
ST. LOUIS, MISSOURI 63101

REPLY TO
ATTENTION OF

SUBJECT: Old Viburnum Tailings Dam, MO 30342

This report presents the results of field inspection and evaluation of the Old Viburnum Tailings Dam. It was prepared under the National Program of Inspection of Non-Federal Dams.

SUBMITTED BY: 23 J N 1981 SIGNED
Chief, Engineering Division — Date

APPROVED BY: 2 N 1981 SIGNED
Colonel, CE, District Engineer — Date

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OLD VIBURNUM TAILINGS DAM

Iron County, Missouri

Missouri Inventory No. 30342

Phase I Inspection Report

National Dam Safety Program

Prepared by

Woodward-Clyde Consultants

Chicago, Illinois

Under Direction of

St Louis District, Corps of Engineers

for

Governor of Missouri

April 1981

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 not to provide a complete evaluation of the safety of the structure nor to provide a guarantee on its future integrity. Rather the purpose of the program is to identify potentially hazardous conditions to the extent they can be identified by a visual examination. The assessment of the general condition of the dam is based upon available data (if any) and visual inspections. Detailed investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify the need for more detailed studies. In view of the limited nature of the Phase I studies no assurance can be given that all deficiencies have been identified.

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 any data which may be available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action removes the normal load on the structure, as well as the reservoir head along with seepage pressures, 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, so that corrective action can be taken. Likewise continued care and maintenance are necessary to minimize the possibility of development of unsafe conditions.

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam	Old Viburnum Tailings Dam
State Located	Missouri
County Located	Iron
Stream	West Prong of Indian Creek
Date of Inspection	21 October 1980

Old Viburnum Tailings Dam, Missouri Inventory Number 30342, was inspected by Richard Berggreen (engineering geologist), Leonard Krazynski (geotechnical engineer), and Sean Tseng (hydrologist). The inspection team was accompanied by Mr John Kennedy and Mr John Boyer of St Joe Lead Co. The dam was constructed to impound lead tailings.

The dam inspection was made following the guidelines presented in the "Recommended Guidelines for Safety Inspection of Dams." These guidelines were developed by the Chief of Engineers, US Army, Washington, DC, with the help of federal and state agencies, professional engineering organizations, and private engineers. The resulting guidelines represent a consensus of the engineering profession. The inspections are intended to provide for an expeditious identification of those dams which may pose hazards to human life or property, based on available data and a visual inspection of the dam. In view of the limited nature of the study, no assurance can be given that all deficiencies have been identified.

The St Louis District (SLD), Corps of Engineers, has classified this dam as having a high hazard potential. The SLD estimated damage zone length extends approximately 14 mi downstream. Within this damage zone are numerous occupied dwellings, two churches, Missouri State Highway C, and an electric transmission line. The contents of a portion of the downstream hazard zone were verified by aerial reconnaissance.

The dam is classified as a large dam based on its height of 115 ft. The storage capacity is approximately 10,200 ac-ft of which about 4600 ac-ft is water storage. The guideline criteria for the large dam classification are: height over 100 ft, or storage capacity over 50,000 ac-ft, whichever gives the larger classification.

The results of the visual inspection indicate the dam is in fair to poor condition. Deficiencies noted consist of: deep erosion gullies on the downstream face and adjacent to the abutments, possible piping cavities at the heads of some erosion gullies, slumps on the downstream edge of the dam crest, potential for wave erosion on the upstream face, and animal burrows on the crest of the dam. Seepage and stability analyses as recommended by the guidelines are not on record, which is also considered a deficiency.

Based on the "Recommended Guidelines for Safety Inspection of Dams," the spillway design flood for a large size dam is 100 percent of the Probable Maximum Flood (PMF).

Hydraulic and hydrologic analyses including multiple dam analyses of the significant upstream dams indicate the dam will not be overtopped by 100 percent of the PMF. The PMF is defined as the flood event that may be expected to occur from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. Discharge through the spillway at 100% of the PMF is calculated at 10,500 ft^3/sec. The maximum spillway capacity just prior to overtopping is calculated at 15,000 ft^3/sec.

Based on the findings of the visual inspection and evaluation of available data, the following remedial measures and studies should be addressed without undue delay. These remedial measures and studies should be performed by or under the direction of an engineer experienced in the design and construction of tailings dams.

1. Repair erosion gullies on the downstream face of the dam. This repair should be followed by an erosion control program consisting of vegetation, matting, top dressing with gravel, admixture treatment, or other means of mitigating erosion of the tailings embankment. This effort should include control of the possible piping cavities at the heads of some of the erosion gullies.

2. Repair animal burrows and implement animal control measures to mitigate further burrowing in the embankment.

3. Prepare seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams." These analyses should be made for appropriate loading conditions, including earthquake loads, and made a matter of record.

4. Evaluate the feasibility of a practical and reliable warning system to alert downstream residents and traffic in the event hazardous conditions develop at this dam.

It is also recommended that a program of periodic inspections be implemented to monitor the performance of the dam and to identify necessary maintenance. Records of the inspections and recommended maintenance should be kept on file. This program should include, but not be limited to the following items:

1. Inspect the embankment for signs of slope instability such as cracking or slumps.

2. Inspect areas of potential piping cavities. It should be kept in mind that piping poses a high hazard to safety due to the easily erodible tailing materials used in the construction of this dam.

3. Inspect the junction of the embankment and abutments, and along the toe of the dam for seepage, with note being made of changes in the amount of seepage or turbidity (soil or tailings) in the seepage water.

4. Inspect the embankment slopes and junction of the embankment and abutments for evidence of significant erosion following heavy precipitation.

These inspections, maintenance recommendations, and remedial measures should be performed by or under the guidance of an engineer experienced in the design, construction, and maintenance of tailings dams.

It is recommended the owner take action without undue delay on the remedial measures concerning the repair and control of the embankment erosion and animal burrowing. The remaining remedial measures and recommendations should be acted on as soon as practical.

WOODWARD-CLYDE CONSULTANTS

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Vice President

OVERVIEW
OLD VIBURNUM TAILINGS DAM

MISSOURI INVENTORY NUMBER 30342

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

OLD VIBURNUM TAILINGS DAM, MISSOURI INVENTORY No. 30342

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15. County Road Dam (31014) consisting of gravel road crossing tailings impoundment. Old Viburnum Tailings Dam out of picture to the right, approximately 1.4 mi.
16. Dams upstream of Old Viburnum Tailings Dam considered in the multiple dam analysis. The upstream-most dam (sand embankment) is Viburnum Tailings Dam, 31016; next downstream dam (grass-covered embankment) is the Railroad Embankment Dam, 31779; downstream-most dam in this picture with paved road along crest is No. 29 Mine Ore Haul Road Dam, 31015. Old Viburnum Tailings Dam is approximately 1.2 mi downstream, to the right, from 31015.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
OLD VIBURNUM TAILINGS DAM, MISSOURI INVENTORY No. 30342

SECTION 1
PROJECT INFORMATION

1.1 General

a. **Authority.** The National Dam Inspection Act, Public Law 92-367, provides for a national inventory and inspection of dams throughout the United States. Pursuant to the above, an inspection was conducted of Old Viburnum Tailings Dam, Missouri Inventory Number 30342.

b. **Purpose of investigation.** "The primary purpose of the Phase I investigation program is to identify expeditiously those dams which may pose hazards to human life or property... The Phase I investigation will develop an assessment of the general condition with respect to safety of the project based upon available data and a visual inspection, determine any need for emergency measures, and conclude if additional studies, investigations and analyses are necessary and warranted" (Chapter 3, "Recommended Guidelines for Safety Inspection of Dams").

c. **Evaluation criteria.** The criteria used to evaluate the dam were established in "Recommended Guidelines for Safety Inspection of Dams," and Engineering Regulation No. 1110-2-106 and Engineering Circular No. 1110-2-188, "Engineering and Design National Program for Inspection of Non-Federal Dams," prepared by the Office of Chief of Engineers, Department of the Army; and "Hydrologic/Hydraulic Standards, Phase I Safety Inspection of Non-Federal Dams," prepared by the St Louis District (SLD), Corps of Engineers. These guidelines were developed with the help of several federal and state agencies, professional engineering organizations, and private engineers.

1.2 Description of Project

a. **Description of dam and appurtenances.** Old Viburnum Tailings Dam is an inactive lead tailings dam. Although its construction and usage are typical of other lead tailings dams in the area, it is atypical of dams constructed for the impoundment of water. The unique nature of these lead tailings dams has a significant impact on their evaluation. A brief description of their construction and usage is necessary to distinguish the differences between these dams and conventional water-retaining dams.

The lead tailings dams in southeastern Missouri have been constructed over a long period of time and include dams ranging from very old dams constructed in the 1800's to new dams still under construction. Although some construction techniques have changed, these dams have many similarities.

At the beginning of a mining operation, a starter dam is frequently constructed of waste rock and residual soil. This dam impounds surface runoff and mine water pumped from the underground workings. The water is used in the ore processing and transport of the tailings waste.

The tailings are the waste material produced by the beneficiation and processing of the lead ore to form a high grade lead concentrate. The coarse tailings fraction (medium to fine sand) is used to construct the dam embankment; the fine fraction (silt and fine sand) is deposited in the reservoir area. Separation of the coarse and fine fractions usually is done by a cyclone separator or by a series of cyclones on the crest of the dam. The underflow or coarse fraction is deposited on the dam and the overflow or fine fraction is deposited in the reservoir.

The dams are typically constructed using the downstream method. That is, as the tailings are added to the dam, they are deposited on the crest and downstream face. As a result, the centerline of the dam crest migrates downstream.

Frequently the dam has a drainage system built into the foundation to aid in lowering the phreatic surface (water table) within the embankment. Water enters the dam both at the crest from the cyclone-deposited tailings and from the upstream face where the dam is in contact with the reservoir. A clay blanket may be constructed on the upstream face to reduce this infiltration from the reservoir.

A decant or water disposal system is typically constructed beneath the dam. This decant system consists of a vertical tower or sloping structure within the reservoir which decants or draws water from near the surface of the reservoir where the water contains the least sediment. This water is then carried in pipes beneath the dam and exits beyond the toe of the dam. From there it may be recycled or released to the natural stream drainage. The intake level of the decant tower or structure is regulated as the tailings and reservoir level rise to maintain a balanced system of inflow and outflow. The decant system also serves as additional discharge in the event of heavy precipitation.

Two characteristics are noteworthy regarding the silt and sand tailings used in the construction of these dams. First, the very uniform grain size and lack of clay or other binder makes this material extremely susceptible to erosion by flowing water. It is unlikely this material could survive any significant overtopping without dam failure. Second, the finely-ground limestone and dolomite tailings are almost barren of nutrients necessary to support vegetation. It is frequently necessary to import topsoil or fertilizer in order to successfully vegetate the dam embankment. This difficulty in vegetating the surface of the dam contributes to the potential for surface erosion of the dam.

The fine tailings fraction, consisting of primarily silt size material, settles out in the reservoir. After consolidation, the material behaves somewhat like natural loess deposits. It is easily eroded by flowing water, but has some apparent cohesion and will stand in near vertical slopes of considerable height.

Old Viburnum Tailings Dam was constructed over a rock-fill starter dam. The main embankment was constructed of cyclone-deposited tailings, apparently maintaining a constant dam crest centerline over the starter dam. The decant system which passed water from the reservoir to the downstream toe was sealed with grout when operations on this dam ended in 1972. The embankment was covered with a thin mantle of soil, and grass was planted to control erosion. However, the vegetation has not become well established and substantial erosion gullies have developed. The most prominent gullies are along the abutments where overland runoff flows onto the tailings embankment.

The spillway is about 900 ft southwest of the dam axis and consists of a cut through the ridge which forms the southeast side of the reservoir and right abutment of the dam. The excavation for the spillway extends into weathered bedrock and little or no erosion in the spillway is anticipated during flood flows.

b. **Location.** Old Viburnum Dam is located on the West Prong of Indian Creek, about 2.5 mi northeast of Viburnum, Iron County, Missouri (Fig. 1). The dam is in Section 19, T35N, R1W, on the USGS Viburnum East, Missouri 7.5-minute quadrangle map (1967).

c. **Size classification.** The dam is classified large based on its height of 115 ft. The storage capacity is approximately 10,200 ac-ft of which about 4600 is water storage. The guideline criteria for the large dam classification are: height over 100 ft, or storage capacity over 50,000 ac-ft, whichever gives the larger size category.

d. **Hazard classification.** The St Louis District (SLD), Corps of Engineers, has classified this dam as having a high hazard potential; we concur with this classification. The SLD estimated damage zone length extends approximately 14 mi downstream. Within this estimated damage zone are numerous occupied dwellings, two churches, Missouri State Highway C, and an electric transmission line. The contents of a portion of the downstream damage zone were verified by aerial reconnaissance.

e. **Ownership.** We understand the dam is owned by St Joe Lead Co, PO Box 500, Viburnum, Missouri, 65566. Correspondence should be sent to the attention of Mr Jack Krokroskia.

f. **Purpose of dam.** The dam was constructed to impound tailings produced in the milling and processing of lead ore mined in the vicinity. The dam has been inactive since 1972.

g. <u>Design and construction history</u>. Information on the design and construction history of this dam was obtained from interviews with Mr John Kennedy and Mr Jack Krokroskia, of St Joe Lead Co, and from maps and plans of the dam and reservoir supplied by St Joe Lead Co.

The dam was designed and built by St Joe Lead Co. Construction on the dam began in 1960.

A rock-fill starter dam was first constructed, keyed with a 10 ft deep and 50 ft wide trench. The crest of the rockfill was at an elevation of approximately 1010 ft.

No drainage system was installed beneath the tailings portion of the dam. The rock-fill starter dam has no outlet drains (see Section A-A, Fig. 3-B).

The tailings portion of the dam was constructed of the coarse tailings fraction deposited from a cyclone separator located at the crest of the dam. The dam crest was raised maintaining a constant centerline over the starter dam, according to the plans supplied by St Joe Lead Co. The final dam crest elevation was given as 1065 ft. Fine tailings were deposited on the upstream face of the dam and filled most of the reservoir.

A decant system carried overflow from the reservoir beneath the dam and discharged beyond the toe of the left abutment. The decant tower extended to elevation 1043 ft and consisted of a 36-in. diameter vertical pipe. The decant pipeline was 24-in. diameter corrugated metal. Following completion of operations at the dam, the decant system pipeline was sealed with grout.

Operations were terminated on this dam in 1972.

Following completion of dam construction, an attempt was made to vegetate the embankment. A thin mantle of soil was spread over the embankment and grass was planted. The grass developed only a partial cover and areas not vegetated have experienced substantial erosion.

h. **Normal operating procedures.** No facilities requiring operation were identified at this site, and no operating procedures were noted. The reservoir level is essentially controlled by flow through the ungated spillway. Two 14-in. diameter siphon pipes located within the spillway cut were used to lower the reservoir elevation during work to seal the decant line, but have not been operated since that time.

1.3 Pertinent Data

a. **Drainage area.** 4.25 mi^2 (including drainage basins for upstream dams)

b. **Discharge at damsite.**

Maximum known flood at damsite	Unknown
Warm water outlet at pool elevation	N/A (Not Applicable)
Diversion tunnel low pool outlet at pool elevation	N/A
Diversion tunnel outlet at pool elevation	N/A
Gated spillway capacity at pool elevation	N/A
Gated spillway capacity at maximum pool elevation	N/A
Ungated spillway capacity at maximum pool elevation	15,000 ft^3/sec
Total spillway capacity at maximum pool elevation	15,000 ft^3/sec

c. **Elevation (ft above MSL).**

Top of dam	1065
Maximum pool-design surcharge	N/A
Full flood control pool	N/A
Recreation pool	N/A
Spillway crest (gated)	N/A
Upstream portal invert diversion tunnel	N/A
Downstream portal invert diversion tunnel	N/A
Streambed at centerline of dam	953 (taken from plans)
Maximum tailwater	Unknown
Toe of dam at maximum section	950 (estimated from plan of dam)

d. **Reservoir.**

Length of maximum pool	8000 ft (includes impoundment for former Intermediate Viburnum Dam, MO 31013)
Length of recreation pool	N/A
Length of flood control pool	N/A

e. **Storage (acre-feet).**

Recreation pool	N/A
Flood control pool	N/A
Design surcharge	N/A
Top of dam	10,700 Total (4600 water, 6100 tailings)

f. **Reservoir Surface (acres).**

Top of dam	286
Maximum pool	286
Flood control pool	N/A
Recreation pool	N/A
Spillway crest	150 (water surface)

g. **Dam.**

Type	Cyclone-deposited lead tailings
Length	1145 ft
Height	115 ft
Top width	20-25 ft (typical)
Side slopes	Downstream 3(H): 1(V) on plans; field measurements varied from about 5(H) to 1(V) at toe to 2.5(H) to 1(V) near the crest. Upstream field measured, varies from 2(H) to 1(V) near base to 3(H) to 1(V) near crest.

Zoning	Reported to have rock-fill starter dam covered with tailings.
Impervious core	None reported
Cutoff	Reported to be 10 ft deep, 50 ft wide trench (backfilled with rock fill).
Grout curtain	None

h. <u>Diversion and regulating tunnel.</u>

Type	None
Length	N/A
Closure	N/A
Access	N/A
Regulating Facilities	N/A

i. <u>Spillway.</u>

Type	Irregular (nearly trapezoidal) cut through crest of ridge southeast of dam; excavated into bedrock.
Length of weir	38 ft at bottom, 100 ft at top
Crest elevation	1045 ft
Gates	None
Downstream channel	Steep slope 4(H) to 1(V), water falls, unlined.

j. <u>Regulating outlets.</u> None

SECTION 2
ENGINEERING DATA

2.1 Design

One sheet showing a design cross section and plan of the dam and spillway was supplied by St Joe Lead Co. A map of the topography of the valley before the dams were constructed was also supplied. Mr John Kennedy and Mr Jack Krokroskia supplied additional information through interviews with the inspection team. The dam was designed by the St Joseph Lead Co, Engineering Department, Bonne Terre, Missouri.

2.2 Construction

The dam was constructed by St Joe Lead Co. Construction of the dam began in 1960. A keyway, 10 ft deep and 50 ft wide, was excavated along the proposed centerline. A rock-fill starter dam was then constructed to an elevation of about 1010 ft, according to the design plans.

The tailings portion of the dam was constructed of the coarse tailings fraction deposited from a cyclone separator located at the crest of the dam. The tailings from the cyclone were spread on both the upstream and downstream slopes in order to maintain a constant centerline over the starter dam. The fine tailings fraction was pumped into the reservoir. The tailings dam was raised to a final crest elevation of 1065 ft. Construction of the dam was finished in 1972.

2.3 Operation

Operations at this dam terminated in 1972 and no operating facilities remain. Water level is controlled by the ungated spillway southeast of the dam. Located within the spillway cut are two 14-in. diameter siphon lines, which also can be used to regulate the reservoir water elevations. The decant system was grouted and no longer operates. No records of the flow through the spillway or of reservoir levels were available.

2.4 Evaluation

a. **Availability.** The available information on engineering and construction is limited to one drawing described above and interviews with St Joe Lead Co employees.

b. **Adequacy.** Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" are not on record. This is a deficiency which should be rectified. These analyses should be performed by an engineer experienced in the design and construction of tailings dams. The analyses should be performed for appropriate loading conditions, including earthquake loads, and made a matter of record.

c. **Validity.** Some minor variations were noted between the design drawings and the as-built dam. The slopes of the dam are not as regular as indicated on the design drawings, varying from 2.5 - 5.0(H) to 1(V) on the downstream slope where the design drawing indicates a uniform 3.0(H) to 1(V) slope. Other features of the drawings, such as the configuration of the starter dam and cut-off trench could not be verified. However, there appeared no reason to question the information obtained from St Joe Lead Co. The information generally agreed with the observations made in the field, but was incomplete according to the guidelines.

2.5 Project Geology

The dam is located on the northern flank of the Ozark structural dome. The bedrock in the area is mapped on the Geologic Map of Missouri (1979) as the Potosi and Eminence Dolomite formations (Fig. 4). The Potosi Dolomite is a light gray medium-to fine-grained siliceous dolomite and typically contains an abundance of quartz druse characteristic of chert-bearing formations. The Eminence Dolomite, which conformably overlies the Potosi Dolomite, is similar in appearance, but contains less chert and quartz. Some large springs and caves have been noted in the Eminence Dolomite; however, no evidence of springs or solution activity was found during the visual inspection of the dam site.

The soil exposed at the dam site is a dark red-brown, plastic residual clay (CL-CH) characteristically developed on the Potosi or Eminence Dolomites. The soil also contains abundant quartz druse gravel typical of soils on the Potosi Dolomite. The soils in this area are mapped on the Missouri General Soils Map (1979) as the Captina-Clarksville-Doniphan Soil Association.

The Palmer Fault System is mapped on the Geologic Map of Missouri (1979) approximately 8 mi north of the dam site. The system is a complex, branching system of faults trending east-west for approximately 40 mi through Crawford and Washington counties. Mapped as north side down, the system appears to offset Precambrian and Paleozoic bedrock and is likelv Paleozoic in age. The area is not considered seismically active and the fault system does not appear to pose a significant hazard as a potential source of strong earthquakes.

The dam is located approximately 115 mi northwest of the line of epicenters for the very large New Madrid earthquakes that occurred in 1811 and 1812. A recurrence of an earthquake of the magnitude of the New Madrid events could cause damage to the dam, but an assessment of this risk is beyond the scope of this Phase I investigation.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. **General.** Old Viburnum Tailings Dam was inspected on 21 October 1980. Mr John Kennedy and Mr John Boyer of St Joe Lead Co accompanied the inspection team. The inspection indicated the dam is in fair to poor condition.

b. **Dam.** Old Viburnum Tailings Dam is a large dam, more than 100 ft high, and is the farthest downstream of a series of six tailings dams (see Section 5.1.d) for the St Joe Lead Co Viburnum operations (see Overview Photo). However, some of these dams are old and their reservoirs are filled with tailings. Consequently, the embankments are no longer acting as dams. Immediately upstream from Old Viburnum Tailings Dam is the former Intermediate Viburnum Tailings Dam (Photo 3). The tailings impounded by Old Viburnum have essentially buried the intermediate dam. A channel has been cut through the embankment of the intermediate dam to allow water upstream and downstream to be at the same level, forming what can be considered a breached dam. At the maximum water surface elevation for Old Viburnum Tailings Dam, the embankment of the intermediate dam would be submerged. For this study, the impoundments for both Old and Intermediate Viburnum Tailings Dams are considered as one reservoir for Old Viburnum Tailings Dam.

The Old Viburnum Tailings Dam was constructed of fine sand lead tailings (Photo 4), deposited from cyclones along the crest of the dam. The material was reported to be 100 percent finer than #60-mesh sieve and appears to be entirely free of any silt or clay binder. It is judged to be very susceptible to erosion in the event of overtopping. No evidence or record of prior overtopping was noted during the visual inspection. The dam also is susceptible to erosion by surface runoff. The embankment has been vegetated with grasses to control erosion, but has developed only an incomplete cover (Photo 5), and gullies, some as deep as 10 ft, have formed in the dam (Photo 6). The deepest gullies appear along the junction with the abutment (Photo 7), where runoff from the hillsides flows onto the more easily erodible tailings. Some of the gullies at the toe of the dam had been repaired by filling prior to the inspection visit (Overview Photo).

The heads of some of the gullies appeared to extend as cavities into the dam (Photo 8), and may have been partially caused by piping through the embankment. However, no clear indication of current or prior piping could be found during the inspection. The reservoir level was low at the time of the inspection, and these features should be inspected when the reservoir level is higher. A potential for piping could be very hazardous to the safety of this dam.

An animal burrow, approximately 8-in. diameter, was noted on the crest of the dam (Photo 9). It could not be determined how deep the burrow extended.

The vertical and horizontal alignment of the dam crest appeared undisrupted. No detrimental settlement or evidence of sinkhole development was noted. Several small slump scarps were noted near the crest of the dam near the northwest and central part of the dam. The scarps ranged from about 1 to 1.5 ft high and indicated slumping in the downstream direction. The scarps were observed to be vegetated, and the toe of the slumps had been eroded and was indistinct, indicating the features were old and probably no longer active. No movement was observed at the toe of the dam, but it should be noted that the toe area was repaired by re-grading shortly prior to our inspection visit.

No riprap or erosion protection, other than grass vegetation, exists on the upstream face of the dam (Photo 10). Some erosion appears to have occurred and steepened the lower portion of the upstream face of the dam. Erosion can be expected to continue in this area when the reservoir level is high.

A series of open-at-the-bottom pipes were on the upper part of the upstream face of the embankment (Fig. A-1 and Photo 11). These were drilled to locate and grout the decant line when operations ended at the dam. These pipes had water estimated at 40 to 50 ft below the surface of the tailings, indicating a deep phreatic surface (water table). No seepage was noted at the downstream toe of the dam. However, a shallow pool of water in the stream channel below the dam could have contained some reservoir seepage, although the evidence was not clear.

c. **Appurtenant structures.**

1. Spillway. The spillway for this dam is a broad, nearly trapezoidal cut through the ridge, about 900 ft southwest of the dam. The ridge runs along the southeast side of the reservoir (Photo 12). The spillway has been excavated into weathered bedrock (Photo 13) and is not judged to be subject to significant erosion during periodic flood flows. Two 14-in. diameter pipes are located within the spillway and extend to the reservoir. These pipes can be used as siphons to lower the lake below the spillway crest elevation. Flow through the spillway at the time of the visual inspection was estimated at 50 ft^3/sec.

2. Decant System. A decant line was constructed running beneath dam. The system consisted of a 36-in. diameter vertical tower to an elevation of 1043 ft, and a 24-in. corrugated metal pipe beneath the reservoir and dam, exiting the dam near the base of the left abutment. Following termination of operations in 1972, a series of holes was drilled to locate the pipe, and it was grouted to seal the decant line.

