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DELAWARE RIVER BASIN

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SCS PA 477 BERKS COUNTY, PENNSYLVANIA

NDS I.D. NO. PA 00720 DER I.D. NO. 6-457 DACW31-80-C-0018 Yew

PHASE I INSPECTION REPORT NATIONAL DAM INSPECTION PROGRAM



Prepared by:

WOODWARD-CLYDE CONSULTANTS 5120 Butler Pike Plymouth Meeting, Pennsylvania 19462

Submitted to:

DEPARTMENT OF THE ARMY Baltimore District, Corps of Engineers Baltimore, Maryland 21203

JANUARY 1980





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This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams for Phase I Investigations. Copies of these guidelines may be obtained from the Office of the Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to expeditiously identify those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed 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 reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

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

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.



PHASE I INSPECTION REPORT NATIONAL DAM INSPECTION PROGRAM

Name of Dam: County Located: State Located: Stream: Coordinates: SCS PA 477 Berks County Pennsylvania Tributary to Mill Creek Latitude 40° 34.3' Longitude 75° 57.8' October 26, 1979

Date of Inspection:

SCS PA 477 is owned and maintained by the Borough of Hamburg. The dam and reservoir are used as a flood control structure for the downstream town of Hamburg, Pennsylvania. The impoundment was designed by the United States Department of Agriculture, Soil Conservation Service (SCS), in 1963, and the structure was officially completed in December 1965.

The dam and its appurtenant facilities are considered to be in good condition. The dam is classified as an "Intermediate" size structure with a "High" hazard classification, consistent with its potential in the event of failure for extensive property damage and loss of life in Hamburg, Pennsylvania.

Calculations indicate that the existing spillway systems are capable of passing the Probable Maximum Flood (PMF) without overtopping. Therefore, the spillway system is considered to be "Adequate".

The visual inspection and review of available documentation indicates that the dam, foundation and its appurtenant structures are in good condition. The only items to be noted are the undesirable vegetation gaining a foothold on the embankment and the emergency spillway slope, and the extensive growth of willows on the embankment at normal pool elevation and the riser access door that cannot be opened.

Considering the overall good condition of the dam, the only recommendations made beyond routine maintenance of the dam are:

1. The multiflora rose should be removed from the drainage swale between the embankment and the highway to prevent the spread of the multiflora rose to the embankment.

- 2. The growth of willows should be removed from the embankment shoreline. Cutting is not sufficient to prevent the growth of willows.
- 3. The access door from the top of the riser should be repaired or replaced, as necessary.

Because of the location of the dam upstream of Hamburg, a formal procedure of observation and warning during periods of high precipitation should be developed and imple-This procedure should include a method of warning mented. downstream residents of the possibility of flooding. The Owner should also develop an operational and maintenance procedure to be used to insure that the dam is maintained in the best possible condition. The primary elements of the operational/maintenance procedure can be obtained from the Soil Conservation Service's "Watersheds and Conservation and Development Operations and Maintenance Handbook". It is important that individuals responsible for the maintenance and operation of the dam are aware of the written procedures.

Mary F. Beck, P.E. Mary F. Beck, P.E. Jeb. 7, 1980 Date Pennsylvania Registration 27447E Woodward-Clyde Consultants 80 John H. Frederick, Jr., P.E Maryland Registration 7301 Woodward-Clyde Consultants APPROVED BY: 20 March 60 ionis THOMAS A. RHEN Date LTC, Corps of Engineers Acting District Engineer iii

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PHASE I INSPECTION REPORT NATIONAL DAM INSPECTION PROGRAM SCS PA 477 NATIONAL ID NO. PA 00720 DER NO. 6-457

> SECTION 1 PROJECT INFORMATION

1.1 General.

a. <u>Authority</u>. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. <u>Purpose</u>. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

SCS PA 477 is a 52 foot Dam and Appurtenances. a. high, 1,550 foot-long dam, with an emergency spillway at the right abutment. The embankment contains an impervious core constructed over a cutoff trench under the dam centerline. About 1,270 feet of the embankment is roughly parallel to U.S. Route 22/Interstate 78. The remaining 280 feet of the embankment forms an angle of about 60 degrees with the highway. The shorter leg contains the maximum section and the principal spillway. The core and cutoff trench, denoted as Section 1, are composed of materials classified as gravelly, sandy clay (CL), silty sand (SM) and clayey sand (SC). The outer shell, denoted as Section 2, consists of more permeable materials classified as silty and clayey gravel (GC, GP-GM, GP-GC, GC-GM) and weathered rock. The upstream slope is 3H: 1V, with a 10 foot wide berm at approximately elevation 494.5, the normal pool level. The downstream slope is 2.5H:1V with a partial rock toe as shown on Plates 2 and 5, Appendix E. The impervious Section 1 core side slopes are 1H:1V, and the cutoff trench side slopes are 2H:lV. The 16 foot wide embankment crest is at design elevation 524.3. Both upstream and downstream slopes are protected with Crownvetch and grass. Plan and cross-sections of the dam are shown on Plates 2 through 6, Appendix E.