No other appurtenant structures were identified at this dam.

d. **Reservoir area.** The reservoir for this dam is nearly filled with fine tailings (Photos 10 and 14). The area considered part of this reservoir includes the former embankment and impoundment for Intermediate Viburnum Tailings Dam. That dam has been breached by an excavated channel. Water upstream and downstream is at the same level, and the embankment is nearly buried by tailings impounded by Old Viburnum Tailings Dam. The area surrounding the reservoir includes wooded hills, a golf course, and several other tailings dams upstream. These tailings dams are the only slopes identified in the area which are considered potentially unstable. Sediment supplied from erosion of these dams or runoff from the wooded hills is considered insignificant relative to the tailings deposits in the reservoir.

e. Downstream channel. The downstream channel consists of an unlined swale down a hillside. The hill slopes steeply from the spillway, estimated to be 4(H) to 1(V), and the spillway is considered the control section for discharge capacity. Some erosion may occur to the banks of the channel during flood flows, but the location of the channel in a separate drainage way from the dam precludes any impact of potential erosion affecting the safety of the dam.

3.2 Evaluation

The results of the visual inspection indicate the dam is in fair to poor condition. Deficiencies noted are: deep erosion gullies on the downstream face and adjacent to the abutments, possible piping cavities at the heads of some erosion gullies, slumps on the downstream side of the dam crest, potential for wave erosion on the upstream face, and animal burrows of unknown depth on the crest of the dam. If any potential for piping does exist during the high reservoir water elevations, it could be seriously detrimental to the safey of this dam.

No evidence was found of disruption of the vertical or horizontal alignment of the dam crest, sinkhole development, or detrimental settlement.

The spillway is excavated into weathered bedrock and is not expected to be subject to significant erosion during periodic flows. The decant system beneath the dam has been grouted.

The reservoir is nearly full of tailings. Additional sedimentation from surrounding areas is anticipated to be insignificant relative to the tailings.

The discharge channel from the spillway flows into the drainage basin southeast of the dam. Erosion which may occur along the banks of the channel will not pose a safety hazard to the dam.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures

No operating procedures currently exist at this facility as the dam is abandoned.

4.2 Maintenance of the Dam

Maintenance on the dam appeared to be limited to repair of some of the erosion gullies near the downstream toe of the dam prior to the inspection visit.

4.3 Maintenance of Operating Facilities

There are no facilities requiring mechanical operation at this dam. One exception may be the siphon consisting of two 14-in. diameter pipes. The operation of this siphon does not appear important to the maintenance of safe reservoir water levels.

4.4 Description of Any Warning System in Effect

The visual inspection did not identify any warning system in effect at this dam.

4.5 Evaluation

There is no formal plan for periodic inspections nor for maintenance. This is considered a deficiency.

The feasibility of a practical warning system should be evaluated to alert downstream residents and traffic should potentially hazardous conditions develop during periods of heavy precipitation.

SECTION 5
HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. **Design data.** No hydrologic or hydraulic design data were available for evaluation of this dam or reservoir; however, dimensions of the dam and spillway were measured during the field inspection 21 October 1980 or taken from construction plans of the dam supplied by St Joe Lead Co. The data are presented on Figs. 3A, 3B and 3C. Other relevant data were measured from the USGS Viburnum East, Missouri 7.5-minute quadrangle map (1967).

b. **Experience data.** No recorded rainfall, runoff, discharge, or pool stage historical data were found for this reservoir. There was no record or evidence that the embankment has been overtopped.

c. **Visual observations.**

1. Watershed. The watershed consists of natural woodlands, a golf course, and other tailings impoundments. Five tailings dams (see Sec 5.1d.) and the Viburnum plant for St Joe Lead Co are located at various distances upstream of this dam. The area of the reservoir at the top of dam elevation is approximately 10 percent of the total drainage area of 4.25 mi^2.

2. Reservoir. The reservoir, dam, and spillway are best described by the maps and photographs enclosed herewith. The purpose of this reservoir is the containment of tailings from lead mining and milling operations.

3. Spillway. The spillway is an irregular, nearly trapezoidal cut through the ridge which forms the southeast side of the reservoir and right abutment. The spillway is excavated into weathered bedrock, is ungated, and is judged to act as the controlling section for flow out of the reservoir. It is not anticipated that significant erosion will occur in the spillway during periodic flood flows.

4. Appurtenant structures. The decant system for this dam has been grouted and is no longer operational. The two 14-in. diameter pipes located within the spillway can be used as siphons to lower the lake level. They were not operating at the time of the inspection, nor were they included in the overtopping analysis.

5. Seepage. Potential seepage through this dam was considered insignificant in the hydrologic analysis of overtopping potential.

d. **Overtopping potential.** One of the primary considerations in the evaluation of this dam is the assessment of the potential for overtopping and possible consequent failure by erosion of the embankment. The embankment materials are judged to be highly susceptible to erosion by flowing water. If overtopped, the embankment would be subject to failure.

The dam crest elevation of 1065 ft, given by St Joe Lead Co personnel in interviews and shown on the plan of dam is considered the top of dam for the overtopping analysis. The spillway is excavated in weathered bedrock, and will not likely experience significant erosion. The distance between the spillway and dam embankment precludes any hazard of possible erosion in the spillway impacting the safety of the dam.

In accordance with the Phase I guidelines a multiple dam analysis was performed for the Old Viburnum Tailings Dam to assess the influence on overtopping potential of the hypothetical breach of the upstream dams. Five dams were identified upstream of the Old Viburnum Tailings Dam. These are:

MO 31013 Intermediate Viburnum Tailings Dam
MO 31014 County Road Dam
MO 31015 No. 29 Mine Ore Haul Road Dam
MO 31016 Viburnum Tailings Dam
MO 31779 Railroad Embankment Dam

Intermediate Viburnum Tailings Dam (MO 31013) is nearly buried by tailings impounded behind Old Viburnum Tailings Dam. The dam (MO 31013) has been breached by a canal and the reservoirs upstream and downstream intercommunicate (Photo 3). This dam (MO 31013) is not judged to pose any constraint to flow, will not impound a reservoir of its own, and was not considered a significant upstream dam in the multiple dam analysis.

The County Road Dam (MO 31014) is similarly buried by tailing impounded against its downstream slope. At the time of the field visit, the dam was observed to be just a road bed perhaps 2 to 3 ft high crossing a tailings impoundment (Photo 15). The tailings upstream and downstream of the road are essentially at the same level. This road is judged to pose only a very minor constraint to flow, will not impound a significant reservoir, and was not considered a significant dam in the multiple dam analysis.

The other three dams (MO 31015, MO 31016, and MO 31779) (Photo 16) are all considered capable of impounding reservoirs which could potentially impact the overtopping analysis of Old Viburnum Tailings Dam in the event of a breach. Pertinent dimensions of these dams have been surveyed and hydraulic/hydrologic analyses in support of the hypothetical breach of each dam have been performed.

A final consideration in this multiple dam analysis is an estimate of the volume of lead tailings that could be released by failure of each of the significant upstream dams. The tailings consist of fine sand and silt. The tailings consolidate fairly rapidly and once consolidated can stand on vertical slopes of considerable height. Consolidated tailings are subject to erosion, but not flow. Inspection of a breached lead tailings dam (St Joe Lead Desloges Dam) indicated a fairly small portion of the impounded tailings was lost during the breach. Estimates from this observed failure suggest less than 2 percent of the impounded tailings were lost. We have assigned a conservative estimate, 10 percent of the impounded tailings, as material lost through a breach. The material impounded by Intermediate Viburnum (31013) and County Road (31014) dams was not considered lost material in that these dams are not considered subject to breach and release of tailings, and the tailings surfaces are covered with a dense growth of cattail vegetation which will inhibit erosion by flowing water.

Hydrologic analyses of this dam, including the multiple dam analyses, for the 1 and 10 percent probability-of-occurrence events and the Probable Maximum Flood (PMF) were based on initial water surface elevations equal to the spillway crest elevation. The analyses indicate the spillway and reservoir will pass 100 percent of the PMF without overtopping the embankment. The PMF is defined as the flood event that may be expected to occur from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The "Recommended Guidelines for Safety Inspection of Dams" requires large dams to pass 100 percent of the PMF as the spillway design flood.

The following table presents the results of the hydraulic/hydrologic analysis for the various precipitation events, assuming no erosion of the dam or spillway.

Precipitation Event	Maximum Reservoir WS Elev. ft, MSL	Maximum Depth Over Dam, ft	Maximum Outflow, ft^3/sec	Duration of Overtopping, hrs
1% Prob	1048.4	0	790	0
50% PMF	1055.6	0	4830	0
100% PMF	1061.9	0	10,540	0

Input data and output summaries for the hydrologic and hydraulic analyses are presented in Appendix B.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. **Visual observations.** The visual inspection of Old Viburnum Tailings Dam identified several small slumps on the downstream side of the dam crest. The scarps of these slumps were vegetated and the toes of the slumps were sufficiently eroded, that they could not be identified. They do not appear to be recent or active features, yet they should be monitored to detect any possible future changes.

No evidence of disruption of the vertical or horizontal alignment of the dam crest, sinkhole development, or of detrimental settlement was noted. An animal burrow of undetermined depth was noted on the crest of the dam. Such burrows could provide piping paths through the embankment, which would be particularly hazardous due to the erodible materials used in the construction of this dam.

Erosion gullies as deep as 10 ft were noted on the downstream face of the dam. Headward erosion of these gullies could, in time, affect the overtopping potential of the dam.

Cavities suggesting possible piping voids were noted at the heads of some gullies. While no clear evidence of piping was observed, these areas should be carefully inspected to evaluate potential for piping when the reservoir is at a higher level than it was during the visual inspection. Piping represents a serious safety hazard for the fine sand tailing materials in this dam.

b. **Design and construction data.** Information on the design and construction of Old Viburnum Tailings Dam was obtained from one drawing supplied by St Joe Lead Co and through interviews with Mr John Kennedy and Mr Jack Krokroskia. Construction procedures are described in Sections 1.2 and 2.2.

Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not on record. This is considered a deficiency which should be rectified.

c. **Operating records.** The dam is inactive at present and has been inactive since 1972. No records were available of water levels, available storage, or flow through the spillway.

d. **Post construction changes.** Following completion of construction of the tailings embankment, the decant system was sealed by grouting. Two 14-in. diameter lines were run from the reservoir through the spillway to lower the level of the reservoir by siphon. After the reservoir level was lowered, the decant line was located by drilling a series of holes in the approximate location. The decant line was located, grouted, and no longer operates. The siphon lines are still in place but have not been used.

e. **Seismic stability.** The dam is in Seismic Zone 2, to which the guidelines assign a moderate damage potential. Since no static stability analysis is available for review, the seismic stability cannot be evaluated.

The saturated and loose, uniform sand and silt size tailings are likely quite susceptible to liquefaction in the event of a strong vibration. No accurate information is available on the phreatic surface or density within the tailings, but substantial deformation and possibly failure of the embankment could occur during a severe seismic event.

SECTION 7
ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment

a. **Safety.** Based on the visual inspection, Old Viburnum Tailings Dam is judged to be in fair to poor condition. The deficiencies identified include: the slumping deformations near the dam crest, the deep gullies being eroded in the downstream face, possible evidence of piping in the embankment, and animal burrows on the dam crest.

Hydraulic and hydrologic analyses indicate the dam will not be overtopped by the Probable Maximum Flood (PMF). This analysis included the hypothetical breach of the significant dams upstream of Old Viburnum Tailings dam, as discussed in Section 5.1d.

Seepage and stability analysis comparable to the "Recommended Guidelines for Safety Inspections of Dams" are not on record, which is considered a deficiency.

b. **Adequacy of information.** The visual inspection and data supplied by St Joe Lead Co provided the base of information for the conclusions and recommendatons presented in this Phase I report.

The lack of static and seismic stability analyses and a seepage analysis, as recommended in the guidelines, precludes an evaluation of the stability of the dam.

c. **Urgency.** The deficiencies described in this report could affect the risk of dam failure. Remedial measures that should be initiated without undue delay are addressed in Section 7.2b.

d. **Necessity for Phase II.** In accordance with the "Recommended Guidelines for Safety Inspection of Dams," the subject investigation is a minimum study.

This study revealed that additional in-depth investigations are needed to complete the assessment of the safety of the dam. Those investigations which should be performed immediately are described in Section 7.2b. It is our understanding from discussions with the St Louis District that any additional investigations are the responsibility of the owner.

7.2 Remedial Measures

a. **Alternatives.** There are several general options which may be considered to reduce the possibility of dam failure or to diminish the harmful consequences of such a failure. Some of these general options are:

1. Remove the dam, or breach it to prevent storage of water;

2. Purchase downstream land that would be adversely impacted by dam failure and restrict human occupancy;

3. Provide a highly reliable flood warning system (generally does not prevent damage but diminishes the chances for loss of life).

b. **Recommendations.** Based on the results of the visual inspection and review of available data, it is recommended that the following remedial measures and studies be conducted without undue delay.

1. Repair erosion gullies on the downstream face of the dam. This repair should be followed by a program of erosion control consisting of vegetation, matting, top dressing with gravel, admixture treatment, or other means of mitigating the erosion of the tailings embankment. This should include control of the possible piping cavities at the heads of some of the erosion gullies.

2. Repair animal burrows on the tailings embankment and implement animal control measures to mitigate future burrowing on the embankment.

The following measures should be performed as soon as practical.

3. Prepare seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams." These analyses should be made for appropriate loading conditions, including seismic loads, and made a matter of record.

4. Evaluate the feasibility of a practical and reliable warning system to alert downstream residents and traffic in the event hazardous conditions develop at this dam.

All remedial measures should be performed by or under the guidance of an engineer experienced in the design and construction of tailings dams.

c. O & M procedures. It is recommended that a program of periodic inspections be implemented as soon as practical. The purpose of this program should be to monitor the performance of the dam and to identify maintenance requirements. Records of the inspections and recommended maintenance should be kept on file. This program should include, but not be limited to the following items.

1. Inspect the embankment for signs of slope instability such as slumping or cracking.

2. Inspect areas of potential piping cavities. It should be kept in mind that piping poses a high hazard to safety due to the easily eroded tailing materials used in the construction of this dam.

3. Inspect the junction of the embankment and abutments and along the toe of the dam for seepage. The inspections should note changes in the amount of seepage or turbidity (soil or tailings) in the seepage water.

4. Inspect the embankment for evidence of significant erosion following heavy precipitation.

These inspections and maintenance recommendations should be conducted by or under the guidance of an engineer experienced in the design and construction of tailings dams.

REFERENCES

Allgood, F. P., and Persinger, I. .D, 1979, Missouri General Soil Map and Soil Association Descriptions: US Department of Agriculture, Soil Conservation Service and Missouri Agricultural Experiment Station.

Department of the Army, Office of the Chief of Engineers, 1977, EC 1110-2-188, National Program of Inspection of Non-Federal Dams.

Department of the Army, Office of the Chief of Engineers, 1979, ER 1110-2-106, National Program of Inspection of Non-Federal Dams.

Hydrologic Engineering Center, US Army Corps of Engineers, 1978, Flood Hydrograph Package (HEC-1) Users Manual for Dam Safety Investigations.

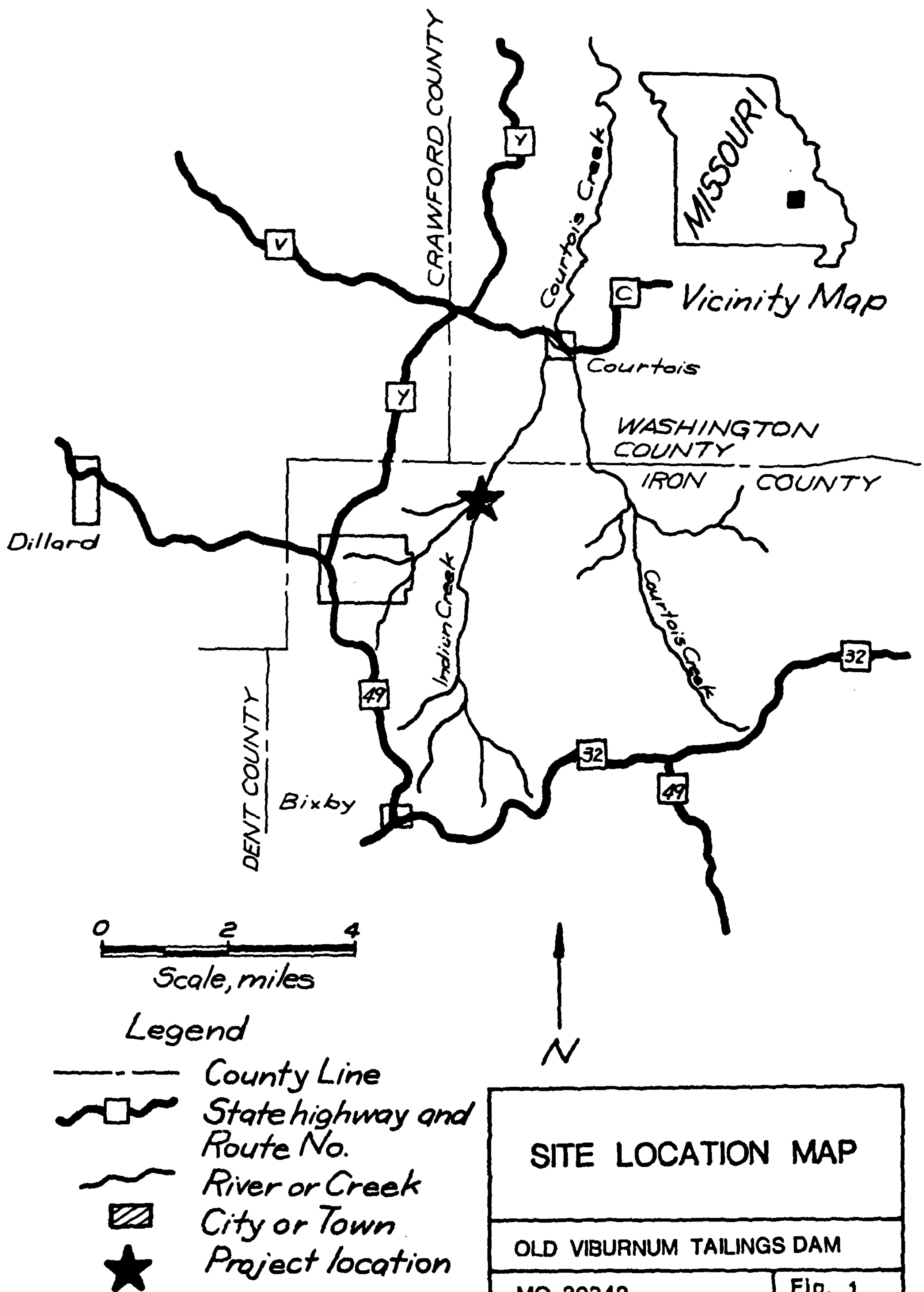
McCracken, M. H., 1971, Structural Features Map of Missouri: Missouri Geological Survey, scale 1:500,000.

Missouri Geological Survey, 1979, Geologic Map of Missouri: Missouri Geological Survey, scale 1:500,000.

St Louis District, US Army Corps of Engineers, 1979, Hydrologic/Hydraulic Standards, Phase I Safety Inspection of Non-Federal Dams.

US Department of Agriculture, Soil Conservation Service, 1971, Hydrology: National Engineering Handbook, Section 4.

US Department of Commerce, US Weather Bureau, 1956, Seasonal Variation of the Probable Maximum Precipitation East of the 105th Meridian for Areas from 10 to 1,000 Square Miles and Durations of 6, 12, 24 and 48 Hours: Hydrometeorological Report No. 33.

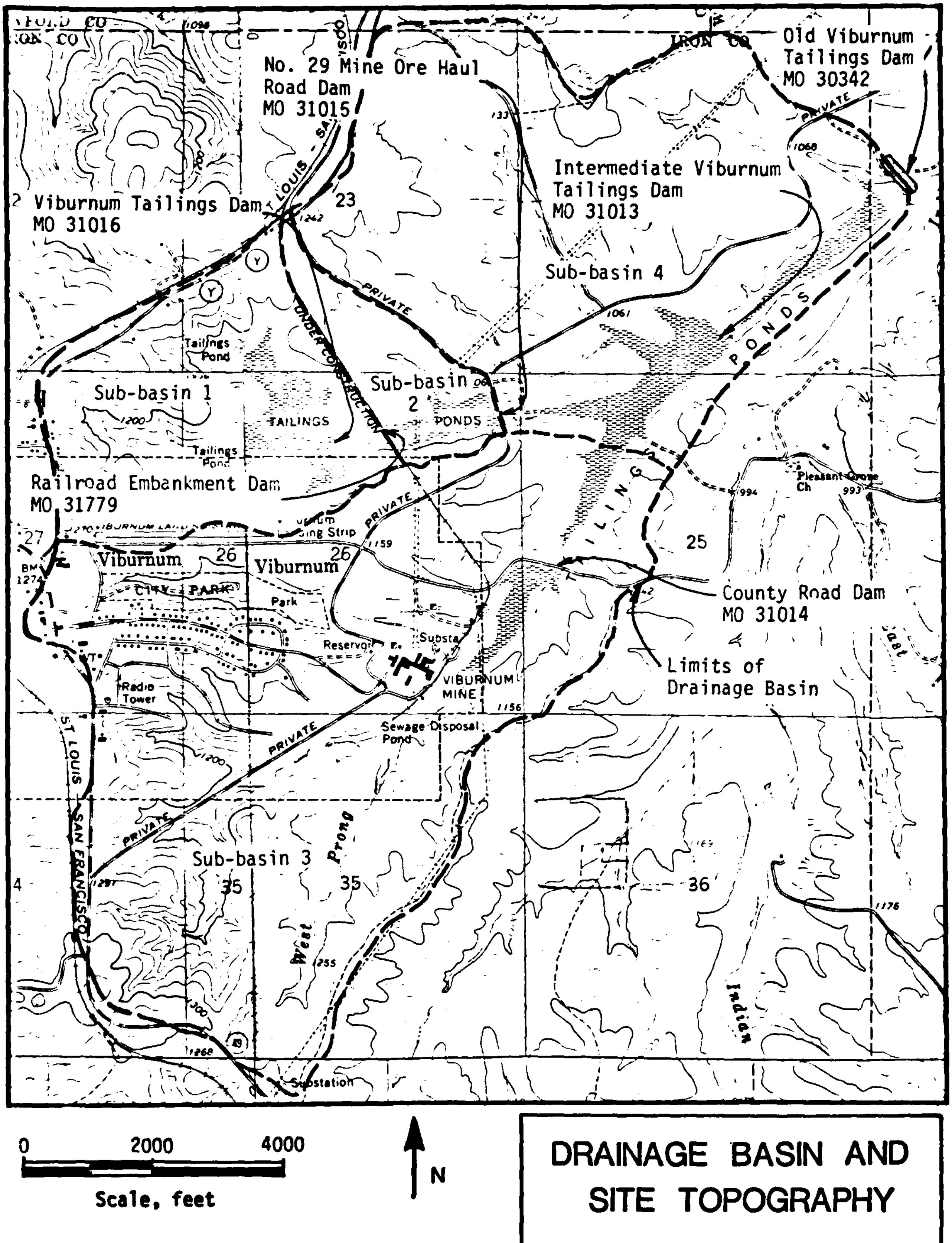


SITE LOCATION MAP

OLD VIBURNUM TAILINGS DAM

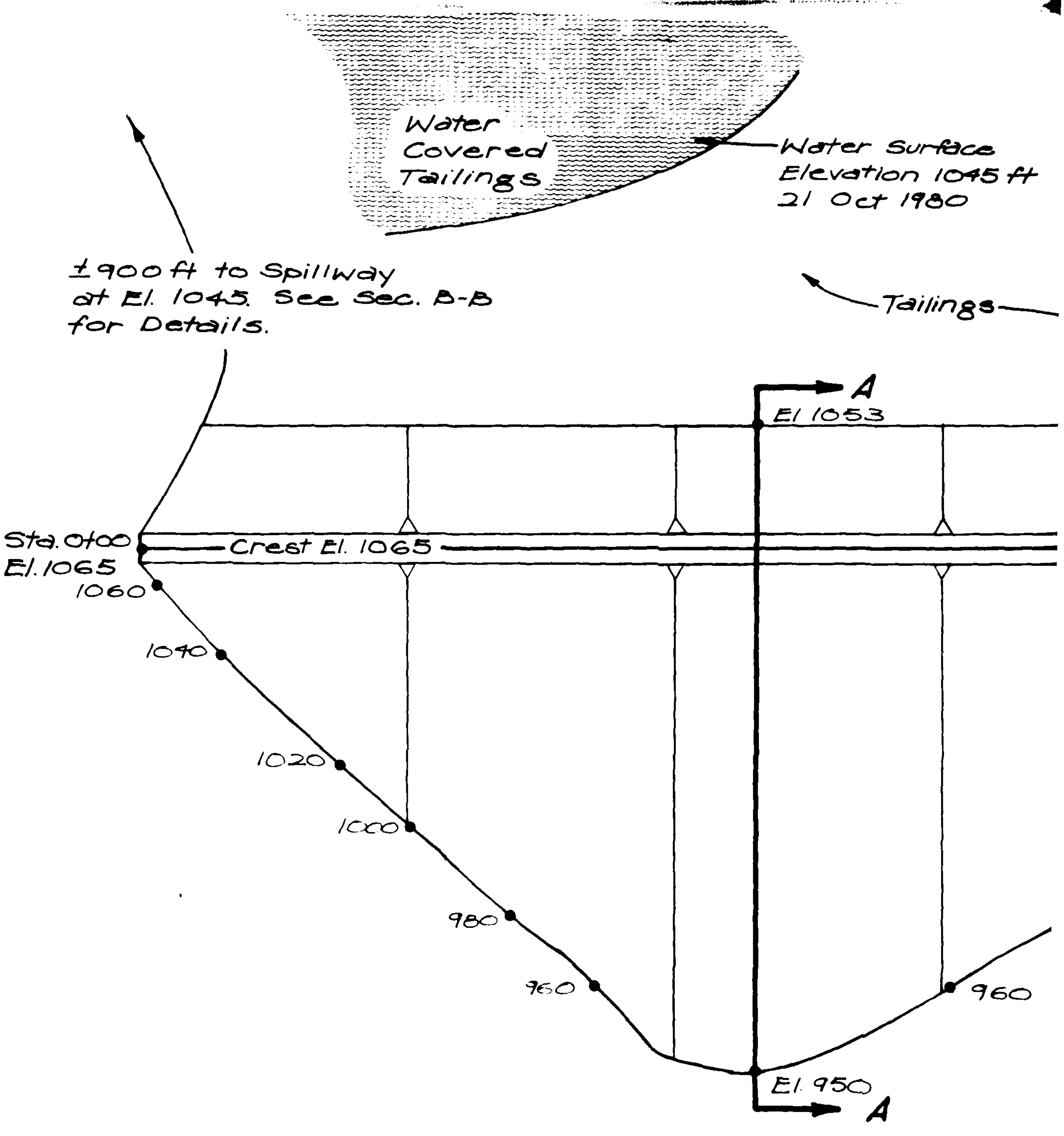
MO 30342

Fig. 1

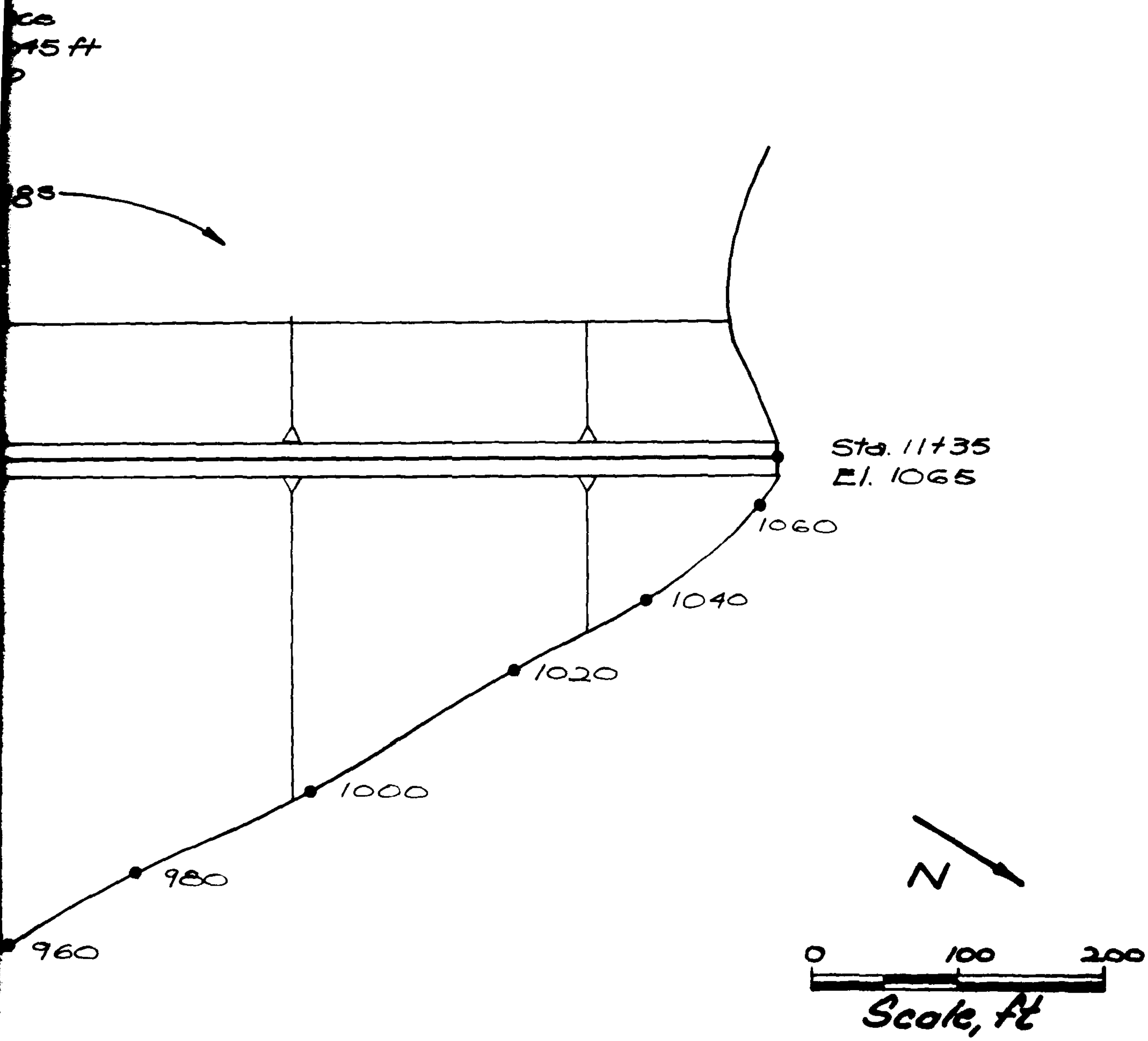


Notes:
1. Topography from USGS Viburnum West and Viburnum East 7.5-minute quadrangle maps (1967).

DRAINAGE BASIN AND SITE TOPOGRAPHY	
OLD VIBURNUM TAILINGS DAM	
MO 30342	Fig. 2



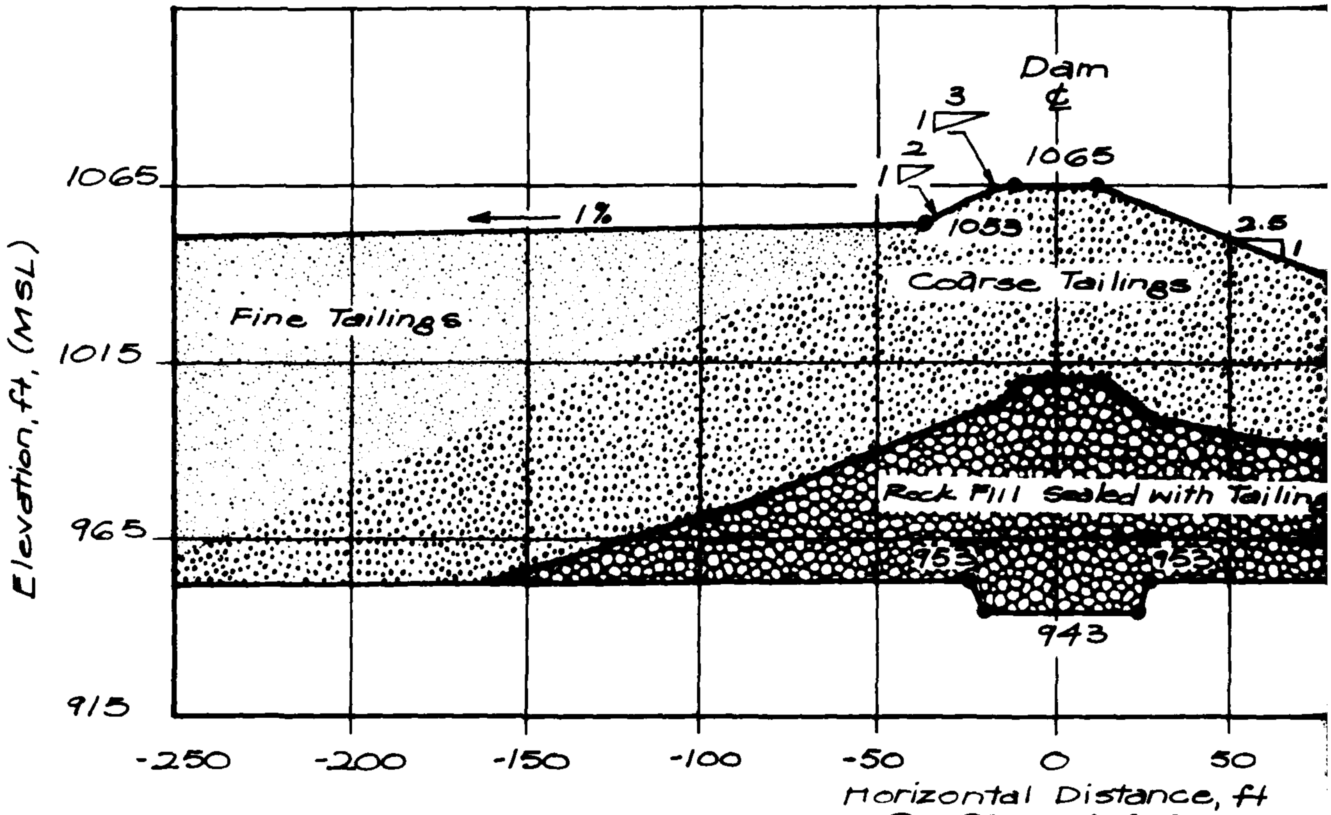
Note:
From St. Joseph Lead Co.
Engineering Department
Drawing No. 68 X 471
3 June 1969



PLAN OF DAM

OLD VIBURNUM TAILINGS DAM

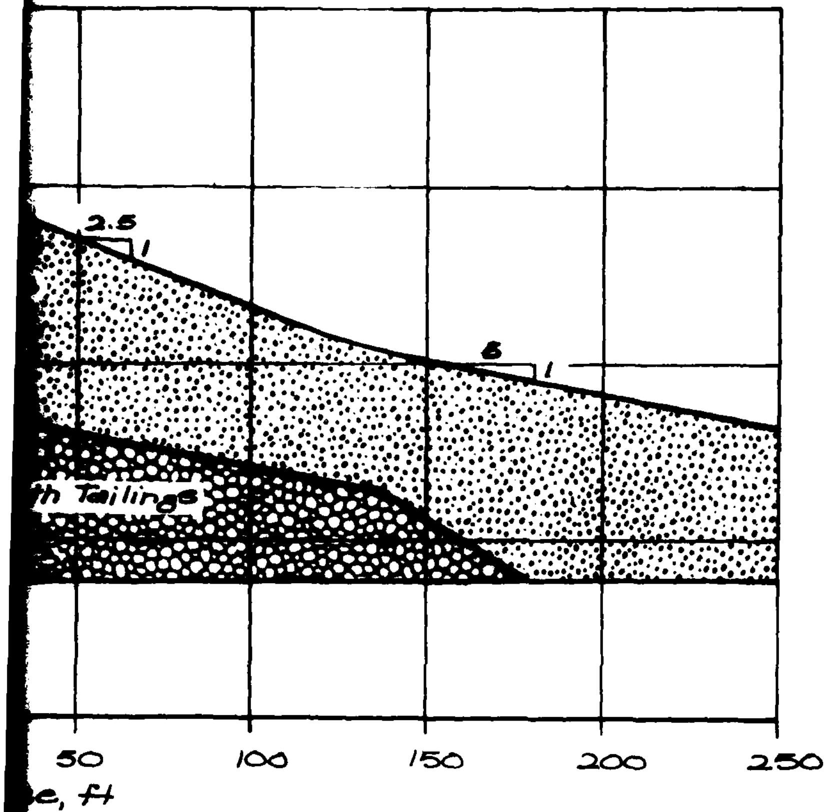
MO 30[illegible]42	Fig. 3 - A



SECTION A-A

Maximum Dam Section

Note:
Modified from St. Joseph Lead Co.
Engineering Department Drawing
No 68X471 3 Jan. 1969



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SECTION OF DAM

OLD VIBURNUM TAILINGS DAM

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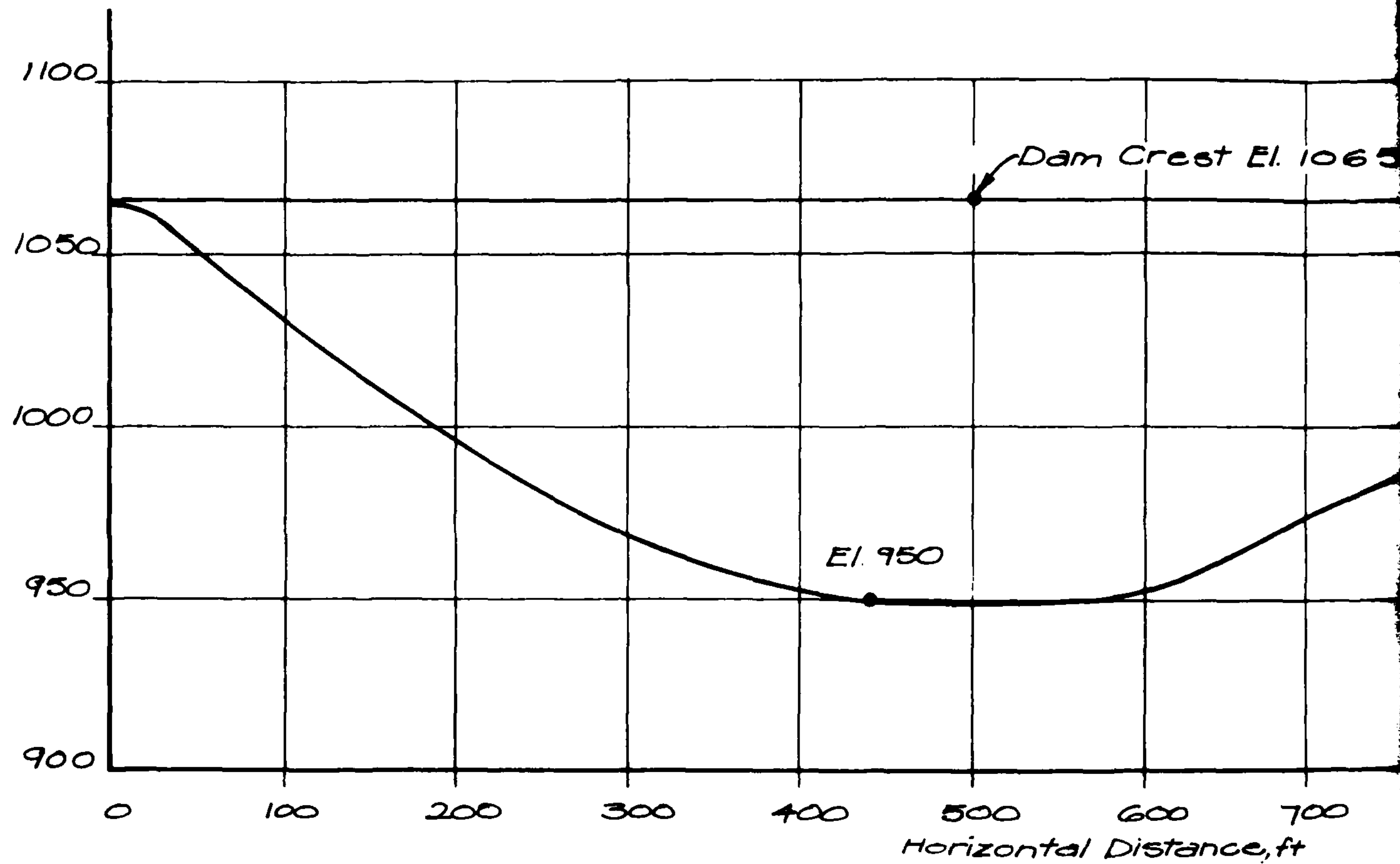
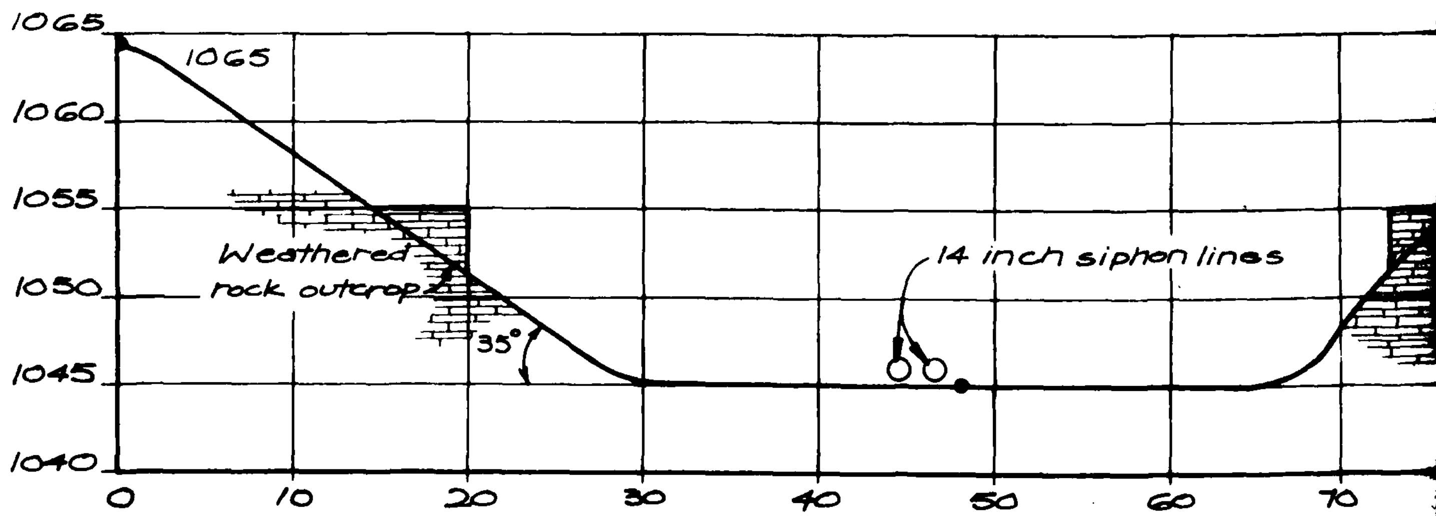


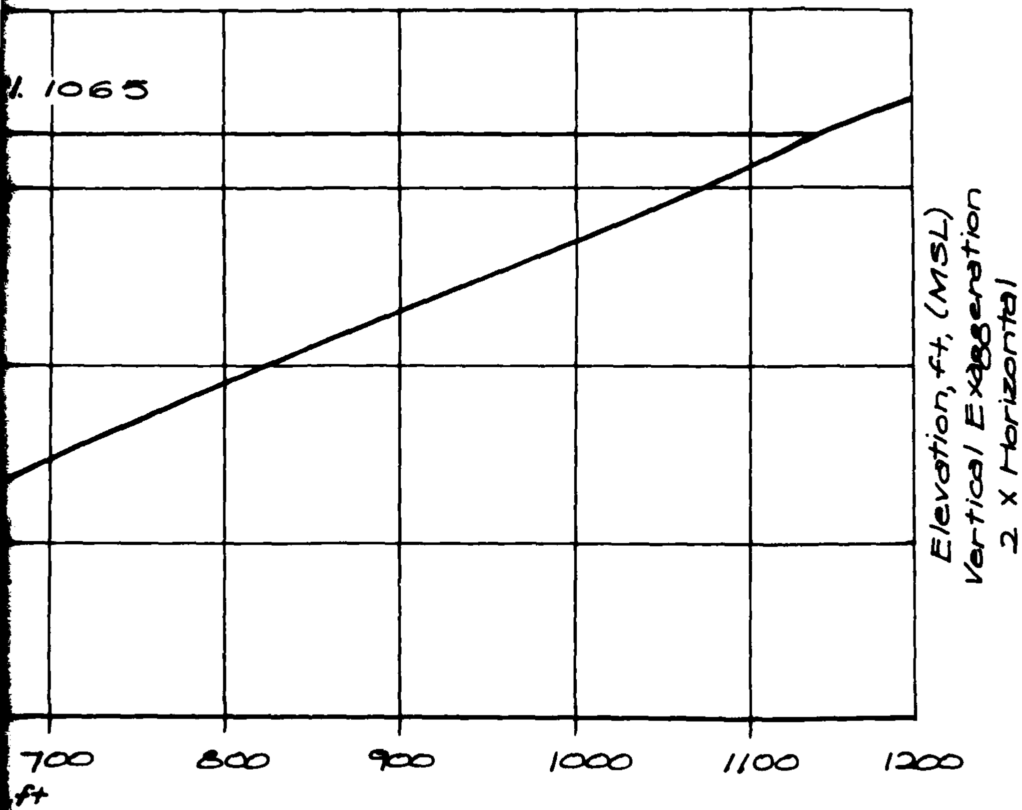
DAM PROFILE

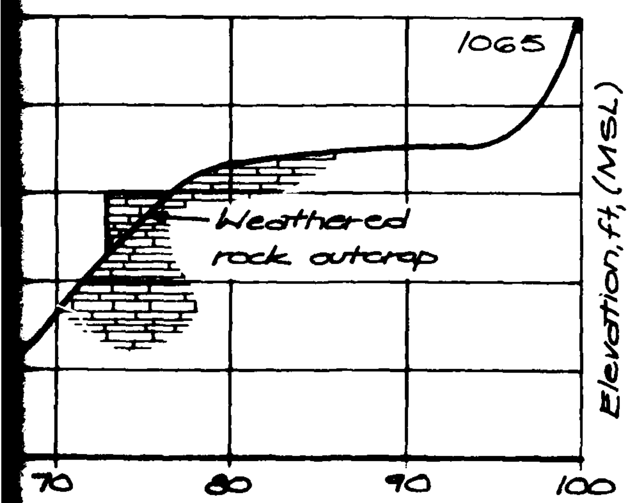


SECTION B-B

Spillway Section

(Looking Upstream in Spillway)





Note: From St. Joseph
Lead Co. Engineering Dept.
Drawing No. 68 X 471
3 Jan. 1969

PROFILE AND SECTION
OF
DAM AND SPILLWAY

OLD VIBURNUM TAILINGS DAM

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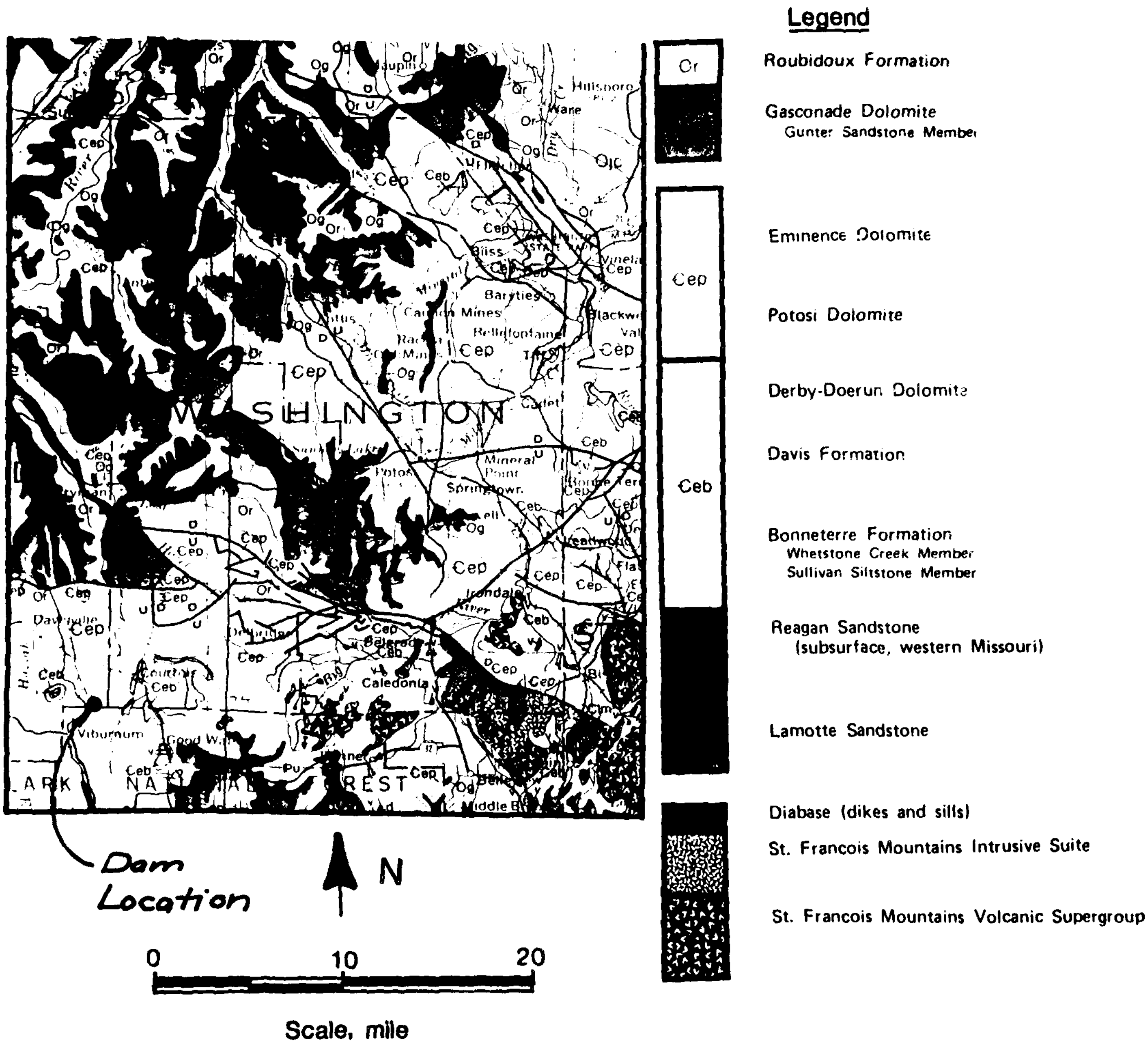


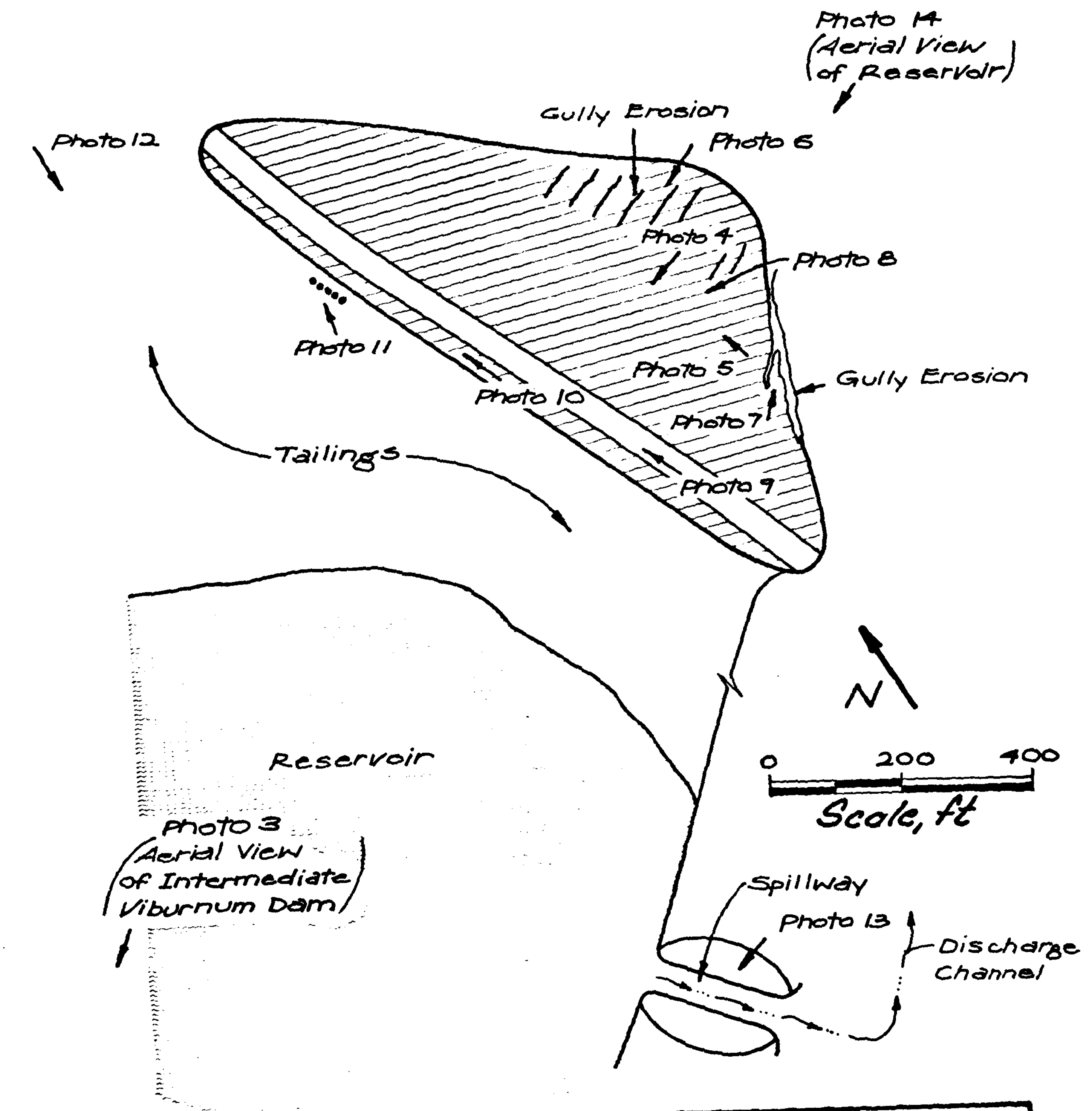
REGIONAL
GEOLOGIC MAP

OLD VIBURNUM TAILINGS DAM

MO 30342 Fig. 4

APPENDIX A

Photographs



Photos 1and2 of downstream hazards
Photos 15and 16 of upstream Dams.