Embankment seepage is controlled by a trench drain near the downstream toe. The trench drain contains an eight inch diameter perforated pipe embedded within its full length

and connected to drains parallel to the principal spillway, and outletting through the impact basin walls. Part of the trench drain is connected to the rock toe by a filter blanket as shown on Plate 5, Appendix E. Я.

The principal spillway consists of a concrete drop inlet riser, a 222 foot long, 30 inch reinforced concrete pipe with eight anti-seep collars, and an impact basin. The reservoir drain, composed of 40 feet of 12 inch diameter corrugated metal pipe, has an inlet invert elevation of 480.5. The riser orifice is at elevation 494.0 and the weir crest elevation is 512.8. The outlet invert and impact basin end sill elevations are 472.38. Typical sections of the principal spillway are presented on Plates 6 through 8 in Appendix E.

The emergency spillway was excavated through rock at the right abutment. The grass-lined trapezoidal channel is approximately 150 feet wide, and the 30 -foot wide level section is at elevation 516.3. A dike constructed between the outlet of the emergency spillway and the downstream toe prevents emergency spillway discharge from flowing against the embankment toe. Similarly, a dike constructed near the bend of the embankment prevents highway drainage from Route 22 from flowing against the downstream toe of the embankment.

b. Location. The dam is located on a tributary of Mill Creek in Windsor Township, Berks County, Pennsylvania. The dam site is located approximately 1.5 miles northeast of downtown Hamburg, Pennsylvania. The dam site and reservoir are located on USGS Quadrangle entitled, "Hamburg, Pennsylvania, Berks County", at coordinates N 40° 34.3' W 75° 57.8'. A regional location plan of SCS PA 477 is shown on Plate 1, Appendix E.

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c. <u>Size Classification</u>. The dam is classified as an "Intermediate" size dam by virtue of its 52 foot height.

d. <u>Hazard Classification</u>. A "High" hazard classification is assigned consistent with the potential for extensive property damage and loss of life downstream of the dam along Mill Creek in Hamburg.

e. <u>Ownership</u>. SCS PA 477 is owned and maintained by Hamburg Borough. All correspondence should be sent to Mr. Charles Clark, Hamburg Borough Manager, 31 North Third Street, Hamburg, Pennsylvania 19526.

f. <u>Purpose of Dam</u>. The purpose of this dam is flood control. This structure is one of three dams built on the Kaercher Creek Watershed to provide flood protection to the Borough of Hamburg.

Design and Construction History. SCS PA 477 was g. constructed as a flood retarding structure under the provi-sions of the Watershed Protection and Flood Prevention Act. It is one of two single-purpose flood control dams and one multi-purpose dam which form the protection for the Kaercher Creek Watershed. Congress approved the appropriation for the dam in 1962. The soils and foundation investigation was made in 1963, and by May 1964, final construction drawings were prepared by SCS. Construction began in 1964, by Feeser constructors, and by December 1965, the structure was com-SCS personnel provided resident engineering and plete. inspection services throughout the construction.

It is reported that in 1969, work costing \$6,000 was performed. Details are unknown.

Normal Operating Procedures. Under normal condih. tions, the pond drain gate is closed and water flows through the principal spillway orifice at elevation 494.0. Excess water is then stored up to the principal spillway weir crest Thereafter, water is stored up to at elevation 512.8. elevation 516.3, and then discharged through the emergency spillway at the right abutment.

1.3 Pertinent Data.

The summary of pertinent data for SCS PA 477 is presented as follows.