PHOTO LOCATION SKETCH	
OLD VIBURNUM TAILINGS DAM	
MO 30342	Fig. A-1

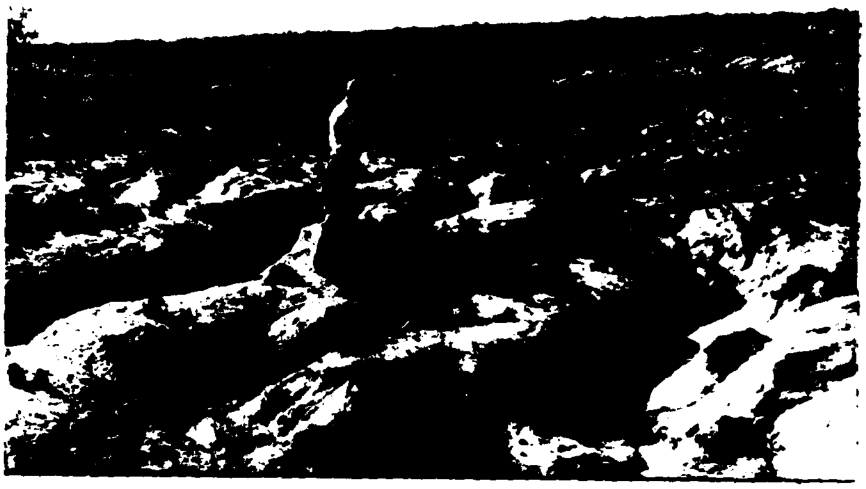
1. Church (foreground) and occupied dwellings in downstream damage zone below Old Viburnum Tailings Dam.

2. Contents of downstream damage zone below Old Viburnum Tailings Dam. This facility includes underground mine workings.

3. Intermediate Viburnum Tailings Dam (MO 31013) upstream from Old Viburnum Tailings Dam.

4. Fine sand tailings used in the construction of the tailings embankment.

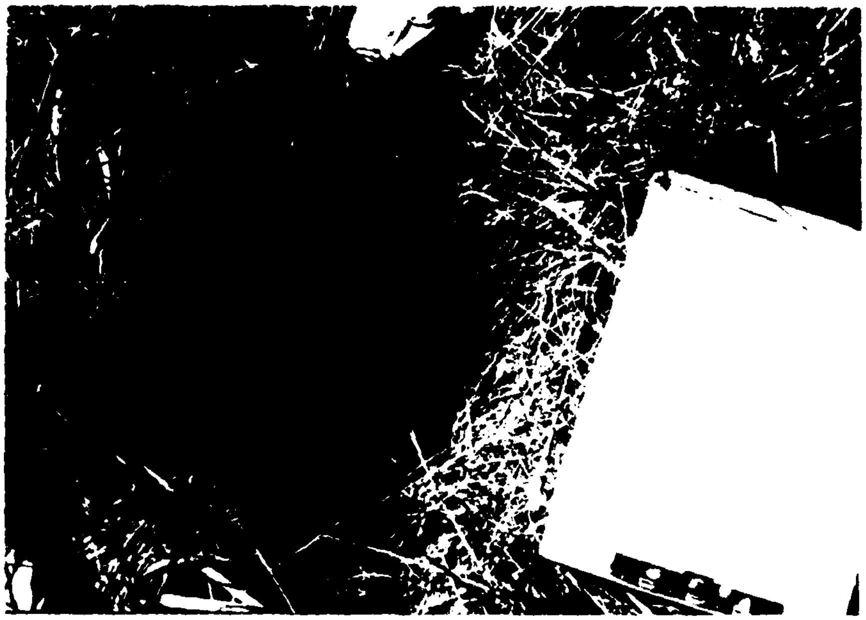
5. Downstream face of the dam showing incomplete grass cover. Looking northwest.



6. Gully erosion on downstream face of dam. Looking southeast from toe of dam.

7. Gully being eroded at junction of embankment and right abutment. Looking northeast(downstream).

8. Possible piping cavity at the head of erosion gully on downstream face of dam.



9. 8-in. diameter animal burrow on the crest of the dam. depth of burrow could not be determined.

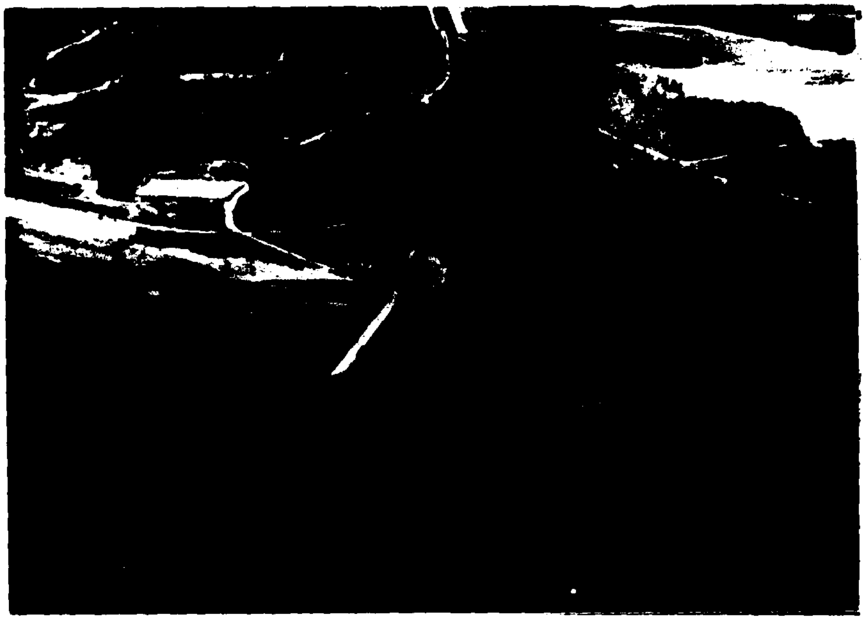
10. Upstream face of dam showing lack of erosion protection. Looking northwest.

11. Pipes drilled to locate decant line, located near present toe of upstream face of dam.

12. Spillway, in the distance, viewed from across tailings reservoir. Looking southwest from haul road on northwest side of the reservoir. Dam embankment is to the left.

13. Spillway excavation in weathered rock. Reservoir in the distance. Looking upstream in spillway (west). Note 14-in. siphon lines used to lower the reservoir below the spillway crest.

14. Reservoir for Old Viburnum Tailings Dam nearly filled with fine tailings deposits. Embankment for Intermediate Viburnum Tailings Dam (MO 31013) extends above the water surface of the reservoir.



15. County Road Dam (MO 31014) consisting of gravel road crossing tailings impoundment. Old Viburnum Tailings Dam out of the picture to the right, approximately 1.4 mi.

16. Dams upstream of Old Viburnum Tailings Dam considered in the multiple dam analysis. The upstream most dam (sand embankment) is Viburnum Tailings Dam (MO 31016); next downstream dam (grass-covered embankment) is the Railroad Embankment Dam (MO 31779); downstream-most dam in this picture with paved road along crest is No. 29 Mine Ore Haul Road Dam (MO 31015). Old Viburnum Tailings Dam is approximately 1.2 mi downstream, to the right, from MO 31015.

APPENDIX B

Hydraulic/Hydrologic Data and Analyses

APPENDIX B
Hydraulic/Hydrologic Data and Analyses

B.1 Procedures

a. General. The hydraulic/hydrologic analyses were performed using the "HEC-1, Dam Safety Version (1 Apr 80)" computer program. These analyses included multiple dam analyses for the significant dams upstream of Old Viburnum Tailings Dam. The inflow hydrographs were developed for various precipitation events by applying them to a synthetic unit hydrograph. The inflow hydrographs were subsequently routed through the reservoir and appurtenant structures by the modified Puls reservoir routing option.

b. Precipitation events. The Probable Maximum Precipitation (PMP) and the 1 and 10 percent probability-of-occurrence events were used in the analyses. Antecedent storms equal to 50 percent of the various PMF events were input to storage or routed through the various reservoirs. The total rainfall and corresponding distributions for the 1 and 10 percent probability events were provided by the St Louis District, Corps of Engineers. The Probable Maximum Precipitation was determined from regional curves prepared by the US Weather Bureau (Hydrometeorological Report Number 33, 1956). The PMP distribution was computed by the HEC-1 program using the standard EM-1110-1411 method.

c. Unit hydrograph. The Soil Conservation Services (SCS) Dimensionless Unit Hydrograph method (SCS, 1971, Hydrology: National Engineering Handbook, Section 4) was used in the analysis. This method was selected because of its simplicity, applicability to drainage areas less than 10 mi^2, and its easy availability within the HEC-1 computer program. Due to the multiple dams upstream and the shape of the drainage basin, the basin was divided into 4 sub-basins in order to develop inflow hydrographs for each dam. These sub-basins are:

1. Upstream of the Railroad Embankment Dam including Viburnum Tailings Dam;
2. From the Railroad Embankment Dam to No. 29 Mine Ore Haul Road Dam;
3. The main drainage basin south of No. 29 Mine Ore Haul Road Dam;
4. The area northwest of Intermediate and Old Viburnum Tailings reservoirs.

(See Fig. 2 for outline of these areas.)

The watershed lag time was computed for each sub-basin using the SCS "curve number method" by an empirical relationship as follows:

$$L = \frac{\ell^{0.8} (s+1)^{0.7}}{1900\ Y^{0.5}} \qquad \text{(Equation 15-4)}$$

where: L = lag in hours
ℓ = hydraulic length of the watershed in feet
$s = \frac{1000}{CN} - 10$
CN = AMC II hydrologic soil curve number as indicated in Section B.2e.
Y = average watershed land slope in percent.

This empirical relationship accounts for the soil cover, average watershed slope and hydraulic length. The lag time for the area between 31016 and 31779 was assumed to be insignificant as the distance between these two dams is very small, approximately 500 ft.

With the lag time thus computed, another empirical relationship is used to compute the time of concentration as follows:

$$T_c = \frac{L}{0.6} \qquad \text{(Equation 15-3)}$$

where: T_c = time of concentration in hours
L = lag in hours.

Subsequent to the computation of the time of concentration, the unit hydrograph duration was approximated utilizing the following relationship:

$$\Delta D \approx 0.133T_c \qquad \text{(Equation 16-12)}$$

where: ΔD = duration of unit excess rainfall
T_c = time of concentration in hours.

The final duration was selected to provide at least three discharge ordinates prior to the peak discharge ordinate of the unit hydrograph. Due to the small size of some of the sub-basins, a unit hydrograph duration of 5 minutes was used.

d. Infiltration losses. The infiltration losses were computed by the HEC-1 computer program internally using the SCS loss function. The curve number of SCS loss rate procedure was established taking into consideration the variables of: (a) antecedent moisture condition, (b) hydrologic soil group classification, (c) vegetative cover and (d) present land usage in the watershed. In addition, the computed basin loss was reduced proportional to the impervious are in the drainage basin.

Antecedent moisture condition III (AMC III) was used for the PMF events and AMC II was used for the 1 and 10 percent probability events, in accordance with the guidelines. The remaining variables are defined in the SCS procedure and judgements in their selection were made on the basis of visual field inspection.

e. Starting elevations. Reservoir starting water surface elevations for the dams were computed by routing antecedent storms equal to 50 percent of the subject storms. This was necessary as some of the dam have no outlet facilities and store all runoff prior to overtopping.

f. Spillway rating curve. The HEC-2 computer program was used to compute the spillway rating curves using spillway cross sections and assuming critical depth over the spillway.

g. Multiple dam analysis. In accordance with the St Louis District Hydrologic/Hydraulic Standards, Phase I Safety Inspection of Non-Federal Dams, 12 December 1979, Section 3.f, a multiple dam analysis was performed to evaluate the impact on overtopping potential of the significant dams upstream of Old Viburnum Tailings Dam.

Three dams considered potentially significant to the overtopping assessment of the subject dam were identified upstream. These are No. 29 Mine Ore Haul Road Dam, MO 31015, Viburnum Tailings Dam, MO 31016, and Railroad Embankment Dam, MO 31779.

The following breach parameters were input to the HEC-1 program on $B cards for the various dams:

Dam Number	Breach Bottom Width (BRWID)	Side Slope of Breach (Z)	Failure Time (TFAIL)	Failure Elevation (FAILEL)	Elevation of Breach Bottom (ELBM)
31015	10 ft	0.5H:1V	1.0 hr	1099.9 ft*	1051.0 ft
31016	10 ft	0.5H:1V	1.0 hr	1164.5 ft	1142.2 ft
31779	10 ft	0.5H:1V	1.0 hr	1142.2 ft*	1123.7 ft

*(For 31015 water surface elevation was allowed to rise 1.0 ft above minimum top of dam before initiation of breach due to the presence of a paved road along the dam crest. For 31779 water surface was allowed to rise 0.3 ft above minimum top of dam before initiation of breach due to presence of railroad bed ballast along crest of dam).

An additional consideration in this multiple dam analysis was an estimate of the volume of lead tailings that could be released by failure of these dams. The tailings consist of fine sand and silt. They consolidate fairly rapidly and once consolidated can stand on vertical slopes of considerable height. These consolidated tailings are subject to erosion by flowing water, but not flow. Inspection of a breached lead tailings dam (St Joe Lead Desloges Dam) indicated a fairly small portion of the impounded tailings was lost during the breach. Estimates from this observed failure suggest less than 2 percent of the impounded tailings were lost by erosion from flowing water. For this analysis we assigned a conservative estimate, 10 percent of the impounded tailings, as material lost through a breach. This volume was included in the HEC-1 computed outflow hydrograph for the purpose of the overtopping analysis of the downstream dams.

B.2 Pertinent Data

a. Drainage area. 4.25 mi^2 total; includes 0.61 mi^2 for sub-basin 1; 0.21 mi^2 for sub-basin 2; 1.76 mi^2 for sub-basin 3; and 1.68 mi^2 for sub-basin 4.

b. Storm duration. A unit hydrograph was developed by the SCS method option of HEC-1 program. The design storm of 24 hours duration was divided into intervals equal to the unit hydrograph duration of 5 minutes (B.1.c).

c. Lag time. 0.77 hr for sub-basin 1; 0.28 hr for sub-basin 2; 0.79 hr for sub-basin 3; 0.58 hr for sub-basin 4.

d. Hydrologic soil group. C & D

e. SCS curve numbers.

1. For PMF- AMC III - Curve Number 89
2. For 1 and 10 percent probability-of-occurrence events - AMC II - Curve Number 76

f. Storage. Elevation-area data were developed by planimetering areas at various elevations on the USGS Viburnum East and West 7.5 *minute quadrangle* maps and the topographic map provided by St. Joe Lead Co. The data were entered on the $A and $E cards so that the HEC-1 program could compute storage volumes for each of the dams.

g. Outflow over dam crest. Analysis indicates the dam will not be overtopped by the PMF.

h. Outflow capacity. The spillway rating curve was developed from the cross section data of the spillways using the HEC-2 backwater program assuming critical flow at the spillway. The results of the above were entered on the Y4 and Y5 cards of the HEC-1 program.

B.3 Results

The results of the analyses as well as the input values to the HEC-1 program follow in this Appendix. Only the results summaries are included, not the intermediate output. Complete copies of the HEC-1 output are available in the project files.

Input Data
100% PMF Event
Old Viburnum Tailings Dam, MO 30342
Overtopping and Multiple Dam Analysis

B5

100% PMF

```
**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION       JULY 1978
  LAST MODIFICATION  01 APR 80
**********************************
A1      VIBURNUM TAILINGS DAM (ST. JOE MINERAL), DAM NO. 30342
A2      WOODWARD-CLYDE CONSULTANTS, HOUSTON JOB NO. 80C224-T100
A3      PROBABLE MAXIMUM FLOOD (PMF)
B     299       0       5      -0      -0      -0      -0      -0      -0      -0
B1      5
J       1       1       1
J1    1.0
K       0    LAKE                                       1
K1 DAM NO. 31016 FLOOD HYDROGRAPH COMPUTATIONS
M       1       2     .61                       1
P       0     26.    102.    120.    130.
T                                                      -1     -87              0.
W2              .77
X      -1    -.05       5
K       1     DAM                                       1
K1      PMF FLOOD ROUTING, OVERTOPPING AND BREACH ANALYSIS
Y                                       1
Y1      1                                         -1155.5      -1
Y41155.5  1156.4  1157.2  1158.5  1159.8  1161.2  1163.0  1164.4  1165.4
Y5     0.    10.0    50.0   200.0   500.0  1000.0  2000.0  3000.0  4000.0
$A    4.4     6.0     6.6     7.6    76.0    90.0    96.0   108.0
$E1140.0  1150.0  1155.0  1159.3  1159.4  1164.5  1170.0  1175.0
$$1155.5
$D1164.5     2.8     1.5
$L     0.    130.    280.    920.   1050.   1250.   1386.
$V1164.5  1164.9  1167.0  1168.0  1168.4  1169.6  1170.8
$B    10.      .5  1142.2     1.0  1155.5  1164.5
K       1    R.R.                                       1
K1      PMF FLOOD ROUTING, OVERTOPPING AND BREACH ANALYSIS
Y                                       1
Y1      1                                         -1132.0      -1
Y41132.0  1134.0  1136.0  1137.0  1138.4  1139.0  1140.0  1141.0  1142.0  1143.0
Y41144.0  1145.0
Y5     0.    84.0    270.   512.0   570.0   600.0   740.0   960.0   1370.   2000.
Y52600.0  3680.0
$A    1.0     1.0     1.0    10.6    11.5    13.9    96.0    119.   130.0
$E1120.0  1132.0  1137.0  1137.1  1140.0  1150.0  1160.0  1170.0  1175.0
$$1132.0
$D1141.9     2.8     1.5
$L     0.   120.3   259.7   332.2   457.9   593.0
$V1141.9  1144.6  1148.0  1149.8  1152.9  1156.2
$B    10.      .5  1123.7      1.  1132.0  1142.2
K       0    LAKE                                       1
K1      DAM NO. 31015 FLOOD HYDROGRAPH COMPUTATIONS
M       1       2     .21                       1
P       0     26.    102.    120.    130.
T                                                      -1     -92             .2
W2              .28
X      -1    -.05       5
K       2    ROAD                                       1
```

```
K1      COMBINE HYDROGRAPHS
K       1   HAUL                                                 1
K1      PMF FLOOD ROUTING, OVERTOPPING AND BREACH ANALYSIS
Y                                       1       1
Y1      1                                                -1098.9
SA   .20     .40     .80     1.3    13.0    20.0    27.0    35.0
SE1050.0  1060.0  1070.0  1079.2  1080.0  1090.0  1100.0  1110.0
SS1098.9             3.0     1.5
SD1098.9     2.8     1.5
SB   10.      .5  1051.0      1.  1098.9  1099.9
K       0    AR1                                                 1
K1      FLOOD HYDROGRAPH FROM WEST SUB-BASIN
M       1       2   1.76                                 1
P       0     26.   102.    120.    130.
T                                                          -1     -89             .05
W2            .79
X      -1    -.05      5
K       0    A2                                                  1
K1      FLOOD HYDROGRAPH FROM NORTH SUB-BASIN
M       1       2   1.68                                 1
P       0     26.   102.    120.    130.
T                                                          -1     -91             .14
W2            .53
X      -1    -.05      5
K       3    LAKE                                                1
K1      COMBINE THREE HYDROGRAPHS
K       1    DAM                                                 1
K1      PROBABLE MAXIMUM FLOOD ROUTING AND OVERTOPPING ANALYSIS
Y                                       1       1
Y1      1                                                -1045.0      -1
Y41045.0  1045.4  1045.9  1046.8  1047.9  1049.0  1050.2  1052.2  1054.6  1059.0
Y41061.5  1065.0  1068.0
Y5    0.    30.0    100.    300.    600.   1000.   1500.   2500.   4000.   7500.
Y510000.  15000.  20000.
SA  14.0   150.0   193.0   259.0   286.0   314.0
SE1043.0  1045.0  1050.0  1060.0  1065.0  1070.0
SS1045.0
SD1065.0     2.8     1.5  1140.0
K      99
```

Input Data
100% PMF Event
Old Viburnum Tailings Dam, MO 30342
Overtopping and Multiple Dam Analysis

Output Summary
100% PMF Event
Old Viburnum Tailings Dam, MO 30342
Upstream Dam No. 31016

B7

```
**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  01 APR 80
**********************************

RUN  DATE: 05 JUN 81
     TIME: 15.55.21

          VIBURNUM TAILINGS DAM (ST. JOE MINERAL), DAM NO. 30342
          WOODWARD-CLYDE CONSULTANTS, HOUSTON JOB NO. 80C224-T100
          PROBABLE MAXIMUM FLOOD (PMF)

                              JOB SPECIFICATION
     NQ     NHR    NMIN    IDAY     IHR    IMIN   METRC    IPLT    IPRT   NSTAN
    299       0       5      -0      -0      -0      -0      -0      -0      -0
                          JOPER     NWT   LROPT   TRACE
                              5      -0      -0      -0

                      MULTI-PLAN ANALYSES TO BE PERFORMED
                         NPLAN= 1 NRTIO= 1 LRTIO= 1
     RTIOS=   1.00

 **********        **********        **********        **********        **********

                          SUB-AREA RUNOFF COMPUTATION

   DAM NO. 31016 FLOOD HYDROGRAPH COMPUTATIONS

             ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
              LAKE       0      -0      -0      -0      -0       1      -0      -0

                              HYDROGRAPH DATA
   IHYDG   IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
       1      2     .61     -0.     .61    1.00    -0.       -0      -0      -0

                               PRECIP DATA
           SPFE     PMS      R6     R12     R24     R48     R72     R96
             0.   26.00  102.00  120.00  130.00    -0.     -0.     -0.

                                LOSS DATA
   LROPT  STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
      -0    -0.     -0.    1.00     -0.     -0.    1.00   -1.00  -87.00    -0.      0.

    CURVE NO =  -87.00  WETNESS =   -1.00  EFFECT CN =   87.00

                           UNIT HYDROGRAPH DATA
                         TC= -0.       LAG=   .77

                              RECESSION DATA
                 STRTQ=   -1.00    QRCSN=    -.05    RTIOR= 5.00

   UNIT HYDROGRAPH 48 END OF PERIOD ORDINATES, TC=   -0.    HOURS, LAG=   .77  VOL= 1.00
  12.     38.     72.    119.    180.    249.    305.    342.    360.    362.
```

RECESSION DATA

STRTQ= -1.00 QRCSN= -.05 RTIOR= 5.00

UNIT HYDROGRAPH 48 END OF PERIOD ORDINATES, TC= -0. HOURS, LAG= .77 VOL= 1.00

12.	38.	72.	119.	180.	249.	305.	342.	360.	362.
353.	330.	302.	270.	229.	188.	155.	131.	111.	95.
81.	69.	58.	49.	41.	35.	29.	25.	21.	18.
15.	13.	11.	9.	8.	7.	5.	5.	4.	4.
3.	3.	2.	2.	1.	1.	1.	0.		

0

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.05	1	.01	.00	.01	1.	1.01	12.30	150	.22	.21	.01	391.
1.01	.10	2	.01	.00	.01	0.	1.01	12.35	151	.22	.21	.01	437.
1.01	.15	3	.01	.00	.01	0.	1.01	12.40	152	.22	.21	.01	489.
1.01	.20	4	.01	.00	.01	0.	1.01	12.45	153	.22	.21	.01	543.
1.01	.25	5	.01	.00	.01	0.	1.01	12.50	154	.22	.21	.01	598.
1.01	.30	6	.01	.00	.01	0.	1.01	12.55	155	.22	.22	.01	652.
1.01	.35	7	.01	.00	.01	0.	1.01	13.00	156	.22	.22	.01	702.
1.01	.40	8	.01	.00	.01	0.	1.01	13.05	157	.27	.26	.01	749.
1.01	.45	9	.01	.00	.01	0.	1.01	13.10	158	.27	.26	.01	793.
1.01	.50	10	.01	.00	.01	0.	1.01	13.15	159	.27	.26	.01	831.
1.01	.55	11	.01	.00	.01	0.	1.01	13.20	160	.27	.26	.01	866.
1.01	1.00	12	.01	.00	.01	0.	1.01	13.25	161	.27	.26	.01	898.
1.01	1.05	13	.01	.00	.01	0.	1.01	13.30	162	.27	.26	.00	930.
1.01	1.10	14	.01	.00	.01	0.	1.01	13.35	163	.27	.26	.00	961.
1.01	1.15	15	.01	.00	.01	0.	1.01	13.40	164	.27	.26	.00	992.
1.01	1.20	16	.01	.00	.01	0.	1.01	13.45	165	.27	.26	.00	1021.
1.01	1.25	17	.01	.00	.01	0.	1.01	13.50	166	.27	.26	.00	1048.
1.01	1.30	18	.01	.00	.01	0.	1.01	13.55	167	.27	.26	.00	1073.
1.01	1.35	19	.01	.00	.01	0.	1.01	14.00	168	.27	.26	.00	1096.
1.01	1.40	20	.01	.00	.01	0.	1.01	14.05	169	.33	.33	.00	1117.
1.01	1.45	21	.01	.00	.01	0.	1.01	14.10	170	.33	.33	.00	1138.
1.01	1.50	22	.01	.00	.01	0.	1.01	14.15	171	.33	.33	.00	1158.
1.01	1.55	23	.01	.00	.01	0.	1.01	14.20	172	.33	.33	.00	1179.
1.01	2.00	24	.01	.00	.01	0.	1.01	14.25	173	.33	.33	.00	1202.
1.01	2.05	25	.01	.00	.01	0.	1.01	14.30	174	.33	.33	.00	1227.
1.01	2.10	26	.01	.00	.01	0.	1.01	14.35	175	.33	.33	.00	1255.
1.01	2.15	27	.01	.00	.01	0.	1.01	14.40	176	.33	.33	.00	1285.
1.01	2.20	28	.01	.00	.01	1.	1.01	14.45	177	.33	.33	.00	1314.
1.01	2.25	29	.01	.00	.01	1.	1.01	14.50	178	.33	.33	.00	1343.
1.01	2.30	30	.01	.00	.01	1.	1.01	14.55	179	.33	.33	.00	1371.
1.01	2.35	31	.01	.00	.01	2.	1.01	15.00	180	.33	.33	.00	1397.
1.01	2.40	32	.01	.00	.01	2.	1.01	15.05	181	.20	.20	.00	1418.
1.01	2.45	33	.01	.00	.01	3.	1.01	15.10	182	.40	.40	.00	1437.
1.01	2.50	34	.01	.00	.01	4.	1.01	15.15	183	.40	.40	.00	1453.
1.01	2.55	35	.01	.00	.01	5.	1.01	15.20	184	.60	.60	.00	1469.
1.01	3.00	36	.01	.00	.01	5.	1.01	15.25	185	.71	.70	.00	1490.
1.01	3.05	37	.01	.00	.01	6.	1.01	15.30	186	1.71	1.70	.01	1535.
1.01	3.10	38	.01	.00	.01	7.	1.01	15.35	187	2.82	2.81	.01	1636.
1.01	3.15	39	.01	.00	.01	8.	1.01	15.40	188	1.11	1.10	.00	1803.
1.01	3.20	40	.01	.00	.01	9.	1.01	15.45	189	.71	.70	.00	2030.
1.01	3.25	41	.01	.00	.01	10.	1.01	15.50	190	.60	.60	.00	2318.
1.01	3.30	42	.01	.00	.01	11.	1.01	15.55	191	.40	.40	.00	2660.
1.01	3.35	43	.01	.00	.01	12.	1.01	16.00	192	.40	.40	.00	3010.
1.01	3.40	44	.01	.00	.01	13.	1.01	16.05	193	.31	.31	.00	3306.
1.01	3.45	45	.01	.00	.01	14.	1.01	16.10	194	.31	.31	.00	3516.
1.01	3.50	46	.01	.01	.01	14.	1.01	16.15	195	.31	.31	.00	3631.
1.01	3.55	47	.01	.01	.01	15.	1.01	16.20	196	.31	.31	.00	3659.
1.01	4.00	48	.01	.01	.01	16.	1.01	16.25	197	.31	.31	.00	3609.
1.01	4.05	49	.01	.01	.01	17.	1.01	16.30	198	.31	.31	.00	3490.
1.01	4.10	50	.01	.01	.01	18.	1.01	16.35	199	.31	.31	.00	3328.
1.01	4.15	51	.01	.01	.01	19.	1.01	16.40	[illegible]	[illegible]	[illegible]		

Output Summary
100% PMF Event
Old Viburnum Tailings Dam, MO 30342
Upstream Dam No. 31016

Output Summary
100% PMF Event
Old Viburnum Tailings Dam, MO 30342
Upstream Dam No. 31016

B9

[illegible]	4.05	49	.01	.01	.01	17.	1.01	16.30	198	.31	.31	.00	[illegible]
[illegible]	4.10	50	.01	.01	.01	18.	1.01	16.35	199	.31	.31	.00	3328.
[illegible]	4.15	51	.01	.01	.01	19.	1.01	16.40	200	.31	.31	.00	3129.
1.01	4.20	52	.01	.01	.01	19.	1.01	16.45	201	.31	.31	.00	2904.
1.01	4.25	53	.01	.01	.01	20.	1.01	16.50	202	.31	.31	.00	2681.
1.01	4.30	54	.01	.01	.01	21.	1.01	16.55	203	.31	.31	.00	2489.
1.01	4.35	55	.01	.01	.01	22.	1.01	17.00	204	.31	.31	.00	2328.
1.01	4.40	56	.01	.01	.01	22.	1.01	17.05	205	.24	.24	.00	2142.
1.01	4.45	57	.01	.01	.01	23.	1.01	17.10	206	.24	.24	.00	2078.
1.01	4.50	58	.01	.01	.01	24.	1.01	17.15	207	.24	.24	.00	1979.
1.01	4.55	59	.01	.01	.01	24.	1.01	17.20	208	.24	.24	.00	1850.
1.01	5.00	60	.01	.01	.01	25.	1.01	17.25	209	.24	.24	.00	1809.
1.01	5.05	61	.01	.01	.01	26.	1.01	17.30	210	.24	.24	.00	1734.
1.01	5.10	62	.01	.01	.01	26.	1.01	17.35	211	.24	.24	.00	1669.
1.01	5.15	63	.01	.01	.01	27.	1.01	17.40	212	.24	.24	.00	1600.
1.01	5.20	64	.01	.01	.01	28.	1.01	17.45	213	.24	.24	.00	1541.
1.01	5.25	65	.01	.01	.01	28.	1.01	17.50	214	.24	.24	.00	1486.
1.01	5.30	66	.01	.01	.01	29.	1.01	17.55	215	.24	.24	.00	1437.
1.01	5.35	67	.01	.01	.01	29.	1.01	18.00	216	.24	.24	.00	1394.
1.01	5.40	68	.01	.01	.01	30.	1.01	18.05	217	.02	.02	.00	1354.
1.01	5.45	69	.01	.01	.01	31.	1.01	18.10	218	.02	.02	.00	1313.
1.01	5.50	70	.01	.01	.01	31.	1.01	18.15	219	.02	.02	.00	1269.
1.01	5.55	71	.01	.01	.01	32.	1.01	18.20	220	.02	.02	.00	1215.
1.01	6.00	72	.01	.01	.01	32.	1.01	18.25	221	.02	.02	.00	1160.
1.01	6.05	73	.07	.04	.03	33.	1.01	18.30	222	.02	.02	.00	1088.
1.01	6.10	74	.07	.04	.03	35.	1.01	18.35	223	.02	.02	.00	1007.
1.01	6.15	75	.07	.04	.03	37.	1.01	18.40	224	.02	.02	.00	915.
1.01	6.20	76	.07	.04	.02	41.	1.01	18.45	225	.02	.02	.00	830.
1.01	6.25	77	.07	.04	.02	47.	1.01	18.50	226	.02	.02	.00	742.
1.01	6.30	78	.07	.04	.02	55.	1.01	18.55	227	.02	.02	.00	657.
1.01	6.35	79	.07	.04	.02	65.	1.01	19.00	228	.02	.02	.00	578.
1.01	6.40	80	.07	.05	.02	77.	1.01	19.05	229	.02	.02	.00	500.
1.01	6.45	81	.07	.05	.02	89.	1.01	19.10	230	.02	.02	.00	441.
1.01	6.50	82	.07	.05	.02	102.	1.01	19.15	231	.02	.02	.00	386.
1.01	6.55	83	.07	.05	.02	115.	1.01	19.20	232	.02	.02	.00	340.
1.01	7.00	84	.07	.05	.02	128.	1.01	19.25	233	.02	.02	.00	302.
1.01	7.05	85	.07	.05	.02	140.	1.01	19.30	234	.02	.02	.00	270.
1.01	7.10	86	.07	.05	.01	151.	1.01	19.35	235	.02	.02	.00	244.
1.01	7.15	87	.07	.05	.01	162.	1.01	19.40	236	.02	.02	.00	221.
1.01	7.20	88	.07	.05	.01	171.	1.01	19.45	237	.02	.02	.00	203.
1.01	7.25	89	.07	.05	.01	179.	1.01	19.50	238	.02	.02	.00	187.
1.01	7.30	90	.07	.05	.01	187.	1.01	19.55	239	.02	.02	.00	173.
1.01	7.35	91	.07	.05	.01	194.	1.01	20.00	240	.02	.02	.00	162.
1.01	7.40	92	.07	.05	.01	200.	1.01	20.05	241	.02	.02	.00	153.
1.01	7.45	93	.07	.05	.01	206.	1.01	20.10	242	.02	.02	.00	145.
1.01	7.50	94	.07	.05	.01	211.	1.01	20.15	243	.02	.02	.00	138.
1.01	7.55	95	.07	.05	.01	216.	1.01	20.20	244	.02	.02	.00	132.
1.01	8.00	96	.07	.05	.01	221.	1.01	20.25	245	.02	.02	.00	127.
1.01	8.05	97	.07	.06	.01	225.	1.01	20.30	246	.02	.02	.00	123.
1.01	8.10	98	.07	.06	.01	229.	1.01	20.35	247	.02	.02	.00	120.
1.01	8.15	99	.07	.06	.01	233.	1.01	20.40	248	.02	.02	.00	117.
1.01	8.20	100	.07	.06	.01	236.	1.01	20.45	249	.02	.02	.00	114.
1.01	8.25	101	.07	.06	.01	239.	1.01	20.50	250	.02	.02	.00	112.
1.01	8.30	102	.07	.06	.01	242.	1.01	20.55	251	.02	.02	.00	110.
1.01	8.35	103	.07	.06	.01	245.	1.01	21.00	252	.02	.02	.00	109.
1.01	8.40	104	.07	.06	.01	247.	1.01	21.05	253	.02	.02	.00	108.
1.01	8.45	105	.07	.06	.01	250.	1.01	21.10	254	.02	.02	.00	107.
1.01	8.50	106	.07	.06	.01	252.	1.01	21.15	255	.02	.02	.00	106.
1.01	8.55	107	.07	.06	.01	254.	1.01	21.20	256	.02	.02	.00	105.
1.01	9.00	108	.07	.06	.01	256.	1.01	21.25	257	.02	.02	.00	104.
1.01	9.05	109	.07	.06	.01	258.	1.01	21.30	258	.02	.02	.00	104.
1.01	9.10	110	.07	.06	.01	260.	1.01	21.35	259	.02	.02	.00	103.
1.01	9.15	111	.07	.06	.01	261.	1.01	21.40	260	.02	.02	.00	103.
1.01	9.20	112	.07	.06	.01	263.	1.01	21.45	261	.02	.02	.00	103.
1.01	9.25	113	.07	.06	.01	264.	1.01	21.50	262	.02	.02	.00	102.
[illegible]	[illegible]	114	.07	.06	.01	[illegible]	[illegible]	21.55	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Output Summary
100% PMF Event
Old Viburnum Tailings Dam, MO 30342
Upstream Dam No. 31016

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1.01	9.00	108	.07	.06	.01	256.	1.01	21.25	257	.02	.02	.00	104.
1.01	9.05	109	.07	.06	.01	258.	1.01	21.30	258	.02	.02	.00	104.
1.01	9.10	110	.07	.06	.01	260.	1.01	21.35	259	.02	.02	.00	103.
1.01	9.15	111	.07	.06	.01	261.	1.01	21.40	260	.02	.02	.00	103.
1.01	9.20	112	.07	.06	.01	263.	1.01	21.45	261	.02	.02	.00	103.
1.01	9.25	113	.07	.06	.01	264.	1.01	21.50	262	.02	.02	.00	102.
1.01	9.30	114	.07	.06	.01	266.	1.01	21.55	263	.02	.02	.00	102.
1.01	9.35	115	.07	.06	.01	267.	1.01	22.00	264	.02	.02	.00	102.
1.01	9.40	116	.07	.06	.01	269.	1.01	22.05	265	.02	.02	.00	102.
1.01	9.45	117	.07	.06	.01	270.	1.01	22.10	266	.02	.02	.00	102.
1.01	9.50	118	.07	.06	.01	271.	1.01	22.15	267	.02	.02	.00	102.
1.01	9.55	119	.07	.06	.01	272.	1.01	22.20	268	.02	.02	.00	102.
1.01	10.00	120	.07	.06	.01	273.	1.01	22.25	269	.02	.02	.00	102.
1.01	10.05	121	.07	.06	.00	274.	1.01	22.30	270	.02	.02	.00	102.
1.01	10.10	122	.07	.06	.00	275.	1.01	22.35	271	.02	.02	.00	102.
1.01	10.15	123	.07	.06	.00	276.	1.01	22.40	272	.02	.02	.00	102.
1.01	10.20	124	.07	.06	.00	277.	1.01	22.45	273	.02	.02	.00	102.
1.01	10.25	125	.07	.06	.00	277.	1.01	22.50	274	.02	.02	.00	102.
1.01	10.30	126	.07	.06	.00	278.	1.01	22.55	275	.02	.02	.00	102.
1.01	10.35	127	.07	.06	.00	279.	1.01	23.00	276	.02	.02	.00	102.
1.01	10.40	128	.07	.06	.00	280.	1.01	23.05	277	.02	.02	.00	102.
1.01	10.45	129	.07	.06	.00	280.	1.01	23.10	278	.02	.02	.00	102.
1.01	10.50	130	.07	.06	.00	281.	1.01	23.15	279	.02	.02	.00	102.
1.01	10.55	131	.07	.06	.00	282.	1.01	23.20	280	.02	.02	.00	102.
1.01	11.00	132	.07	.06	.00	282.	1.01	23.25	281	.02	.02	.00	102.
1.01	11.05	133	.07	.06	.00	283.	1.01	23.30	282	.02	.02	.00	102.
1.01	11.10	134	.07	.06	.00	284.	1.01	23.35	283	.02	.02	.00	102.
1.01	11.15	135	.07	.06	.00	284.	1.01	23.40	284	.02	.02	.00	102.
1.01	11.20	136	.07	.06	.00	285.	1.01	23.45	285	.02	.02	.00	102.
1.01	11.25	137	.07	.06	.00	285.	1.01	23.50	286	.02	.02	.00	102.
1.01	11.30	138	.07	.06	.00	286.	1.01	23.55	287	.02	.02	.00	102.
1.01	11.35	139	.07	.06	.00	286.	1.02	0.	288	.02	.02	.00	102.
1.01	11.40	140	.07	.06	.00	287.	1.02	.05	289	0.	0.	0.	102.
1.01	11.45	141	.07	.06	.00	287.	1.02	.10	290	0.	0.	0.	101.
1.01	11.50	142	.07	.06	.00	288.	1.02	.15	291	0.	0.	0.	99.
1.01	11.55	143	.07	.06	.00	288.	1.02	.20	292	0.	0.	0.	97.
1.01	12.00	144	.07	.06	.00	288.	1.02	.25	293	0.	0.	0.	93.
1.01	12.05	145	.22	.21	.01	290.	1.02	.30	294	0.	0.	0.	88.
1.01	12.10	146	.22	.21	.01	297.	1.02	.35	295	0.	0.	0.	81.
1.01	12.15	147	.22	.21	.01	308.	1.02	.40	296	0.	0.	0.	74.
1.01	12.20	148	.22	.21	.01	326.	1.02	.45	297	0.	0.	0.	66.
1.01	12.25	149	.22	.21	.01	353.	1.02	.50	298	0.	0.	0.	58.
							1.02	.55	299	0.	0.	0.	50.

SUM	33.80	32.07	1.73	151140.
	(859.)(	815.)(	44.)(	4279.)(

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3659.	1662.	525.	505.	151121.
CMS	104.	47.	15.	14.	4279.
INCHES		25.34	32.01	32.01	32.01
MM		643.62	812.98	813.00	813.00
AC-FT		824.	1041.	1041.	1041.
THOUS CU M		1016.	1284.	1284.	1284.

HYDROGRAPH AT STA LAKE FOR PLAN 1, RTIO 1

1.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	1.	1.	1.
2.	2.	3.	4.	5.	5.	6.	7.	8.	9.
10.	11.	12.	13.	14.	14.	15.	16.	17.	18.
19.	19.	20.	21.	22.	22.	23.	24.	24.	25.
26.	26.	27.	28.	28.	29.	29.	30.	[illegible]	[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
19.	19.	20.	21.	22.	22.	23.	24.	24.	25.
26.	26.	27.	28.	28.	29.	29.	30.	31.	31.
32.	32.	33.	35.	37.	41.	47.	55.	65.	77.
89.	102.	115.	128.	140.	151.	162.	171.	179.	187.
194.	200.	206.	211.	216.	221.	225.	229.	233.	236.
239.	242.	245.	247.	250.	252.	254.	256.	258.	260.
261.	263.	264.	266.	267.	269.	270.	271.	272.	273.
274.	275.	276.	277.	277.	278.	279.	280.	280.	281.
282.	282.	283.	284.	284.	285.	285.	286.	286.	287.
287.	288.	288.	288.	290.	297.	308.	326.	353.	391.
437.	489.	543.	598.	652.	702.	749.	793.	831.	866.
898.	930.	961.	992.	1021.	1048.	1073.	1096.	1117.	1138.
1158.	1179.	1202.	1227.	1255.	1285.	1314.	1343.	1371.	1397.
1418.	1437.	1453.	1469.	1490.	1535.	1636.	1803.	2030.	2318.
2660.	3010.	3306.	3516.	3631.	3659.	3609.	3490.	3328.	3129.
2904.	2681.	2489.	2328.	2192.	2078.	1979.	1890.	1809.	1734.
1665.	1600.	1541.	1496.	1437.	1394.	1354.	1313.	1269.	1219.
1160.	1088.	1007.	919.	830.	742.	657.	578.	506.	441.
386.	340.	302.	270.	244.	221.	203.	187.	173.	162.
153.	145.	138.	132.	127.	123.	120.	117.	114.	112.
110.	109.	108.	107.	106.	105.	104.	104.	103.	103.
103.	102.	102.	102.	102.	102.	102.	102.	102.	102.
102.	102.	102.	102.	102.	102.	102.	102.	102.	102.
102.	102.	102.	102.	102.	102.	102.	102.	102.	101.
99.	97.	93.	88.	81.	74.	66.	58.	50.	

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3659.	1662.	525.	505.	151121.
CMS	104.	47.	15.	14.	4279.
INCHES		25.34	32.01	32.01	32.01
MM		643.62	812.98	813.00	813.00
AC-FT		824.	1041.	1041.	1041.
THOUS CU M		1016.	1284.	1284.	1284.

Output Summary
100% PMF Event
Old Viburnum Tailings Dam, MO 30342
Upstream Dam No. 31016

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HYDROGRAPH ROUTING

PMF FLOOD ROUTING, OVERTOPPING AND BREACH ANALYSIS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
DAM	1	-0	-0	-0	-0	1	-0	-0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
-0.	-0.	-0.	1	-0	-0	-0	-0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	-0	-0	-0.	-0.	-0.	-1156.	-1

STAGE	1155.50	1156.40	1157.20	1158.50	1159.80	1161.20	1163.00	1164.40	1165.40
FLOW	0.	10.00	50.00	200.00	500.00	1000.00	2000.00	3000.00	4000.00

SURFACE AREA=	4.	6.	7.	8.	76.	90.	96.	108.
CAPACITY=	0.	52.	83.	114.	117.	540.	1052.	1561.
ELEVATION=	1140.	1150.	1155.	1159.	1159.	1165.	1170.	1175.

CREL SPWID COQW EXPW ELEVL COOL CAREA EXPL

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ELEVATION=	1140.	1150.	1155.	1159.	1159.	1165.	1170.	1175.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
1155.5	-0.	-0.	-0.	-0.	-0.	-0.	-0.

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1164.5	2.8	1.5	-0.

CREST LENGTH	0.	130.	280.	920.	1050.	1250.	1386.
AT OR BELOW ELEVATION	1164.5	1164.9	1167.0	1168.0	1168.4	1169.6	1170.8

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
10.	.50	1142.20	1.00	1155.50	1164.50

STATION DAM, PLAN 1, RATIO 1

Output Summary
100% PMF Event
Old Viburnum Tailings Dam, MO 30342
Upstream Dam No. 31016

Output Summary
100% PMF Event
Old Viburnum Tailings Dam, MO 30342
Upstream Dam No. 31779

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                                HYDROGRAPH ROUTING

                 PMF FLOOD ROUTING, OVERTOPPING AND BREACH ANALYSIS

                    ISTAQ   ICOMP   IECON   ITAPE   JPLT   JPRT   INAME  ISTAGE  IAUTO
                     R.R.       1      -0      -0     -0     -0       1      -0     -0
                                        ROUTING DATA
             QLOSS   CLOSS    AVG    IRES   ISAME   IOPT   IPMP           LSTR
               -0.     -0.     -0.      1      -0     -0     -0             -0

                    NSTPS   NSTDL     LAG  AMSKK      X    TSK   STORA  ISPRAT
                        1      -0      -0    -0.    -0.    -0.  -1132.      -1

 STAGE     1132.00   1134.00   1136.00   1137.00   1138.40   1139.00   1140.00   1141.00   1142.00   1143.00
           1144.00   1145.00

 FLOW           0.     84.00    270.00    512.00    570.00    600.00    740.00    960.00   1370.00   2000.00
           2600.00   3680.00

SURFACE AREA=        1.      1.      1.     11.     12.     14.     96.    119.    130.

  CAPACITY=          0.     12.     17.     17.     50.    176.    664.   1737.   2360.

 ELEVATION=       1120.   1132.   1137.   1137.   1140.   1150.   1160.   1170.   1175.

                   CREL   SPWID   COQW   EXPW   ELEVL   COOL   CAREA   EXPL
                 1132.0     -0.    -0.    -0.     -0.    -0.     -0.    -0.

                                        DAM DATA
                              TOPEL   COQD   EXPD  DAMWID
                             1141.9    2.8    1.5     -0.

 CREST LENGTH         0.     120.     260.     332.     458.     593.
 AT OR BELOW
 ELEVATION       1141.9   1144.6   1148.0   1149.8   1152.9   1156.2

                                     DAM BREACH DATA
                         BRWID      Z     ELBM   TFAIL     WSEL  FAILEL
                           10.    .50  1123.70    1.00  1132.00  1142.20

                             STATION   R.R., PLAN 1, RATIO 1
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Output Summary
100% PMF Event
Old Viburnum Tailings Dam, MO 30342
Upstream Dam No. 31015

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SUB-AREA RUNOFF COMPUTATION

DAM NO. 31015 FLOOD HYDROGRAPH COMPUTATIONS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
LAKE	0	-0	-0	-0	-0	1	-0	-0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	.21	-0.	.21	1.00	-0.	-0	-0	-0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.	26.00	102.00	120.00	130.00	-0.	-0.	-0.

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
-0	-0.	-0.	1.00	-0.	-0.	1.00	-1.00	-92.00	-0.	.20

CURVE NO = -92.00 WETNESS = -1.00 EFFECT CN = 92.00

UNIT HYDROGRAPH DATA

TC= -0. LAG= .28

RECESSION DATA

STRTQ= -1.00 QRCSN= -.05 RTIOR= 5.00

UNIT HYDROGRAPH 19 END OF PERIOD ORDINATES, TC= -0. HOURS, LAG= .28 VOL= 1.00

48. 159. 286. 314. 272. 194. 121. 80. 53. 34.
23. 15. 10. 6. 4. 3. 2. 1. 0.