- 1.59 a. Drainage Area (square miles)
- b. Discharge at Dam Site (cfs) Maximum Known Flood at Dam Site Unknown 5,380 At Design High Water At Top of Dam 10,030 c. Elevation (feet above MSL)
- 524.3 Top of Dam 521.7 Design High Water 516.3 Emergency Spillway Crest Principal Spillway 512.8 Weir Crest Orifice 494.0 Pond Drain 480.5 Conduit Outlet Invert and Impact Basin End Sill 472.38 đ. Reservoir Length (feet) Length at Normal Pool 540 2,000

Length at Design High Water

e.	Storage (acre-feet) Sediment/Normal Pool To Emergency Spillway Crest To Top of Dam	11 207 371
f.	Reservoir Surface Area (acres) Sediment/Normal Pool Design High Water	2.6 20
g.	Embankment Data Type Volume Length Maximum Height Top Width Side Slopes Upstream Downstream Cutoff Grout Curtain	Zoned earth fill 142,523 cu yds 1,550 feet 52 feet 16 feet 3H:1V 2.5H:1V Trench beneath dam centerline None
h.	Principal Spillway Type Elevations Weir Crest Orifice Pond Drain Inlet Conduit Outlet Invert and Impact Basin End Sill	Reinforced concrete drop inlet riser, 30 inch conduit and im- pact basin 512.8 494.0 480.5 472.38
i.	Emergency Spillway Type Width Side Slopes Right Left Elevation	Trapezoidal channel 150 feet 2H:lV 2.5H:lV 5l6.3

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SECTION 2 ENGINEERING DATA

2.1 Design.

a. <u>Data Available</u>. A summary of engineering data on SCS PA 477 is attached as Appendix B. Engineering data available for review is contained in a several hundred page design folder prepared by the United States Department of Agriculture, Soil Conservation Service (SCS), and an 18 page set of "as-built" drawings also prepared by SCS. No other documentation was available.

b. <u>Design Features</u>. The principal design features of SCS PA 477 are illustrated on the plans and profiles enclosed in Appendix E as Plates 2 through 8. These plates were reproduced from as-built drawings prepared by SCS. A description of the design features is also described in Section 1.2, paragraph a, and pertinent data relative to the structure is presented in Section 1.3.

2.2 Construction.

The known construction history is presented in Section 1.2, paragraph g. No construction records for this dam were available for review, and SCS construction documentation reportedly no longer exists.

2.3 Operational Data.

Operational records, water level measurements and rainfall records are not maintained within this watershed, although rainfall records are kept at a wastewater treatment plant about 0.8 mile southwest of the dam. The station has been a National Weather Service reporting station since 1978.

2.4 Evaluation.

a. <u>Availability</u>. All engineering data evaluated and reproduced for this report were provided by SCS.

b. <u>Adequacy</u>. The design data included in SCS state files are considered adequate to evaluate the design of the dam and appurtenant structures.

c. <u>Validity</u>. There is no reason to question the validity of this data.

SECTION 3 VISUAL INSPECTION

3.1 Findings.

a. <u>General</u>. Observations and comments of the field inspection team are contained in the checklist enclosed herein as Appendix A, and are summarized and evaluated as follows. In general, the dam and its appurtenant structures are considered to be in good condition. At the time of the inspection, stream flow was passing through the riser of the principal spillway, preventing access into the riser or inspection of the discharge conduit.

b. <u>Dam</u>. During the visual inspection, there were no indications of distortion in alignment or grade that would be indicative of movement of the embankment or foundation. The vegetative cover on both the upstream and downstream slopes is considered in less than good condition. The major source of unauthorized traffic to the dam is from U.S. Route 22/Interstate 78. A path has been worn through the embankment cover, as shown in Photograph No. 8, Appendix C, but no significant erosion has resulted. Multiflora rose is starting to grow in the drainage swale between the embankment and the highway, near the footpath, as shown in Photograph No. 9, Appendix C. Multiflora rose is undesirable in that it prevents vegetation from growing along the ground surface and permits erosion. Although the rose is not on the embankment, it should be removed from the drainage swale to prevent its spread. Brambles are also beginning to grow on both the upstream and downstream slopes. The upstream slope has several three to four year old saplings, as shown in Photograph No. 5, Appendix C, which should be moved. A more serious problem is the willow trees that are growing along the reservoir edge, as shown in Photographs No. 1 and No. 6. Although these have been cut, they grow very rapidly with extensive root systems. Rather than being cut, these willows should be completely removed.

The embankment crest is considered to be in good condition. During the October 1979 visual inspection, no evidence was noted of vehicle traffic along the dam crest. However, by December, ruts were appearing through the vegetation, although not in the embankment itself, as shown in Photograph No. 7, Appendix C.

The vertical and horizontal alignments were checked and found to be satisfactory. Junctions between the embankment and abutment and the embankment and spillway are judged to be in good condition with no excessive erosion or deterioration. A small amount of clear seepage was noted

entering below water level from the right of the impact basin. No water was flowing from the embankment drains outletting through the impact basin walls, but slight seepage was noted within the rock to the left of the impact basin. Standing water was noted at the upper end of the drainage swale between the embankment and the highway. Three cast iron pipes were observed draining into the reservoir at the upper end. See sheet 5a of Appendix A.

c. Appurtenant Structures.