0

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.05	1	.01	.00	.01	0.	1.01	12.30	150	.22	.22	.00	301.
1.01	.10	2	.01	.00	.01	1.	1.01	12.35	151	.22	.22	.00	314.
1.01	.15	3	.01	.00	.01	2.	1.01	12.40	152	.22	.22	.00	332.
1.01	.20	4	.01	.00	.01	2.	1.01	12.45	153	.22	.22	.00	340.
1.01	.25	5	.01	.00	.01	3.	1.01	12.50	154	.22	.22	.00	346.
1.01	.30	6	.01	.00	.01	4.	1.01	12.55	155	.22	.22	.00	349.
1.01	.35	7	.01	.00	.01	4.	1.01	13.00	156	.22	.22	.00	352.
1.01	.40	8	.01	.00	.01	4.	1.01	13.05	157	.27	.26	.00	356.
1.01	.45	9	.01	.00	.01	4.	1.01	13.10	158	.27	.26	.00	364.
1.01	.50	10	.01	.00	.01	5.	1.01	13.15	159	.27	.26	.00	377.
1.01	.55	11	.01	.00	.01	5.	1.01	13.20	160	.27	.26	.00	391.
1.01	1.00	12	.01	.00	.01	5.	1.01	13.25	161	.27	.26	.00	404.
1.01	1.05	13	.01	.00	.01	5.	1.01	13.30	162	.27	.26	.00	413.
1.01	1.10	14	.01	.00	.01	5.	1.01	13.35	163	.27	.26	.00	418.
1.01	1.15	15	.01	.00	.01	5.	1.01	13.40	164	.27	.26	.00	422.
1.01	1.20	16	.01	.00	.01	5.	1.01	13.45	165	.27	.26	.00	424.
1.01	1.25	17	.01	.00	.01	5.	1.01	13.50	166	.27	.26	.00	426.
1.01	1.30	18	.01	.00	.01	6.	1.01	13.55	167	.27	.26	.00	427.
1.01	1.35	19	.01	.01	.01	6.	1.01	14.00	168	.27	.26	.00	428.
1.01	1.40	20	.01	.01	.01	7.	1.01	14.05	169	.33	.33	.00	431.
1.01	1.45	21	.01	.01	.01	7.	1.01	14.10	170	.33	.33	.00	442.
1.01	1.50	22	.01	.01	.01	8.	1.01	14.15	171	.33	.33	.00	461.
1.01	1.55	23	.01	.01	.01	8.	1.01	14.20	172	.33	.33	.00	482.
1.01	2.00	24	.01	.01	.01	9.	1.01	14.25	173	.33	.33	.00	501.
1.01	2.05	25	.01	.01	.01	9.	1.01	14.30	174	.33	.33	.00	514.
1.01	2.10	26	.01	[illegible]	[illegible]	9.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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1.	1.45	21	.01	.01	.01	7.	1.01	14.10	170	.33	.33	.00	442.
1.	1.50	22	.01	.01	.01	8.	1.01	14.15	171	.33	.33	.00	461.
1.01	1.55	23	.01	.01	.01	8.	1.01	14.20	172	.33	.33	.00	482.
1.01	2.00	24	.01	.01	.01	9.	1.01	14.25	173	.33	.33	.00	501.
1.01	2.05	25	.01	.01	.01	9.	1.01	14.30	174	.33	.33	.00	514.
1.01	2.10	26	.01	.01	.01	9.	1.01	14.35	175	.33	.33	.00	522.
1.01	2.15	27	.01	.01	.01	10.	1.01	14.40	176	.33	.33	.00	527.
1.01	2.20	28	.01	.01	.01	10.	1.01	14.45	177	.33	.33	.00	531.
1.01	2.25	29	.01	.01	.01	11.	1.01	14.50	178	.33	.33	.00	533.
1.01	2.30	30	.01	.01	.01	11.	1.01	14.55	179	.33	.33	.00	535.
1.01	2.35	31	.01	.01	.01	11.	1.01	15.00	180	.33	.33	.00	536.
1.01	2.40	32	.01	.01	.01	12.	1.01	15.05	181	.20	.20	.00	530.
1.01	2.45	33	.01	.01	.01	12.	1.01	15.10	182	.40	.40	.00	520.
1.01	2.50	34	.01	.01	.01	12.	1.01	15.15	183	.40	.40	.00	515.
1.01	2.55	35	.01	.01	.01	12.	1.01	15.20	184	.60	.60	.00	542.
1.01	3.00	36	.01	.01	.01	13.	1.01	15.25	185	.71	.70	.00	606.
1.01	3.05	37	.01	.01	.01	13.	1.01	15.30	186	1.71	1.71	.00	758.
1.01	3.10	38	.01	.01	.01	13.	1.01	15.35	187	2.82	2.82	.00	1088.
1.01	3.15	39	.01	.01	.01	13.	1.01	15.40	188	1.11	1.11	.00	1569.
1.01	3.20	40	.01	.01	.01	14.	1.01	15.45	189	.71	.70	.00	1985.
1.01	3.25	41	.01	.01	.01	14.	1.01	15.50	190	.60	.60	.00	2100.
1.01	3.30	42	.01	.01	.01	14.	1.01	15.55	191	.40	.40	.00	1951.
1.01	3.35	43	.01	.01	.01	14.	1.01	16.00	192	.40	.40	.00	1655.
1.01	3.40	44	.01	.01	.00	15.	1.01	16.05	193	.31	.31	.00	1348.
1.01	3.45	45	.01	.01	.00	15.	1.01	16.10	194	.31	.31	.00	1109.
1.01	3.50	46	.01	.01	.00	15.	1.01	16.15	195	.31	.31	.00	921.
1.01	3.55	47	.01	.01	.00	15.	1.01	16.20	196	.31	.31	.00	783.
1.01	4.00	48	.01	.01	.00	15.	1.01	16.25	197	.31	.31	.00	687.
1.01	4.05	49	.01	.01	.00	16.	1.01	16.30	198	.31	.31	.00	623.
1.01	4.10	50	.01	.01	.00	16.	1.01	16.35	199	.31	.31	.00	582.
1.01	4.15	51	.01	.01	.00	16.	1.01	16.40	200	.31	.31	.00	555.
1.01	4.20	52	.01	.01	.00	16.	1.01	16.45	201	.31	.31	.00	537.
1.01	4.25	53	.01	.01	.00	16.	1.01	16.50	202	.31	.31	.00	525.
1.01	4.30	54	.01	.01	.00	16.	1.01	16.55	203	.31	.31	.00	517.
1.01	4.35	55	.01	.01	.00	16.	1.01	17.00	204	.31	.31	.00	511.
1.01	4.40	56	.01	.01	.00	17.	1.01	17.05	205	.24	.24	.00	503.
1.01	4.45	57	.01	.01	.00	17.	1.01	17.10	206	.24	.24	.00	491.
1.01	4.50	58	.01	.01	.00	17.	1.01	17.15	207	.24	.24	.00	471.
1.01	4.55	59	.01	.01	.00	17.	1.01	17.20	208	.24	.24	.00	449.
1.01	5.00	60	.01	.01	.00	17.	1.01	17.25	209	.24	.24	.00	431.
1.01	5.05	61	.01	.01	.00	17.	1.01	17.30	210	.24	.24	.00	418.
1.01	5.10	62	.01	.01	.00	17.	1.01	17.35	211	.24	.24	.00	410.
1.01	5.15	63	.01	.01	.00	17.	1.01	17.40	212	.24	.24	.00	405.
1.01	5.20	64	.01	.01	.00	18.	1.01	17.45	213	.24	.24	.00	401.
1.01	5.25	65	.01	.01	.00	18.	1.01	17.50	214	.24	.24	.00	399.
1.01	5.30	66	.01	.01	.00	18.	1.01	17.55	215	.24	.24	.00	398.
1.01	5.35	67	.01	.01	.00	18.	1.01	18.00	216	.24	.24	.00	397.
1.01	5.40	68	.01	.01	.00	18.	1.01	18.05	217	.02	.02	.00	385.
1.01	5.45	69	.01	.01	.00	18.	1.01	18.10	218	.02	.02	.00	390.
1.01	5.50	70	.01	.01	.00	18.	1.01	18.15	219	.02	.02	.00	288.
1.01	5.55	71	.01	.01	.00	18.	1.01	18.20	220	.02	.02	.00	216.
1.01	6.00	72	.01	.01	.00	18.	1.01	18.25	221	.02	.02	.00	156.
1.01	6.05	73	.07	.05	.01	20.	1.01	18.30	222	.02	.02	.00	113.
1.01	6.10	74	.07	.05	.01	27.	1.01	18.35	223	.02	.02	.00	94.
1.01	6.15	75	.07	.05	.01	39.	1.01	18.40	224	.02	.02	.00	80.
1.01	6.20	76	.07	.05	.01	52.	1.01	18.45	225	.02	.02	.00	68.
1.01	6.25	77	.07	.06	.01	64.	1.01	18.50	226	.02	.02	.00	58.
1.01	6.30	78	.07	.06	.01	73.	1.01	18.55	227	.02	.02	.00	49.
1.01	6.35	79	.07	.06	.01	79.	1.01	19.00	228	.02	.02	.00	42.
1.01	6.40	80	.07	.06	.01	83.	1.01	19.05	229	.02	.02	.00	39.
1.01	6.45	81	.07	.06	.01	86.	1.01	19.10	230	.02	.02	.00	37.
1.01	6.50	82	.07	.06	.01	88.	1.01	19.15	231	.02	.02	.00	37.
1.01	6.55	83	.07	.06	.01	90.	1.01	19.20	232	.02	.02	.00	36.
1.01	7.00	84	.07	.06	.01	91.	1.01	19.25	233	.02	.02	.00	35.
1.01	7.05	85	.07	.06	.01	93.	1.01	19.30	234	.02	.02	.00	35.

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[illegible]	6.45	81	.07	.06	.01	86.	1.01	19.10	230	.02	.02	.00	37.
1.01	6.50	82	.07	.06	.01	88.	1.01	19.15	231	.02	.02	.00	37.
1.01	6.55	83	.07	.06	.01	90.	1.01	19.20	232	.02	.02	.00	36.
1.01	7.00	84	.07	.06	.01	91.	1.01	19.25	233	.02	.02	.00	35.
1.01	7.05	85	.07	.06	.01	93.	1.01	19.30	234	.02	.02	.00	35.
1.01	7.10	86	.07	.06	.01	94.	1.01	19.35	235	.02	.02	.00	35.
1.01	7.15	87	.07	.06	.01	94.	1.01	19.40	236	.02	.02	.00	35.
1.01	7.20	88	.07	.06	.01	95.	1.01	19.45	237	.02	.02	.00	35.
1.01	7.25	89	.07	.06	.00	96.	1.01	19.50	238	.02	.02	.00	35.
1.01	7.30	90	.07	.06	.00	96.	1.01	19.55	239	.02	.02	.00	35.
1.01	7.35	91	.07	.06	.00	97.	1.01	20.00	240	.02	.02	.00	35.
1.01	7.40	92	.07	.06	.00	97.	1.01	20.05	241	.02	.02	.00	35.
1.01	7.45	93	.07	.06	.00	97.	1.01	20.10	242	.02	.02	.00	35.
1.01	7.50	94	.07	.06	.00	98.	1.01	20.15	243	.02	.02	.00	35.
1.01	7.55	95	.07	.06	.00	98.	1.01	20.20	244	.02	.02	.00	35.
1.01	8.00	96	.07	.06	.00	98.	1.01	20.25	245	.02	.02	.00	35.
1.01	8.05	97	.07	.06	.00	99.	1.01	20.30	246	.02	.02	.00	35.
1.01	8.10	98	.07	.06	.00	99.	1.01	20.35	247	.02	.02	.00	35.
1.01	8.15	99	.07	.06	.00	99.	1.01	20.40	248	.02	.02	.00	35.
1.01	8.20	100	.07	.06	.00	100.	1.01	20.45	249	.02	.02	.00	35.
1.01	8.25	101	.07	.06	.00	100.	1.01	20.50	250	.02	.02	.00	35.
1.01	8.30	102	.07	.06	.00	100.	1.01	20.55	251	.02	.02	.00	35.
1.01	8.35	103	.07	.06	.00	100.	1.01	21.00	252	.02	.02	.00	35.
1.01	8.40	104	.07	.06	.00	100.	1.01	21.05	253	.02	.02	.00	35.
1.01	8.45	105	.07	.06	.00	101.	1.01	21.10	254	.02	.02	.00	35.
1.01	8.50	106	.07	.06	.00	101.	1.01	21.15	255	.02	.02	.00	35.
1.01	8.55	107	.07	.06	.00	101.	1.01	21.20	256	.02	.02	.00	35.
1.01	9.00	108	.07	.06	.00	101.	1.01	21.25	257	.02	.02	.00	35.
1.01	9.05	109	.07	.06	.00	101.	1.01	21.30	258	.02	.02	.00	35.
1.01	9.10	110	.07	.06	.00	101.	1.01	21.35	259	.02	.02	.00	35.
1.01	9.15	111	.07	.06	.00	102.	1.01	21.40	260	.02	.02	.00	35.
1.01	9.20	112	.07	.06	.00	102.	1.01	21.45	261	.02	.02	.00	35.
1.01	9.25	113	.07	.06	.00	102.	1.01	21.50	262	.02	.02	.00	35.
1.01	9.30	114	.07	.06	.00	102.	1.01	21.55	263	.02	.02	.00	35.
1.01	9.35	115	.07	.06	.00	102.	1.01	22.00	264	.02	.02	.00	35.
1.01	9.40	116	.07	.06	.00	102.	1.01	22.05	265	.02	.02	.00	35.
1.01	9.45	117	.07	.06	.00	102.	1.01	22.10	266	.02	.02	.00	35.
1.01	9.50	118	.07	.06	.00	102.	1.01	22.15	267	.02	.02	.00	35.
1.01	9.55	119	.07	.06	.00	102.	1.01	22.20	268	.02	.02	.00	35.
1.01	10.00	120	.07	.06	.00	103.	1.01	22.25	269	.02	.02	.00	35.
1.01	10.05	121	.07	.06	.00	103.	1.01	22.30	270	.02	.02	.00	35.
1.01	10.10	122	.07	.06	.00	103.	1.01	22.35	271	.02	.02	.00	35.
1.01	10.15	123	.07	.06	.00	103.	1.01	22.40	272	.02	.02	.00	35.
1.01	10.20	124	.07	.06	.00	103.	1.01	22.45	273	.02	.02	.00	35.
1.01	10.25	125	.07	.06	.00	103.	1.01	22.50	274	.02	.02	.00	35.
1.01	10.30	126	.07	.06	.00	103.	1.01	22.55	275	.02	.02	.00	35.
1.01	10.35	127	.07	.06	.00	103.	1.01	23.00	276	.02	.02	.00	35.
1.01	10.40	128	.07	.06	.00	103.	1.01	23.05	277	.02	.02	.00	35.
1.01	10.45	129	.07	.06	.00	103.	1.01	23.10	278	.02	.02	.00	35.
1.01	10.50	130	.07	.06	.00	103.	1.01	23.15	279	.02	.02	.00	35.
1.01	10.55	131	.07	.06	.00	103.	1.01	23.20	280	.02	.02	.00	35.
1.01	11.00	132	.07	.06	.00	103.	1.01	23.25	281	.02	.02	.00	35.
1.01	11.05	133	.07	.06	.00	103.	1.01	23.30	282	.02	.02	.00	35.
1.01	11.10	134	.07	.06	.00	104.	1.01	23.35	283	.02	.02	.00	35.
1.01	11.15	135	.07	.06	.00	104.	1.01	23.40	284	.02	.02	.00	35.
1.01	11.20	136	.07	.06	.00	104.	1.01	23.45	285	.02	.02	.00	35.
1.01	11.25	137	.07	.06	.00	104.	1.01	23.50	286	.02	.02	.00	35.
1.01	11.30	138	.07	.06	.00	104.	1.01	23.55	287	.02	.02	.00	35.
1.01	11.35	139	.07	.06	.00	104.	1.02	0.	288	.02	.02	.00	35.
1.01	11.40	140	.07	.06	.00	104.	1.02	.05	289	0.	0.	0.	34.
1.01	11.45	141	.07	.06	.00	104.	1.02	.10	290	0.	0.	0.	31.
1.01	11.50	142	.07	.06	.00	104.	1.02	.15	291	0.	0.	0.	26.
1.01	11.55	143	.07	.06	.00	104.	1.02	.20	292	0.	0.	0.	22.
1.01	12.00	144	.07	.06	.00	104.	1.02	.25	293	0.	0.	0.	19.
1.01	12.05	145	[illegible]	[illegible]	.00	[illegible]	[illegible]	.30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Output Summary
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
.	11.45	141	.07	.06	.00	104.	1.02	.10	290	0.	0.	0.	31.
1.01	11.50	142	.07	.06	.00	104.	1.02	.15	291	0.	0.	0.	26.
1.01	11.55	143	.07	.06	.00	104.	1.02	.20	292	0.	0.	0.	22.
1.01	12.00	144	.07	.06	.00	104.	1.02	.25	293	0.	0.	0.	19.
1.01	12.05	145	.22	.22	.00	111.	1.02	.30	294	0.	0.	0.	16.
1.01	12.10	146	.22	.22	.00	136.	1.02	.35	295	0.	0.	0.	14.
1.01	12.15	147	.22	.22	.00	180.	1.02	.40	296	0.	0.	0.	12.
1.01	12.20	148	.22	.22	.00	228.	1.02	.45	297	0.	0.	0.	10.
1.01	12.25	149	.22	.22	.00	270.	1.02	.50	298	0.	0.	0.	8.
							1.02	.55	299	0.	0.	0.	7.
									SUM	33.80	32.98	.82	53703.
										(859.)(	838.)(	21.)(	1520.70)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2100.	589.	186.	180.	53712.
CMS	59.	17.	5.	5.	1521.
INCHES		26.09	33.03	33.05	33.05
MM		662.67	838.86	839.35	839.35
AC-FT		292.	370.	370.	370.
THOUS CU M		360.	456.	456.	456.

HYDROGRAPH AT STA LAKE FOR PLAN 1, RTIO 1

0.	1.	2.	2.	3.	4.	4.	4.	4.	5.
5.	5.	5.	5.	5.	5.	5.	6.	6.	7.
7.	8.	8.	9.	9.	9.	10.	10.	11.	11.
11.	12.	12.	12.	12.	13.	13.	13.	13.	14.
14.	14.	14.	15.	15.	15.	15.	15.	16.	16.
16.	16.	16.	16.	16.	17.	17.	17.	17.	17.
17.	17.	17.	18.	18.	18.	18.	18.	18.	18.
18.	18.	20.	27.	39.	52.	64.	73.	79.	83.
86.	88.	90.	91.	93.	94.	94.	95.	96.	96.
97.	97.	97.	98.	98.	98.	99.	99.	99.	100.
100.	100.	100.	100.	101.	101.	101.	101.	101.	101.
102.	102.	102.	102.	102.	102.	102.	102.	102.	103.
103.	103.	103.	103.	103.	103.	103.	103.	103.	103.
103.	103.	103.	104.	104.	104.	104.	104.	104.	104.
104.	104.	104.	104.	111.	136.	180.	228.	270.	301.
319.	332.	340.	346.	349.	352.	356.	364.	377.	391.
404.	413.	418.	422.	424.	426.	427.	428.	431.	442.
461.	482.	501.	514.	522.	527.	531.	533.	535.	536.
530.	520.	515.	542.	606.	758.	1088.	1569.	1985.	2100.
1951.	1655.	1348.	1109.	921.	783.	687.	623.	582.	555.
537.	525.	517.	511.	503.	491.	471.	449.	431.	418.
410.	405.	401.	399.	398.	397.	385.	350.	286.	216.
156.	113.	94.	80.	68.	58.	49.	42.	39.	37.
37.	36.	35.	35.	35.	35.	35.	35.	35.	35.
35.	35.	35.	35.	35.	35.	35.	35.	35.	35.
35.	35.	35.	35.	35.	35.	35.	35.	35.	35.
35.	35.	35.	35.	35.	35.	35.	35.	35.	35.
35.	35.	35.	35.	35.	35.	35.	35.	34.	31.
26.	22.	19.	16.	14.	12.	10.	8.	7.	

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2100.	589.	186.	180.	53712.
CMS	59.	17.	5.	5.	1521.
INCHES		26.09	33.03	33.05	33.05
MM		662.67	838.86	839.35	839.35
AC-FT		292.	370.	370.	370.
THOUS CU M		360.	456.	456.	456.

Output Summary
100% PMF Event
Old Viburnum Tailings Dam, MO 30342
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THOUS CU M	360.	456.	456.	456.

HYDROGRAPH AT STA LAKE FOR PLAN 1, RTIO 1

0.	1.	2.	2.	3.	4.	4.	4.	4.	5.
5.	5.	5.	5.	5.	5.	5.	6.	6.	7.
7.	8.	8.	9.	9.	9.	10.	10.	11.	11.
11.	12.	12.	12.	12.	13.	13.	13.	13.	14.
14.	14.	14.	15.	15.	15.	15.	15.	16.	16.
16.	16.	16.	16.	16.	17.	17.	17.	17.	17.
17.	17.	17.	18.	18.	18.	18.	18.	18.	18.
18.	18.	20.	27.	39.	52.	64.	73.	79.	83.
86.	88.	90.	91.	93.	94.	94.	95.	96.	96.
97.	97.	97.	98.	98.	98.	99.	99.	99.	100.
100.	100.	100.	100.	101.	101.	101.	101.	101.	101.
102.	102.	102.	102.	102.	102.	102.	102.	102.	103.
103.	103.	103.	103.	103.	103.	103.	103.	103.	103.
103.	103.	103.	104.	104.	104.	104.	104.	104.	104.
104.	104.	104.	104.	111.	136.	180.	228.	270.	301.
319.	332.	340.	346.	349.	352.	356.	364.	377.	391.
404.	413.	418.	422.	424.	426.	427.	428.	431.	442.
461.	482.	501.	514.	522.	527.	531.	533.	535.	536.
530.	520.	515.	542.	606.	758.	1088.	1569.	1985.	2100.
1951.	1655.	1348.	1109.	921.	783.	687.	623.	582.	555.
537.	525.	517.	511.	503.	491.	471.	449.	431.	418.
410.	405.	401.	399.	398.	397.	385.	350.	286.	216.
156.	113.	94.	80.	68.	58.	49.	42.	39.	37.
37.	36.	35.	35.	35.	35.	35.	35.	35.	35.
35.	35.	35.	35.	35.	35.	35.	35.	35.	35.
35.	35.	35.	35.	35.	35.	35.	35.	35.	35.
35.	35.	35.	35.	35.	35.	35.	35.	35.	35.
35.	35.	35.	35.	35.	35.	35.	35.	35.	35.
35.	35.	35.	35.	35.	35.	35.	35.	34.	31.
26.	22.	19.	16.	14.	12.	10.	8.	7.	

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2100.	589.	186.	180.	53712.
CMS	59.	17.	5.	5.	1521.
INCHES		26.09	33.03	33.05	33.05
MM		662.67	838.86	839.35	839.35
AC-FT		292.	370.	370.	370.
THOUS CU M		360.	456.	456.	456.

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COMBINE HYDROGRAPHS

COMBINE HYDROGRAPHS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
ROAD	2	-0	-0	-0	-0	1	-0	-0

SUM OF 2 HYDROGRAPHS AT ROAD PLAN 1 RTIO 1

0.	1.	2.	2.	3.	4.	4.	4.	4.	5.
5.	5.	5.	5.	5.	5.	5.	6.	6.	7.
7.	8.	8.	9.	9.	9.	10.	10.	11.	11.
11.	12.	12.	12.	13.	13.	13.	13.	14.	14.
14.	15.	15.	15.	16.	16.	16.	17.	17.	17.
17.	18.	18.	18.	19.	19.	19.	20.	20.	20.

5.	5.	5.	5.	[illegible]	[illegible]	[illegible]	[illegible]		
7.	8.	8.	9.	9.	9.	10.	10.	11.	11.
11.	12.	12.	12.	13.	13.	13.	13.	14.	14.
14.	15.	15.	15.	16.	16.	16.	17.	17.	17.
17.	18.	18.	18.	19.	19.	19.	20.	20.	20.
21.	21.	21.	22.	22.	22.	23.	23.	24.	24.
24.	25.	27.	34.	46.	60.	72.	81.	87.	92.
96.	100.	104.	109.	113.	118.	123.	129.	135.	143.
153.	163.	173.	185.	204.	218.	230.	241.	250.	258.
266.	274.	281.	287.	293.	301.	309.	316.	323.	330.
335.	340.	345.	349.	352.	355.	358.	360.	363.	365.
367.	368.	370.	371.	373.	375.	377.	378.	379.	380.
381.	381.	382.	383.	384.	384.	385.	386.	387.	387.
388.	388.	389.	390.	398.	423.	469.	521.	569.	610.
644.	677.	711.	736.	750.	759.	769.	784.	805.	827.
849.	867.	882.	896.	909.	922.	937.	942.	947.	959.
980.	1003.	1024.	1040.	1051.	1061.	1068.	1075.	1082.	1088.
1088.	1084.	1085.	1120.	1193.	1354.	1699.	2205.	2647.	2787.
2605.	2403.	2149.	1969.	1845.	1798.	1823.	1972.	1936.	2046.
2150.	2249.	2360.	2481.	2609.	2738.	2863.	2983.	3146.	3313.
3516.	3737.	3965.	3603.	3325.	2578.	2217.	2199.	2108.	2014.
1927.	1857.	1809.	1763.	1717.	1670.	1622.	1574.	1530.	1486.
1439.	1393.	1347.	1301.	1256.	1212.	1169.	1126.	1085.	1047.
1017.	994.	970.	946.	923.	900.	878.	856.	835.	815.
794.	775.	755.	737.	719.	701.	684.	667.	651.	635.
620.	605.	591.	577.	563.	550.	538.	529.	520.	513.
505.	497.	490.	483.	476.	469.	462.	455.	449.	442.
425.	393.	354.	318.	287.	261.	243.	230.	218.	206.
194.	183.	174.	165.	157.	149.	142.	134.	127.	

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3965.	1871.	706.	680.	203467.
CMS	112.	53.	20.	19.	5762.
INCHES		21.23	32.05	32.06	32.06
MM		539.20	814.15	814.28	814.28
AC-FT		928.	1401.	1401.	1401.
THOUS CU M		1145.	1728.	1728.	1728.

Output Summary
100% PMF Event
Old Viburnum Tailings Dam, MO 30342
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HYDROGRAPH ROUTING

PMF FLOOD ROUTING, OVERTOPPING AND BREACH ANALYSIS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
HAUL	1	-0	-0	-0	-0	1	-0	-0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
-0.	-0.	-0.	1	1	-0	-0	-0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	-0	-0	-0.	-0.	-0.	-1099.	-0

SURFACE AREA=	0.	0.	1.	1.	13.	20.	27.	35.
CAPACITY=	0.	3.	9.	18.	23.	187.	421.	730.
ELEVATION=	1050.	1060.	1070.	1079.	1080.	1090.	1100.	1110.

CREL	SPWID	COQW	EXPW	ELEVL	COOL	CAREA	EXPL
1098.9	-0.	3.0	1.5	-0.	-0.	-0.	-0.

ELEVATI.	1050.	1060.	1070.	1079.	1080.	1090.	1100.	1110.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
1098.9	-0.	3.0	1.5	-0.	-0.	-0.	-0.

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1098.9	2.8	1.5	-0.

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
10.	.50	1051.00	1.00	1098.90	1099.90

STATION HAUL, PLAN 1, RATIO 1

Output Summary
100% PMF Event
Old Viburnum Tailings Dam, MO 30342
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Output Summary
100% PMF Event
Old Viburnum Tailings Dam, MO 30342
Upstream Sub-basin 3

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SUB-AREA RUNOFF COMPUTATION

FLOOD HYDROGRAPH FROM WEST SUB-BASIN

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
AR1	0	-0	-0	-0	-0	1	-0	-0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	1.76	-0.	1.76	1.00	-0.	-0	-0	-0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.	26.00	102.00	120.00	130.00	-0.	-0.	-0.

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
-0	-0.	-0.	1.00	-0.	-0.	1.00	-1.00	-89.00	-0.	.05

CURVE NO = -89.00 WETNESS = -1.00 EFFECT CN = 89.00

UNIT HYDROGRAPH DATA

TC= -0. LAG= .79

RECESSION DATA

STRTQ= -1.00 QRCSN= -.05 RTIOR= 5.00

UNIT HYDROGRAPH 49 END OF PERIOD ORDINATES, TC= -0. HOURS, LAG= .79 VOL= 1.00

31.	103.	195.	318.	482.	676.	839.	951.	1012.	1022.
1010.	948.	877.	794.	691.	569.	468.	396.	335.	285.
247.	210.	179.	149.	129.	109.	93.	78.	67.	56.
48.	41.	35.	29.	25.	21.	18.	15.	13.	11.
10.	9.	7.	6.	5.	4.	3.	2.	1.	

0

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.05	1	.01	.00	.01	2.	1.01	12.30	150	.22	.22	.01	1126.
1.01	.10	2	.01	.00	.01	1.	1.01	12.35	151	.22	.22	.00	1254.
1.01	.15	3	.01	.00	.01	1.	1.01	12.40	152	.22	.22	.00	1400.
1.01	.20	4	.01	.00	.01	1.	1.01	12.45	153	.22	.22	.00	1554.
1.01	.25	5	.01	.00	.01	2.	1.01	12.50	154	.22	.22	.00	1711.
1.01	.30	6	.01	.00	.01	2.	1.01	12.55	155	.22	.22	.00	1866.
1.01	.35	7	.01	.00	.01	2.	1.01	13.00	156	.22	.22	.00	2012.
1.01	.40	8	.01	.00	.01	3.	1.01	13.05	157	.27	.26	.00	2140.
1.01	.45	9	.01	.00	.01	4.	1.01	13.10	158	.27	.26	.00	2276.
1.01	.50	10	.01	.00	.01	4.	1.01	13.15	159	.27	.26	.00	2352.
1.01	.55	11	.01	.00	.01	5.	1.01	13.20	160	.27	.26	.00	2455.
1.01	1.00	12	.01	.00	.01	6.	1.01	13.25	161	.27	.26	.00	2589.
1.01	1.05	13	.01	.00	.01	6.	1.01	13.30	162	.27	.26	.00	2682.
1.01	1.10	14	.01	.00	.01	7.	1.01	13.35	163	.27	.26	.00	2772.
1.01	1.15	15	.01	.00	.01	7.	1.01	13.40	164	.27	.26	.00	2859.
1.01	1.20	16	.01	.00	.01	8.	1.01	13.45	165	.27	.26	.00	2943.
1.01	1.25	17	.01	.00	.01	8.	1.01	13.50	166	.27	.26	.00	3022.
1.01	1.30	18	.01	.00	.01	8.	1.01	13.55	167	.27	.26	.00	3096.
1.01	1.35	19	.01	.00	.01	9.	1.01	14.00	168	.27	.26	.00	3163.
1.01	1.40	20	.01	.00	.01	9.	1.01	14.05	169	.33	.33	.00	3229.
1.01	1.45	21	.01	.00	.01	9.	1.01	14.10	170	.33	.33	.00	3285.
1.01	1.50	22	.01	.00	.01	10.	1.01	14.15	171	.33	.33	.00	3344.
1.01	1.55	23	.01	.00	.01	10.	1.01	14.20	172	.33	.33	.00	3404.
1.01	2.00	24	.01	.00	.01	11.	1.01	14.25	173	.33	.33	.00	3469.
1.01	2.05	25	.01	.00	.01	12.	1.01	14.30	174	[illegible]	[illegible]	[illegible]	[illegible]
1.01	2.10	26	.01	.00	[illegible]	[illegible]							

Output Summary
100% PMF Event
Old Viburnum Tailings Dam, MO 30342
Upstream Sub-basin 3

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1.	1.55	23	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1.	2.00	24	.01	.00	.01	11.	1.01	14.25	173	.33	.33	.00	3464.
1.01	2.05	25	.01	.00	.01	12.	1.01	14.30	174	.33	.33	.00	3541.
1.01	2.10	26	.01	.00	.01	13.	1.01	14.35	175	.33	.33	.00	3620.
1.01	2.15	27	.01	.00	.01	15.	1.01	14.40	176	.33	.33	.00	3703.
1.01	2.20	28	.01	.00	.01	16.	1.01	14.45	177	.33	.33	.00	3788.
1.01	2.25	29	.01	.00	.01	18.	1.01	14.50	178	.33	.33	.00	3870.
1.01	2.30	30	.01	.00	.01	21.	1.01	14.55	179	.33	.33	.00	3950.
1.01	2.35	31	.01	.00	.01	23.	1.01	15.00	180	.33	.33	.00	4024.
1.01	2.40	32	.01	.00	.01	26.	1.01	15.05	181	.20	.20	.00	4088.
1.01	2.45	33	.01	.00	.01	28.	1.01	15.10	182	.40	.40	.00	4142.
1.01	2.50	34	.01	.00	.01	31.	1.01	15.15	183	.40	.40	.00	4190.
1.01	2.55	35	.01	.00	.01	34.	1.01	15.20	184	.60	.60	.00	4238.
1.01	3.00	36	.01	.01	.01	37.	1.01	15.25	185	.71	.70	.00	4300.
1.01	3.05	37	.01	.01	.01	40.	1.01	15.30	186	1.71	1.71	.01	4421.
1.01	3.10	38	.01	.01	.01	43.	1.01	15.35	187	2.82	2.81	.01	4655.
1.01	3.15	39	.01	.01	.01	45.	1.01	15.40	188	1.11	1.11	.00	5149.
1.01	3.20	40	.01	.01	.01	48.	1.01	15.45	189	.71	.70	.00	5760.
1.01	3.25	41	.01	.01	.01	51.	1.01	15.50	190	.60	.60	.00	6543.
1.01	3.30	42	.01	.01	.01	54.	1.01	15.55	191	.40	.40	.00	7482.
1.01	3.35	43	.01	.01	.01	56.	1.01	16.00	192	.40	.40	.00	8472.
1.01	3.40	44	.01	.01	.01	59.	1.01	16.05	193	.31	.31	.00	9328.
1.01	3.45	45	.01	.01	.01	62.	1.01	16.10	194	.31	.31	.00	9956.
1.01	3.50	46	.01	.01	.01	64.	1.01	16.15	195	.31	.31	.00	10326.
1.01	3.55	47	.01	.01	.01	67.	1.01	16.20	196	.31	.31	.00	10453.
1.01	4.00	48	.01	.01	.01	69.	1.01	16.25	197	.31	.31	.00	10370.
1.01	4.05	49	.01	.01	.01	71.	1.01	16.30	198	.31	.31	.00	10073.
1.01	4.10	50	.01	.01	.01	74.	1.01	16.35	199	.31	.31	.00	9654.
1.01	4.15	51	.01	.01	.01	76.	1.01	16.40	200	.31	.31	.00	9138.
1.01	4.20	52	.01	.01	.01	78.	1.01	16.45	201	.31	.31	.00	8527.
1.01	4.25	53	.01	.01	.01	80.	1.01	16.50	202	.31	.31	.00	7885.
1.01	4.30	54	.01	.01	.01	82.	1.01	16.55	203	.31	.31	.00	7312.
1.01	4.35	55	.01	.01	.01	85.	1.01	17.00	204	.31	.31	.00	6835.
1.01	4.40	56	.01	.01	.01	87.	1.01	17.05	205	.24	.24	.00	6433.
1.01	4.45	57	.01	.01	.01	88.	1.01	17.10	206	.24	.24	.00	6052.
1.01	4.50	58	.01	.01	.01	90.	1.01	17.15	207	.24	.24	.00	5804.
1.01	4.55	59	.01	.01	.01	92.	1.01	17.20	208	.24	.24	.00	5543.
1.01	5.00	60	.01	.01	.01	94.	1.01	17.25	209	.24	.24	.00	5304.
1.01	5.05	61	.01	.01	.01	96.	1.01	17.30	210	.24	.24	.00	5080.
1.01	5.10	62	.01	.01	.01	98.	1.01	17.35	211	.24	.24	.00	4877.
1.01	5.15	63	.01	.01	.01	99.	1.01	17.40	212	.24	.24	.00	4688.
1.01	5.20	64	.01	.01	.01	101.	1.01	17.45	213	.24	.24	.00	4513.
1.01	5.25	65	.01	.01	.01	102.	1.01	17.50	214	.24	.24	.00	4352.
1.01	5.30	66	.01	.01	.01	104.	1.01	17.55	215	.24	.24	.00	4207.
1.01	5.35	67	.01	.01	.01	105.	1.01	18.00	216	.24	.24	.00	4077.
1.01	5.40	68	.01	.01	.01	107.	1.01	18.05	217	.02	.02	.00	3957.
1.01	5.45	69	.01	.01	.01	108.	1.01	18.10	218	.02	.02	.00	3834.
1.01	5.50	70	.01	.01	.01	110.	1.01	18.15	219	.02	.02	.00	3706.
1.01	5.55	71	.01	.01	.01	111.	1.01	18.20	220	.02	.02	.00	3563.
1.01	6.00	72	.01	.01	.01	113.	1.01	18.25	221	.02	.02	.00	3397.
1.01	6.05	73	.07	.04	.02	115.	1.01	18.30	222	.02	.02	.00	3156.
1.01	6.10	74	.07	.04	.02	120.	1.01	18.35	223	.02	.02	.00	2967.
1.01	6.15	75	.07	.05	.02	128.	1.01	18.40	224	.02	.02	.00	2720.
1.01	6.20	76	.07	.05	.02	140.	1.01	18.45	225	.02	.02	.00	2465.
1.01	6.25	77	.07	.05	.02	158.	1.01	18.50	226	.02	.02	.00	2214.
1.01	6.30	78	.07	.05	.02	183.	1.01	18.55	227	.02	.02	.00	1969.
1.01	6.35	79	.07	.05	.02	214.	1.01	19.00	228	.02	.02	.00	1740.
1.01	6.40	80	.07	.05	.01	250.	1.01	19.05	229	.02	.02	.00	1530.
1.01	6.45	81	.07	.05	.01	289.	1.01	19.10	230	.02	.02	.00	1339.
1.01	6.50	82	.07	.05	.01	329.	1.01	19.15	231	.02	.02	.00	1173.
1.01	6.55	83	.07	.05	.01	369.	1.01	19.20	232	.02	.02	.00	1035.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.01	19.25	233	.02	.02	.00	921.

Output Summary
100% PMF Event
Old Viburnum Tailings Dam, MO 30342
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[illegible]	[illegible]	81	.07	.05	.01	289.	1.01	19.10	230	.02	.02	.00	1339.
[illegible]	[illegible]	82	.07	.05	.01	329.	1.01	19.15	231	.02	.02	.00	1173.
[illegible]	6.55	83	.07	.05	.01	369.	1.01	19.20	232	.02	.02	.00	1035.
[illegible]	7.00	84	.07	.05	.01	409.	1.01	19.25	233	.02	.02	.00	921.
[illegible]	7.05	85	.07	.05	.01	446.	1.01	19.30	234	.02	.02	.00	823.
1.01	7.10	86	.07	.05	.01	481.	1.01	19.35	235	.02	.02	.00	740.
1.01	7.15	87	.07	.05	.01	513.	1.01	19.40	236	.02	.02	.00	671.
1.01	7.20	88	.07	.05	.01	541.	1.01	19.45	237	.02	.02	.00	612.
1.01	7.25	89	.07	.06	.01	566.	1.01	19.50	238	.02	.02	.00	563.
1.01	7.30	90	.07	.06	.01	588.	1.01	19.55	239	.02	.02	.00	521.
1.01	7.35	91	.07	.06	.01	608.	1.01	20.00	240	.02	.02	.00	486.
1.01	7.40	92	.07	.06	.01	626.	1.01	20.05	241	.02	.02	.00	457.
1.01	7.45	93	.07	.06	.01	643.	1.01	20.10	242	.02	.02	.00	432.
1.01	7.50	94	.07	.06	.01	658.	1.01	20.15	243	.02	.02	.00	410.
1.01	7.55	95	.07	.06	.01	672.	1.01	20.20	244	.02	.02	.00	392.
1.01	8.00	96	.07	.06	.01	684.	1.01	20.25	245	.02	.02	.00	377.
1.01	8.05	97	.07	.06	.01	696.	1.01	20.30	246	.02	.02	.00	364.
1.01	8.10	98	.07	.06	.01	706.	1.01	20.35	247	.02	.02	.00	353.
1.01	8.15	99	.07	.06	.01	716.	1.01	20.40	248	.02	.02	.00	343.
1.01	8.20	100	.07	.06	.01	725.	1.01	20.45	249	.02	.02	.00	335.
1.01	8.25	101	.07	.06	.01	733.	1.01	20.50	250	.02	.02	.00	329.
1.01	8.30	102	.07	.06	.01	740.	1.01	20.55	251	.02	.02	.00	323.
1.01	8.35	103	.07	.06	.01	747.	1.01	21.00	252	.02	.02	.00	318.
1.01	8.40	104	.07	.06	.01	754.	1.01	21.05	253	.02	.02	.00	314.
1.01	8.45	105	.07	.06	.01	760.	1.01	21.10	254	.02	.02	.00	311.
1.01	8.50	106	.07	.06	.01	765.	1.01	21.15	255	.02	.02	.00	308.
1.01	8.55	107	.07	.06	.01	770.	1.01	21.20	256	.02	.02	.00	305.
1.01	9.00	108	.07	.06	.01	775.	1.01	21.25	257	.02	.02	.00	303.
1.01	9.05	109	.07	.06	.00	780.	1.01	21.30	258	.02	.02	.00	301.
1.01	9.10	110	.07	.06	.00	784.	1.01	21.35	259	.02	.02	.00	299.
1.01	9.15	111	.07	.06	.00	788.	1.01	21.40	260	.02	.02	.00	298.
1.01	9.20	112	.07	.06	.00	792.	1.01	21.45	261	.02	.02	.00	297.
1.01	9.25	113	.07	.06	.00	795.	1.01	21.50	262	.02	.02	.00	296.
1.01	9.30	114	.07	.06	.00	798.	1.01	21.55	263	.02	.02	.00	295.
1.01	9.35	115	.07	.06	.00	801.	1.01	22.00	264	.02	.02	.00	295.
1.01	9.40	116	.07	.06	.00	804.	1.01	22.05	265	.02	.02	.00	295.
1.01	9.45	117	.07	.06	.00	807.	1.01	22.10	266	.02	.02	.00	295.
1.01	9.50	118	.07	.06	.00	810.	1.01	22.15	267	.02	.02	.00	295.
1.01	9.55	119	.07	.06	.00	812.	1.01	22.20	268	.02	.02	.00	295.
1.01	10.00	120	.07	.06	.00	815.	1.01	22.25	269	.02	.02	.00	295.
1.01	10.05	121	.07	.06	.00	817.	1.01	22.30	270	.02	.02	.00	295.
1.01	10.10	122	.07	.06	.00	819.	1.01	22.35	271	.02	.02	.00	295.
1.01	10.15	123	.07	.06	.00	821.	1.01	22.40	272	.02	.02	.00	295.
1.01	10.20	124	.07	.06	.00	823.	1.01	22.45	273	.02	.02	.00	295.
1.01	10.25	125	.07	.06	.00	825.	1.01	22.50	274	.02	.02	.00	295.
1.01	10.30	126	.07	.06	.00	826.	1.01	22.55	275	.02	.02	.00	295.
1.01	10.35	127	.07	.06	.00	828.	1.01	23.00	276	.02	.02	.00	295.
1.01	10.40	128	.07	.06	.00	829.	1.01	23.05	277	.02	.02	.00	295.
1.01	10.45	129	.07	.06	.00	831.	1.01	23.10	278	.02	.02	.00	295.
1.01	10.50	130	.07	.06	.00	832.	1.01	23.15	279	.02	.02	.00	295.
1.01	10.55	131	.07	.06	.00	834.	1.01	23.20	280	.02	.02	.00	295.
1.01	11.00	132	.07	.06	.00	835.	1.01	23.25	281	.02	.02	.00	295.
1.01	11.05	133	.07	.06	.00	836.	1.01	23.30	282	.02	.02	.00	295.
1.01	11.10	134	.07	.06	.00	838.	1.01	23.35	283	.02	.02	.00	295.
1.01	11.15	135	.07	.06	.00	839.	1.01	23.40	284	.02	.02	.00	295.
1.01	11.20	136	.07	.06	.00	840.	1.01	23.45	285	.02	.02	.00	295.
1.01	11.25	137	.07	.06	.00	841.	1.01	23.50	286	.02	.02	.00	295.
1.01	11.30	138	.07	.06	.00	842.	1.01	23.55	287	.02	.02	.00	295.
1.01	11.35	139	.07	.06	.00	843.	1.02	0.	288	.02	.02	.00	295.
1.01	11.40	140	.07	.06	.00	844.	1.02	.05	289	0.	0.	0.	294.
1.01	11.45	141	.07	.06	.00	845.	1.02	.10	290	0.	0.	0.	292.
1.01	11.50	142	.07	.06	.00	846.	1.02	.15	291	0.	0.	0.	288.
1.01	11.55	143	.07	.06	.00	847.	1.02	.20	292	0.	0.	0.	281.
1.01	12.00	144	.07	.06	.00	848.	1.02	.25	293	0.	[illegible]		
1.01	12.05	145	[illegible]	[illegible]	[illegible]								

Output Summary
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Old Viburnum Tailings Dam, MO 30342
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1.0	10.35	127	.07	.06	.00	828.	1.01	23.00	276	.02	.02	.00	295.
1.0	10.40	128	.07	.06	.00	829.	1.01	23.05	277	.02	.02	.00	295.
1.01	10.45	129	.07	.06	.00	831.	1.01	23.10	278	.02	.02	.00	295.
1.01	10.50	130	.07	.06	.00	832.	1.01	23.15	279	.02	.02	.00	295.
1.01	10.55	131	.07	.06	.00	834.	1.01	23.20	280	.02	.02	.00	295.
1.01	11.00	132	.07	.06	.00	835.	1.01	23.25	281	.02	.02	.00	295.
1.01	11.05	133	.07	.06	.00	836.	1.01	23.30	282	.02	.02	.00	295.
1.01	11.10	134	.07	.06	.00	838.	1.01	23.35	283	.02	.02	.00	295.
1.01	11.15	135	.07	.06	.00	839.	1.01	23.40	284	.02	.02	.00	295.
1.01	11.20	136	.07	.06	.00	840.	1.01	23.45	285	.02	.02	.00	295.
1.01	11.25	137	.07	.06	.00	841.	1.01	23.50	286	.02	.02	.00	295.
1.01	11.30	138	.07	.06	.00	842.	1.01	23.55	287	.02	.02	.00	295.
1.01	11.35	139	.07	.06	.00	843.	1.02	0.	288	.02	.02	.00	295.
1.01	11.40	140	.07	.06	.00	844.	1.02	.05	289	0.	0.	0.	294.
1.01	11.45	141	.07	.06	.00	845.	1.02	.10	290	0.	0.	0.	292.
1.01	11.50	142	.07	.06	.00	846.	1.02	.15	291	0.	0.	0.	288.
1.01	11.55	143	.07	.06	.00	847.	1.02	.20	292	0.	0.	0.	281.
1.01	12.00	144	.07	.06	.00	848.	1.02	.25	293	0.	0.	0.	270.
1.01	12.05	145	.22	.21	.01	853.	1.02	.30	294	0.	0.	0.	256.
1.01	12.10	146	.22	.21	.01	870.	1.02	.35	295	0.	0.	0.	239.
1.01	12.15	147	.22	.21	.01	900.	1.02	.40	296	0.	0.	0.	217.
1.01	12.20	148	.22	.22	.01	949.	1.02	.45	297	0.	0.	0.	195.
1.01	12.25	149	.22	.22	.01	1023.	1.02	.50	298	0.	0.	0.	173.
							1.02	.55	299	0.	0.	0.	151.
									SUM	33.80	32.43	1.37	440970.
										(859.)(	824.)(	35.)(	12486.))

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	10453.	4804.	1531.	1475.	440892.
CMS	296.	136.	43.	42.	12485.
INCHES		25.39	32.36	32.37	32.37
MM		645.00	822.03	822.08	822.08
AC-FT		2382.	3036.	3036.	3036.
THOUS CU M		2939.	3745.	3745.	3745.

HYDROGRAPH AT STA ARI FOR PLAN 1, RTIO 1

2.	1.	1.	1.	2.	2.	2.	3.	4.	4.
5.	6.	6.	7.	7.	8.	8.	8.	9.	9.
9.	10.	10.	11.	12.	13.	15.	16.	18.	21.
23.	26.	28.	31.	34.	37.	40.	43.	45.	48.
51.	54.	56.	59.	62.	64.	67.	69.	71.	74.
76.	78.	80.	82.	85.	87.	88.	90.	92.	94.
96.	98.	99.	101.	102.	104.	105.	107.	108.	110.
111.	113.	115.	120.	128.	140.	158.	183.	214.	250.
289.	329.	369.	408.	446.	481.	513.	541.	566.	588.
608.	626.	643.	658.	672.	684.	696.	706.	716.	725.
733.	740.	747.	754.	760.	765.	770.	775.	780.	784.
788.	792.	795.	798.	801.	804.	807.	810.	812.	815.
817.	819.	821.	823.	825.	826.	828.	829.	831.	832.
834.	835.	836.	838.	839.	840.	841.	842.	843.	844.
845.	846.	847.	848.	853.	870.	900.	949.	1023.	1126.
1254.	1400.	1554.	1711.	1866.	2012.	2148.	2276.	2392.	2495.
2589.	2682.	2772.	2859.	2943.	3022.	3096.	3163.	3225.	3285.
[illegible]344.	3404.	3469.	3541.	3620.	3703.	3788.	3870.	3950.	4024.
[illegible]038.	4142.	4190.	4238.	4300.	4421.	4695.	5149.	5760.	6543.
7402.	8472.	9328.	9956.	10326.	10453.	10370.	10073.	9654.	9138.
8527.	7885.	7312.	6839.	6433.	6092.	5804.	5543.	5304.	5080.
4877.	4688.	4513.	4352.	4207.	4077.	3957.	3834.	3706.	3563.
3397.	3196.	2967.	2720.	2465.	2214.	1969.	1740.	1530.	1339.
1173.	1035.	921.	823.	740.	671.	612.	563.	521.	486.
457.	432.	410.	392.	377.	364.	353.	343.	335.	329.
323.	318.	314.	311.	308.	[illegible]	[illegible]	[illegible]	[illegible]	

Output Summary
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1173.	1035.	921.	823.	740.	671.	612.	563.	521.	486.
457.	432.	410.	392.	377.	364.	353.	343.	335.	329.
323.	318.	314.	311.	308.	305.	303.	301.	299.	298.
297.	296.	295.	295.	295.	295.	295.	295.	295.	295.
295.	295.	295.	295.	295.	295.	295.	295.	295.	295.
295.	295.	295.	295.	295.	295.	295.	295.	294.	292.
288.	281.	270.	256.	238.	217.	195.	173.	151.	

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	10453.	4804.	1531.	1475.	440892.
CMS	296.	136.	43.	42.	12485.
INCHES		25.39	32.36	32.37	32.37
MM		645.00	822.03	822.08	822.08
AC-FT		2382.	3036.	3036.	3036.
THOUS CU M		2939.	3745.	3745.	3745.

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SUB-AREA RUNOFF COMPUTATION

FLOOD HYDROGRAPH FROM NORTH SUB-BASIN

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
A2	0	-0	-0	-0	-0	1	-0	-0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	1.68	-0.	1.68	1.00	-0.	-0	-0	-0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.	26.00	102.00	120.00	130.00	-0.	-0.	-0.

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
-0	-0.	-0.	1.00	-0.	-0.	1.00	-1.00	-91.00	-0.	.14

CURVE NO = -91.00 WETNESS = -1.00 EFFECT CN = 91.00

UNIT HYDROGRAPH DATA

TC= -0. LAG= .53

RECESSION DATA

STRTQ= -1.00 QRCSN= -.05 RTIOR= 5.00

UNIT HYDROGRAPH 34 END OF PERIOD ORDINATES, TC= -0. HOURS, LAG= .53 VOL= 1.00

88.	259.	525.	891.	1209.	1384.	1417.	1349.	1207.	1025.
790.	604.	473.	376.	301.	238.	187.	147.	116.	91.
72.	56.	45.	36.	28.	22.	17.	14.	12.	9.
7.	5.	3.	1.						