1. <u>Principal Spillway</u>. As shown on Photograph No. 1, the riser is located within the upstream berm at the shoreline. Exposed portions of the riser were inspected and evaluated to be in good condition with no signs of excessive concrete deterioration, spalling or other structural deficiencies or defects. The interior of the intake riser could not be inspected as one hinge was rusted on the access door and the door could not be opened. The pond drain sluice gate was exercised and found to operate easily.

The outlet channel was inspected and observed to be in good condition with no excessive erosion or bank undercutting, as shown in Photograph No. 3.

2. <u>Emergency Spillway</u>. The grass-lined emergency spillway at the right abutment was inspected and found to be stable and in good condition. The approach channel was wet with hillside seepage or standing rainwater. Sumac is growing on the right spillway slope above the elevation of the dam. At the time of the inspection, a brush pile at the entrance of the spillway was stored, reportedly until it could be burned at the first snowfall. The emergency spillway is shown in Photograph No. 4.

d. <u>Reservoir</u>. At the time of the inspection, the pond was at the sediment/normal pool elevation. The reservoir slopes are well vegetated to the water's edge. A small pond at the upper end of the reservoir tends to trap sediment. This pond is below design high water elevation.

e. <u>Downstream Channel</u>. As shown on Plate 1, Appendix E, Mill Creek flows southwest to the Borough of Hamburg, Pennsylvania. About 750 feet below the dam, the stream passes under U.S. Route 22/Interstate 78, as shown in Photograph No. 10. About 800 feet farther downstream, the outflow from SCS PA 477 is joined by the discharge from SCS PA 476, a flood control dam in an adjacent valley. The confluence is shown in Photograph No. 11. There is a pumping station and wastewater treatment plant built near the stream in the next 1.25 miles before Mill Creek enters Hamburg and passes under homes and businesses, as shown in Photograph No. 12. Site 477 is one of

three dams designed and built to protect the Borough of Hamburg from flood water damage, and a "High" hazard classification is justified.

3.2 Evaluation.

Inspection of the dam and appurtenant facilities disclosed no evidence of apparent past or present movement that would indicate existing instability of the dam, principal spillway or emergency spillway. Interior portions of the principal spillway and discharge pipe could not be inspected due to flow through the system and a rusted door hinge. The principal spillway discharge channel is in good condition, with no excessive bank undercutting or erosion. The emergency spillway channel and the area below the dam were observed to be in good condition. The reservoir shoreline has an abundant growth of willow trees which should be removed. Undesirable vegetation should be removed from the embankment, both upstream and downstream slopes, and in the drainage channel between the embankment and the adjacent highway.

SECTION 4 OPERATIONAL PROCEDURES

4.1 Procedures.

Operational procedures are discussed in Section 1.2. Operation of the dam does not require a dam tender. Under normal conditions, flow discharges through the principal spillway orifice or over the weirs of the principal spillway and through the 30 inch conduit at the base of the embankment. Excess water is stored and then discharged over the crest of the emergency spillway. As reported by the Owner's representatives, water has never flowed over the emergency spillway. The Owner's representative reports that they do not have a written operational and maintenance procedure.

4.2 Maintenance of the Dam.

The dam is maintained by the Borough of Hamburg, who periodically check the embankment, mow the grass and remove woody vegetation.

4.3 Maintenance of Operating Facilities.

Maintenance of these facilities includes twice yearly inspection, and operation and lubrication of the pond drain sluice gate.

4.4 Warning Systems In Effect.

Hamburg Borough representatives indicate that no written warning procedure is in effect. The Borough Manager indicated that they would coordinate warning of downstream residents with the local Civil Defence unit in the event a hazardous condition developed.

4.5 Evaluation.

It is judged that the current operating procedure, which does not require a dam tender, is a realistic means of operating the relatively simple control facilities of SCS PA 477. There are no written operational procedures, maintenance procedure or any type of warning system. Maintenance and operating procedures should be developed, including a checklist of items to be observed, operated, inspected and maintained on a regular basis. Since a formal warning procedure does not exist, one should be developed and implemented during periods of extreme rainfall. This procedure should consist of a detailed method of notifying residents downstream if potentially high flows are imminent or if a dangerous condition is developing.

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SECTION 5 HYDROLOGY/HYDRAULICS

5.1 Evaluation of Features.

a. <u>Design Data</u>. The complete folder of design calculations was reviewed and portions of this folder are presented in Appendix D.

The watershed is about 1.5 miles long, and averages about one mile wide, having a total area of approximately 1.59 square miles. Elevations range from about 1,500 feet in the upper reaches of the watershed to 494 feet at normal pool elevation. The watershed is approximately 60 percent wooded, with the remainder open or farmland. There is very little residential development within the watershed. Residential development can be expected to progress slowly.