0

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.05	1	.01	.00	.01	2.	1.01	12.30	150	.22	.22	.00	1496.
1.01	.10	2	.01	.00	.01	2.	1.01	12.35	151	.22	.22	.00	1714.
1.01	.15	3	.01	.00	.01	3.	1.01	12.40	152	.22	.22	.00	1922.
1.01	.20	4	.01	.00	.01	4.	1.01	12.45	153	.22	.22	.00	2108.
1.01	.25	5	.01	.00	.01	7.	1.01	12.50	154	.22	.22	.00	2267.
1.01	.30	6	.01	.00	.01	9.	1.01	12.55	155	.22	.22	.00	2390.
1.01	.35	7	.01	.00	.01	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Output Summary
100% PMF Event
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[illegible]	.10	2	.01	.00	.01	2.	1.01	12.35	151	.22	.22	.00	[illegible]
[illegible]	.15	3	.01	.00	.01	3.	1.01	12.40	152	.22	.22	.00	1922.
1.01	.20	4	.01	.00	.01	4.	1.01	12.45	153	.22	.22	.00	2108.
1.01	.25	5	.01	.00	.01	7.	1.01	12.50	154	.22	.22	.00	2267.
1.01	.30	6	.01	.00	.01	9.	1.01	12.55	155	.22	.22	.00	2390.
1.01	.35	7	.01	.00	.01	12.	1.01	13.00	156	.22	.22	.00	2484.
1.01	.40	8	.01	.00	.01	15.	1.01	13.05	157	.27	.26	.00	2563.
1.01	.45	9	.01	.00	.01	17.	1.01	13.10	158	.27	.26	.00	2634.
1.01	.50	10	.01	.00	.01	19.	1.01	13.15	159	.27	.26	.00	2704.
1.01	.55	11	.01	.00	.01	21.	1.01	13.20	160	.27	.26	.00	2782.
1.01	1.00	12	.01	.00	.01	22.	1.01	13.25	161	.27	.26	.00	2865.
1.01	1.05	13	.01	.00	.01	23.	1.01	13.30	162	.27	.26	.00	2950.
1.01	1.10	14	.01	.00	.01	24.	1.01	13.35	163	.27	.26	.00	3031.
1.01	1.15	15	.01	.00	.01	24.	1.01	13.40	164	.27	.26	.00	3106.
1.01	1.20	16	.01	.00	.01	25.	1.01	13.45	165	.27	.26	.00	3171.
1.01	1.25	17	.01	.00	.01	25.	1.01	13.50	166	.27	.26	.00	3227.
1.01	1.30	18	.01	.00	.01	26.	1.01	13.55	167	.27	.26	.00	3270.
1.01	1.35	19	.01	.00	.01	27.	1.01	14.00	168	.27	.26	.00	3303.
1.01	1.40	20	.01	.00	.01	29.	1.01	14.05	169	.33	.33	.00	3335.
1.01	1.45	21	.01	.00	.01	31.	1.01	14.10	170	.33	.33	.00	3373.
1.01	1.50	22	.01	.00	.01	33.	1.01	14.15	171	.33	.33	.00	3425.
1.01	1.55	23	.01	.00	.01	36.	1.01	14.20	172	.33	.33	.00	3497.
1.01	2.00	24	.01	.00	.01	39.	1.01	14.25	173	.33	.33	.00	3588.
1.01	2.05	25	.01	.01	.01	42.	1.01	14.30	174	.33	.33	.00	3688.
1.01	2.10	26	.01	.01	.01	45.	1.01	14.35	175	.33	.33	.00	3769.
1.01	2.15	27	.01	.01	.01	48.	1.01	14.40	176	.33	.33	.00	3884.
1.01	2.20	28	.01	.01	.01	51.	1.01	14.45	177	.33	.33	.00	3968.
1.01	2.25	29	.01	.01	.01	55.	1.01	14.50	178	.33	.33	.00	4039.
1.01	2.30	30	.01	.01	.01	58.	1.01	14.55	179	.33	.33	.00	4054.
1.01	2.35	31	.01	.01	.01	61.	1.01	15.00	180	.33	.33	.00	4137.
1.01	2.40	32	.01	.01	.01	64.	1.01	15.05	181	.20	.20	.00	4159.
1.01	2.45	33	.01	.01	.01	67.	1.01	15.10	182	.40	.40	.00	4165.
1.01	2.50	34	.01	.01	.01	70.	1.01	15.15	183	.40	.40	.00	4175.
1.01	2.55	35	.01	.01	.01	73.	1.01	15.20	184	.60	.60	.00	4200.
1.01	3.00	36	.01	.01	.01	75.	1.01	15.25	185	.71	.70	.00	4296.
1.01	3.05	37	.01	.01	.01	78.	1.01	15.30	186	1.71	1.71	.00	4551.
1.01	3.10	38	.01	.01	.01	81.	1.01	15.35	187	2.82	2.82	.01	5284.
1.01	3.15	39	.01	.01	.01	83.	1.01	15.40	188	1.11	1.11	.00	6398.
1.01	3.20	40	.01	.01	.01	86.	1.01	15.45	189	.71	.70	.00	7917.
1.01	3.25	41	.01	.01	.01	88.	1.01	15.50	190	.60	.60	.00	9648.
1.01	3.30	42	.01	.01	.01	90.	1.01	15.55	191	.40	.40	.00	11121.
1.01	3.35	43	.01	.01	.01	92.	1.01	16.00	192	.40	.40	.00	12008.
1.01	3.40	44	.01	.01	.01	94.	1.01	16.05	193	.31	.31	.00	12268.
1.01	3.45	45	.01	.01	.01	96.	1.01	16.10	194	.31	.31	.00	11981.
1.01	3.50	46	.01	.01	.01	98.	1.01	16.15	195	.31	.31	.00	11279.
1.01	3.55	47	.01	.01	.01	100.	1.01	16.20	196	.31	.31	.00	10284.
1.01	4.00	48	.01	.01	.01	102.	1.01	16.25	197	.31	.31	.00	9141.
1.01	4.05	49	.01	.01	.01	104.	1.01	16.30	198	.31	.31	.00	8117.
1.01	4.10	50	.01	.01	.01	106.	1.01	16.35	199	.31	.31	.00	7282.
1.01	4.15	51	.01	.01	.01	107.	1.01	16.40	200	.31	.31	.00	6611.
1.01	4.20	52	.01	.01	.01	109.	1.01	16.45	201	.31	.31	.00	6074.
1.01	4.25	53	.01	.01	.01	111.	1.01	16.50	202	.31	.31	.00	5635.
1.01	4.30	54	.01	.01	.00	112.	1.01	16.55	203	.31	.31	.00	5255.
1.01	4.35	55	.01	.01	.00	114.	1.01	17.00	204	.31	.31	.00	5025.
1.01	4.40	56	.01	.01	.00	115.	1.01	17.05	205	.24	.24	.00	4867.
1.01	4.45	57	.01	.01	.00	117.	1.01	17.10	206	.24	.24	.00	4621.
1.01	4.50	58	.01	.01	.00	118.	1.01	17.15	207	.24	.24	.00	4453.
1.01	4.55	59	.01	.01	.00	119.	1.01	17.20	208	.24	.24	.00	4290.
1.01	5.00	60	.01	.01	.00	121.	1.01	17.25	209	.24	.24	.00	4129.
1.01	5.05	61	.01	.01	.00	122.	1.01	17.30	210	.24	.24	.00	3973.
1.01	5.10	62	.01	.01	.00	123.	1.01	17.35	211	.24	.24	.00	3828.
1.01	5.15	63	.01	.01	.00	124.	1.01	17.40	212	.24	.24	.00	3698.
1.01	5.20	64	.01	.01	.00	125.	1.01	17.45	213	.24	.24	.00	3588.
1.01	5.25	65	.01	.01	.00	126.	1.01	17.50	214	.24	[illegible]	[illegible]	[illegible]
1.01	5.30	66	[illegible]	[illegible]									

Output Summary
100% PMF Event
Old Viburnum Tailings Dam, MO 30342
Upstream Sub-basin 4

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1.	5.00	60	.01	.01	.00	121.	1.01	17.25	209	.24	.24	.00	4124.
1.	5.05	61	.01	.01	.00	122.	1.01	17.30	210	.24	.24	.00	3973.
1.01	5.10	62	.01	.01	.00	123.	1.01	17.35	211	.24	.24	.00	3820.
1.01	5.15	63	.01	.01	.00	124.	1.01	17.40	212	.24	.24	.00	3698.
1.01	5.20	64	.01	.01	.00	125.	1.01	17.45	213	.24	.24	.00	3588.
1.01	5.25	65	.01	.01	.00	126.	1.01	17.50	214	.24	.24	.00	3456.
1.01	5.30	66	.01	.01	.00	128.	1.01	17.55	215	.24	.24	.00	3425.
1.01	5.35	67	.01	.01	.00	129.	1.01	18.00	216	.24	.24	.00	3368.
1.01	5.40	68	.01	.01	.00	130.	1.01	18.05	217	.02	.02	.00	3302.
1.01	5.45	69	.01	.01	.00	131.	1.01	18.10	218	.02	.02	.00	3206.
1.01	5.50	70	.01	.01	.00	132.	1.01	18.15	219	.02	.02	.00	3058.
1.01	5.55	71	.01	.01	.00	133.	1.01	18.20	220	.02	.02	.00	2835.
1.01	6.00	72	.01	.01	.00	134.	1.01	18.25	221	.02	.02	.00	2550.
1.01	6.05	73	.07	.05	.02	138.	1.01	18.30	222	.02	.02	.00	2232.
1.01	6.10	74	.07	.05	.01	149.	1.01	18.35	223	.02	.02	.00	1910.
1.01	6.15	75	.07	.05	.01	170.	1.01	18.40	224	.02	.02	.00	1604.
1.01	6.20	76	.07	.05	.01	206.	1.01	18.45	225	.02	.02	.00	1332.
1.01	6.25	77	.07	.05	.01	255.	1.01	18.50	226	.02	.02	.00	1102.
1.01	6.30	78	.07	.05	.01	312.	1.01	18.55	227	.02	.02	.00	924.
1.01	6.35	79	.07	.05	.01	370.	1.01	19.00	228	.02	.02	.00	788.
1.01	6.40	80	.07	.05	.01	428.	1.01	19.05	229	.02	.02	.00	681.
1.01	6.45	81	.07	.06	.01	481.	1.01	19.10	230	.02	.02	.00	597.
1.01	6.50	82	.07	.06	.01	527.	1.01	19.15	231	.02	.02	.00	529.
1.01	6.55	83	.07	.06	.01	565.	1.01	19.20	232	.02	.02	.00	475.
1.01	7.00	84	.07	.06	.01	596.	1.01	19.25	233	.02	.02	.00	433.
1.01	7.05	85	.07	.06	.01	621.	1.01	19.30	234	.02	.02	.00	400.
1.01	7.10	86	.07	.06	.01	643.	1.01	19.35	235	.02	.02	.00	374.
1.01	7.15	87	.07	.06	.01	662.	1.01	19.40	236	.02	.02	.00	354.
1.01	7.20	88	.07	.06	.01	678.	1.01	19.45	237	.02	.02	.00	338.
1.01	7.25	89	.07	.06	.01	692.	1.01	19.50	238	.02	.02	.00	325.
1.01	7.30	90	.07	.06	.01	703.	1.01	19.55	239	.02	.02	.00	315.
1.01	7.35	91	.07	.06	.01	714.	1.01	20.00	240	.02	.02	.00	307.
1.01	7.40	92	.07	.06	.01	723.	1.01	20.05	241	.02	.02	.00	301.
1.01	7.45	93	.07	.06	.01	731.	1.01	20.10	242	.02	.02	.00	296.
1.01	7.50	94	.07	.06	.01	738.	1.01	20.15	243	.02	.02	.00	293.
1.01	7.55	95	.07	.06	.01	744.	1.01	20.20	244	.02	.02	.00	289.
1.01	8.00	96	.07	.06	.00	750.	1.01	20.25	245	.02	.02	.00	287.
1.01	8.05	97	.07	.06	.00	755.	1.01	20.30	246	.02	.02	.00	285.
1.01	8.10	98	.07	.06	.00	760.	1.01	20.35	247	.02	.02	.00	283.
1.01	8.15	99	.07	.06	.00	764.	1.01	20.40	248	.02	.02	.00	282.
1.01	8.20	100	.07	.06	.00	768.	1.01	20.45	249	.02	.02	.00	282.
1.01	8.25	101	.07	.06	.00	771.	1.01	20.50	250	.02	.02	.00	282.
1.01	8.30	102	.07	.06	.00	775.	1.01	20.55	251	.02	.02	.00	282.
1.01	8.35	103	.07	.06	.00	778.	1.01	21.00	252	.02	.02	.00	282.
1.01	8.40	104	.07	.06	.00	781.	1.01	21.05	253	.02	.02	.00	282.
1.01	8.45	105	.07	.06	.00	783.	1.01	21.10	254	.02	.02	.00	282.
1.01	8.50	106	.07	.06	.00	786.	1.01	21.15	255	.02	.02	.00	282.
1.01	8.55	107	.07	.06	.00	788.	1.01	21.20	256	.02	.02	.00	282.
1.01	9.00	108	.07	.06	.00	790.	1.01	21.25	257	.02	.02	.00	282.
1.01	9.05	109	.07	.06	.00	792.	1.01	21.30	258	.02	.02	.00	282.
1.01	9.10	110	.07	.06	.00	794.	1.01	21.35	259	.02	.02	.00	282.
1.01	9.15	111	.07	.06	.00	795.	1.01	21.40	260	.02	.02	.00	282.
1.01	9.20	112	.07	.06	.00	797.	1.01	21.45	261	.02	.02	.00	282.
1.01	9.25	113	.07	.06	.00	799.	1.01	21.50	262	.02	.02	.00	282.
1.01	9.30	114	.07	.06	.00	800.	1.01	21.55	263	.02	.02	.00	282.
1.01	9.35	115	.07	.06	.00	802.	1.01	22.00	264	.02	.02	.00	282.
1.01	9.40	116	.07	.06	.00	803.	1.01	22.05	265	.02	.02	.00	282.
1.01	9.45	117	.07	.06	.00	804.	1.01	22.10	266	.02	.02	.00	282.
1.01	9.50	118	.07	.06	.00	806.	1.01	22.15	267	.02	.02	.00	282.
1.01	9.55	119	.07	.06	.00	807.	1.01	22.20	268	.02	.02	.00	282.
1.01	10.00	120	.07	.06	.00	808.	1.01	22.25	269	.02	.02	.00	282.
1.01	10.05	121	.07	.06	.00	809.	1.01	22.30	270	.02	.02	.00	282.
1.01	10.10	122	.07	.06	.00	810.	1.01	22.35	271	.02	.02	.00	282.
1.01	10.15	123	.07	.06	.00	811.	1.01	22.40	272	.02	.02	.00	282.
1.01	10.20	124	.07	.06	.00	812.	1.01	22.45	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]	10.05	121	.07	.06	.00	[illegible]							
1	10.10	122	.07	.06	.00	810.	1.01	22.35	271	.02	.02	.00	282.
1.	10.15	123	.07	.06	.00	811.	1.01	22.40	272	.02	.02	.00	282.
1.01	10.20	124	.07	.06	.00	812.	1.01	22.45	273	.02	.02	.00	282.
1.01	10.25	125	.07	.06	.00	813.	1.01	22.50	274	.02	.02	.00	282.
1.01	10.30	126	.07	.06	.00	814.	1.01	22.55	275	.02	.02	.00	282.
1.01	10.35	127	.07	.06	.00	815.	1.01	23.00	276	.02	.02	.00	282.
1.01	10.40	128	.07	.06	.00	816.	1.01	23.05	277	.02	.02	.00	282.
1.01	10.45	129	.07	.06	.00	816.	1.01	23.10	278	.02	.02	.00	282.
1.01	10.50	130	.07	.06	.00	817.	1.01	23.15	279	.02	.02	.00	282.
1.01	10.55	131	.07	.06	.00	818.	1.01	23.20	280	.02	.02	.00	282.
1.01	11.00	132	.07	.06	.00	818.	1.01	23.25	281	.02	.02	.00	282.
1.01	11.05	133	.07	.06	.00	819.	1.01	23.30	282	.02	.02	.00	282.
1.01	11.10	134	.07	.06	.00	820.	1.01	23.35	283	.02	.02	.00	282.
1.01	11.15	135	.07	.06	.00	820.	1.01	23.40	284	.02	.02	.00	282.
1.01	11.20	136	.07	.06	.00	821.	1.01	23.45	285	.02	.02	.00	282.
1.01	11.25	137	.07	.06	.00	822.	1.01	23.50	286	.02	.02	.00	282.
1.01	11.30	138	.07	.06	.00	822.	1.01	23.55	287	.02	.02	.00	282.
1.01	11.35	139	.07	.06	.00	823.	1.02	0.	288	.02	.02	.00	282.
1.01	11.40	140	.07	.06	.00	823.	1.02	.05	289	0.	0.	0.	280.
1.01	11.45	141	.07	.06	.00	824.	1.02	.10	290	0.	0.	0.	274.
1.01	11.50	142	.07	.06	.00	824.	1.02	.15	291	0.	0.	0.	263.
1.01	11.55	143	.07	.06	.00	825.	1.02	.20	292	0.	0.	0.	243.
1.01	12.00	144	.07	.06	.00	825.	1.02	.25	293	0.	0.	0.	217.
1.01	12.05	145	.22	.22	.00	839.	1.02	.30	294	0.	0.	0.	187.
1.01	12.10	146	.22	.22	.00	879.	1.02	.35	295	0.	0.	0.	159.
1.01	12.15	147	.22	.22	.00	960.	1.02	.40	296	0.	0.	0.	136.
1.01	12.20	148	.22	.22	.00	1097.	1.02	.45	297	0.	0.	0.	116.
1.01	12.25	149	.22	.22	.00	1283.	1.02	.50	298	0.	0.	0.	98.
							1.02	.55	299	0.	0.	0.	84.

SUM 33.80 32.80 1.00 426425.
(859.)(833.)(25.)(12075.01)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	12268.	4656.	1480.	1426.	426362.
CMS	347.	132.	42.	40.	12073.
INCHES		25.78	32.78	32.79	32.79
MM		654.82	832.64	832.84	832.84
AC-FT		2309.	2936.	2936.	2936.
THOUS CU M		2848.	3621.	3622.	3622.

Output Summary
100% PMF Event
Old Viburnum Tailings Dam, MO 30342
Upstream Sub-basin 4

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HYDROGRAPH AT STA A2 FOR PLAN 1, RTIO 1

2.	2.	3.	4.	7.	9.	12.	15.	17.	19.
21.	22.	23.	24.	24.	25.	25.	26.	27.	29.
31.	33.	36.	39.	42.	45.	48.	51.	55.	58.
61.	64.	67.	70.	73.	75.	78.	81.	83.	86.
88.	90.	92.	94.	96.	98.	100.	102.	104.	106.
107.	109.	111.	112.	114.	115.	117.	118.	119.	121.
122.	123.	124.	125.	126.	128.	129.	130.	131.	132.
133.	134.	138.	149.	170.	206.	255.	312.	370.	428.
481.	527.	565.	596.	621.	643.	662.	678.	692.	703.
714.	723.	731.	738.	744.	750.	755.	760.	764.	768.
771.	775.	778.	781.	783.	786.	788.	790.	792.	794.
795.	797.	799.	800.	802.	803.	804.	806.	807.	808.
809.	810.	811.	812.	813.	814.	815.	816.	816.	817.
818.	818.	819.	820.	820.	821.	822.	822.	823.	823.
824.	824.	825.	825.	839.	879.	960.	1097.	1283.	1496.
1714.	1922.	2108.	2267.	2390.	2484.	2563.	2634.	2704.	2782.
2865.	2950.	3031.	3106.	3171.	3227.	3270.	3303.	3335.	3373.
3425.	3497.	3588.	3688.	3789.	3884.	3968.	4039.	4094.	4137.
4159.	4169.	4175.	4200.	4296.	4591.	5284.	6398.	7917.	9648.
11121.	12008.	12268.	11981.	11279.	10284.	9141.	8117.	7282.	6611.
6074.	5639.	5295.	5025.	4807.	4621.	4453.	4290.	4129.	3973.

2865.	2950.	3031.	3106.	3171.	3227.	3270.	3303.	3335.	3373.
3425.	3497.	3588.	3688.	3789.	3884.	3968.	4039.	4094.	4137.
4159.	4169.	4175.	4200.	4296.	4591.	5284.	6398.	7917.	9648.
11121.	12008.	12268.	11981.	11279.	10284.	9141.	8117.	7282.	6611.
6074.	5639.	5295.	5025.	4907.	4621.	4453.	4290.	4129.	3973.
3828.	3698.	3588.	3496.	3425.	3368.	3302.	3206.	3058.	2835.
2550.	2232.	1910.	1604.	1332.	1102.	924.	788.	681.	597.
529.	475.	433.	400.	374.	354.	338.	325.	315.	307.
301.	296.	293.	289.	287.	285.	283.	282.	282.	282.
282.	282.	282.	282.	282.	282.	282.	282.	282.	282.
282.	282.	282.	282.	282.	282.	282.	282.	282.	282.
282.	282.	282.	282.	282.	282.	282.	282.	282.	282.
282.	282.	282.	282.	282.	282.	282.	282.	280.	274.
263.	243.	217.	187.	159.	136.	116.	98.	84.	

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	12268.	4656.	1480.	1426.	426362.
CMS	347.	132.	42.	40.	12073.
INCHES		25.78	32.79	32.79	32.79
MM		654.82	832.64	832.84	832.84
AC-FT		2309.	2936.	2936.	2936.
THOUS CU M		2848.	3621.	3622.	3622.

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COMBINE HYDROGRAPHS

COMBINE THREE HYDROGRAPHS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
LAKE	3	-0	-0	-0	-0	1	-0	-0

SUM OF 3 HYDROGRAPHS AT LAKE PLAN 1 RTIO 1

3.	3.	4.	6.	5.	11.	15.	18.	21.	24.
26.	28.	29.	31.	32.	33.	33.	35.	36.	38.
40.	43.	46.	50.	54.	58.	63.	68.	73.	78.
84.	90.	95.	101.	107.	112.	118.	123.	128.	134.
139.	144.	149.	153.	158.	163.	167.	171.	175.	180.
183.	187.	191.	195.	198.	202.	205.	208.	211.	215.
218.	221.	223.	226.	229.	232.	234.	237.	239.	241.
244.	246.	253.	268.	298.	346.	413.	494.	585.	678.
769.	856.	934.	1004.	1067.	1124.	1175.	1219.	1257.	1292.
1322.	1349.	1374.	1396.	1416.	1434.	1451.	1466.	1580.	1936.
2599.	3582.	4847.	6314.	7866.	9367.	10674.	11648.	12120.	11941.
2161.	1877.	1946.	1944.	1954.	1961.	1968.	1975.	1981.	1987.
1992.	1997.	2001.	2006.	2010.	2014.	2019.	2022.	2026.	2029.
2032.	2035.	2038.	2040.	2043.	2045.	2048.	2050.	2052.	2054.
2056.	2058.	2060.	2062.	2087.	2162.	2312.	2550.	2860.	3219.
3602.	3988.	4363.	4707.	5003.	5253.	5477.	5689.	5894.	6097.
6297.	6493.	6680.	6857.	7020.	7167.	7298.	7407.	7505.	7613.
7743.	7898.	8075.	8265.	8458.	8645.	8822.	8983.	9125.	9247.
9335.	9396.	9449.	9546.	9768.	10318.	11576.	13613.	16219.	18965.
21313.	22957.	23806.	23947.	23479.	22542.	21323.	20049.	18856.	17763.
16727.	15748.	14937.	14313.	13816.	13418.	13087.	12785.	12534.	12374.
12166.	12066.	12007.	11593.	11005.	10259.	9521.	9231.	8905.	8433.
7897.	7302.	6697.	6100.	5527.	4997.	4527.	4115.	3752.	3433.
3153.	2916.	2713.	2537.	2383.	2248.	2130.	2025.	1932.	1851.
1782.	1728.	1680.	1634.	1594.	1556.	1521.	1489.	1459.	1431.
1405.	1380.	1357.	1335.	1313.	1293.	1274.	1255.	1237.	1220.

Output Summary
100% PMF Event
Old Viburnum Tailings Dam. MO 30342
Combine Upstream Hydrographs

35.	9396.	9449.	9546.	9768.	10318.	11576.	13613.	16219.	18965.
313.	22957.	23806.	23947.	23479.	22542.	21323.	20049.	18856.	17763.
16727.	15748.	14937.	14313.	13816.	13418.	13087.	12785.	12534.	12324.
12166.	12066.	12007.	11593.	11005.	10259.	9521.	9231.	8905.	8433.
7897.	7302.	6697.	6100.	5527.	4997.	4527.	4115.	3752.	3433.
3153.	2916.	2713.	2537.	2383.	2248.	2130.	2025.	1932.	1851.
1782.	1728.	1680.	1634.	1594.	1556.	1521.	1489.	1459.	1431.
1405.	1380.	1357.	1335.	1313.	1293.	1274.	1255.	1237.	1220.
1203.	1187.	1172.	1158.	1144.	1130.	1118.	1108.	1100.	1092.
1084.	1076.	1069.	1062.	1055.	1048.	1041.	1034.	1027.	1021.
1008.	981.	944.	907.	874.	847.	826.	811.	797.	777.
750.	712.	666.	612.	557.	505.	456.	409.	366.	

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	23947.	11201.	3921.	3777.	1129421.
CMS	678.	317.	111.	107.	31982.
INCHES		24.46	34.25	34.25	34.25
MM		621.27	869.94	870.04	870.04
AC-FT		5554.	7778.	7778.	7778.
THOUS CU M		6851.	9593.	9594.	9594.

Output Summary
100% PMF Event
Old Viburnum Tailings Dam. MO 30342
Combine Upstream Hydrographs

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

RATIOS APPLIED TO FLOWS

OPERATION	STATION	AREA	PLAN	RATIO 1 1.00
HYDROGRAPH AT	LAKE	.61 (1.58)	1	3659. (103.63)(
ROUTED TO	DAM	.61 (1.58)	1	2008. (56.85)(
ROUTED TO	R.R.	.61 (1.58)	1	3564. (100.92)(
HYDROGRAPH AT	LAKE	.21 (.54)	1	2100. (59.47)(
2 COMBINED	ROAD	.82 (2.12)	1	3965. (112.28)(
ROUTED TO	HAUL	.82 (2.12)	1	10548. (298.70)(
HYDROGRAPH AT	AR1	1.76 (4.56)	1	10453. (296.00)(
HYDROGRAPH AT	A2	1.69 (4.35)	1	12268. (347.38)(
3 COMBINED	LAKE	4.26 (11.03)	1	23947. (678.11)(
ROUTED TO	DAM	4.26 (11.03)	1	10538. (298.41)(

Output Summary
100% PMF Event
Old Viburnum Tailings Dam, MO 30342
Summary of Multiple Dam Analysis

Output Summary
100% PMF Event
Old Viburnum Tailings Dam, MO 30342
Summary of Multiple Dam Analysis

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SUMMARY OF DAM SAFETY ANALYSIS
Upstream Dam No. 31016

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1155.50	1155.50	1164.50
STORAGE	87.	87.	540.
OUTFLOW	0.	0.	3100.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1163.01	0.	409.	2008.	0.	17.25	0.

SUMMARY OF DAM SAFETY ANALYSIS
Upstream Dam No. 31779

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1132.00	1132.00	1141.90
STORAGE	12.	12.	72.
OUTFLOW	0.	0.	1329.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1142.66	.76	81.	3564.	.87	17.75	16.75

SUMMARY OF DAM SAFETY ANALYSIS
Upstream Dam No. 31015

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1098.90	1098.90	1098.90
STORAGE	392.	392.	392.
OUTFLOW	0.	0.	0.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1100.01	1.11	421.	10568.	8.58	9.10	8.17

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1045.00	1045.00	1065.00
STORAGE	140.	140.	4609.
OUTFLOW	0.	0.	15000.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1061.88	0.	3742.	10538.	0.	18.00	0.

Output Summary
100% PMF Event
Old Viburnum Tailings Dam, MO 30342
Overtopping Analysis

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1045.00	1045.00	1065.00
STORAGE	140.	140.	4609.
OUTFLOW	0.	0.	15000.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	1055.65	0.	2185.	4832.	0.	17.92	0.

Output Summary
50% PMF Event
Old Viburnum Tailings Dam, MO 30342
Overtopping Analysis

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SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1045.00	1045.00	1065.00
STORAGE	140.	140.	4609.
OUTFLOW	0.	0.	15000.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1048.43	0.	704.	793.	0.	14.58	0.

Output Summary
100 Year Probability Event
Old Viburnum Tailings Dam, MO 30342
Overtopping Analysis

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END

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