In accordance with criteria established by Federal (OCE) Guidelines, the recommended spillway design flood for this "Intermediate" size dam and "High" hazard classification is the Probable Maximum Flood (PMF). The Soil Conservation Service designed this dam as a Class C structure, which requires that the spillway systems be designed to pass the PMF.

b. <u>Experience Data</u>. There are no records of reservoir levels kept for this dam. Rainfall is measured at the treatment plant about 0.8 mile southwest of the dam and has been reported to the National Weather Service since 1978. There are no estimates or records of previous high water levels.

c. <u>Visual Observations</u>. At the time of the inspection, there were no conditions observed that would indicate a reduced spillway capacity during an extreme event. Other observations regarding the condition of the downstream channel, spillways and reservoir are located in Appendix A and discussed in greater detail in Section 3.

d. <u>Overtopping Potential</u>. The dam was designed to pass the PMF without overtopping. The PMF inflow hydrograph was determined according to procedures in the SCS National Engineering Handbook, Section 4 (NEH-4), and is presented in Appendix D. The flood routing was done according to NEH-5, a graphical procedure. As the graphical flood routing was not available for review, the original design PMF inflow hydrograph was entered into the HEC-1, Dam Safety Version, computer program and the flood routing performed. In summary, the peak inflow was computed as 9,782 cfs, resulting from a six hour

storm with 27.6 inches of rainfall producing 24.3 inches of runoff. The storm was routed through the reservoir to produce a peak discharge of 9,145 cfs and a maximum water level elevation of 524.03, below the top of the dam. The spillway systems for this dam are considered to be "Adequate" as the dam will pass the PMF without overtopping.

e. <u>Downstream Conditions</u>. About 750 feet below the dam, discharge passes under U.S. Route 22 (Interstate 78), Photograph 10, Appendix C, and 800 feet farther downstream the discharge from SCS PA 477 combines with the outflow of SCS PA 476, Photograph 11. SCS PA 476 is a flood control dam in the adjacent watershed. In the next 1.25 miles is a pumping station and a wastewater treatment plant built adjacent to the stream and subject to damage in the event of dam failure. In Hamburg, the stream flows under houses and businesses; see Photograph 12 in Appendix C. It is apparent, by comparing the relative sizes of the stream channel through Hamburg and the emergency spillway, that property damage would occur during an extreme event and it is judged that failure during the PMF would significantly increase property damage and loss of life.

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SECTION 6 STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

Visual Observations. Visual observations detected 8. no evidence of existing or impending embankment instability. Upstream and downstream slopes appeared stable, with no surficial cracks, slides or other indications of deep seated instability. Both upstream and downstream slopes are densely vegetated with Crownvetch mixed with undesirable vegetation, and the embankment appears to be in good condition. There were no exterior signs or other evidence to indicate that the internal drainage systems were not operating properly. It is noted, however, that during this inspection, the reservoir was at the elevation of the sediment/normal pool and the embankment was not retaining a significant head of water, which could affect the internal drainage system.

A small amount of clear seepage was noted entering below water level from the right of the impact basin and noted within the rock toe to the left of the impact basin.

Exposed portions of the principal spillway were inspected and judged to be in good condition. The interior of the riser was not inspected as the access door could not be opened. The pond drain sluice gate was exercised and operated easily. The emergency spillway was also inspected and assessed to be in good condition.

b. Design and Construction Data. Design documentation is very complete as a several hundred page design folder prepared by the Soil Conservation Service (SCS) was available and reviewed at their office for this investigation. Data included in these files are a soils and foundation investigation report, summary of stability analysis for the embankment, and structural design for the principal spillway. Included in the design folder is a complete set of hydrologic and hydraulic calculations, with the exception of the graphical flood routing. Also included in this report are a complete set of specifications and an estimate of the quantity of materials used in the embankment. Documents pertaining to the design also include an 18 sheet set of drawings prepared by SCS and stamped "as-built".

A stability analysis of the embankment was performed by SCS using the Swedish circle method on the upstream slope for full rapid drawdown conditions and on the downstream slope for steady seepage. Soil strength parameters for the core (Section 1) material were determined from one consolidatedundrained triaxial compression test series on compacted borrow soil. Strength parameters for the shell (Section 2) material were selected based upon the results of two test series. It was assumed that the foundation materials had sufficient strength to prevent a failure arc from passing through the embankment.

The reported results of the stability analysis are as follows:

Slope	Condition	Factor of Safety
Upstream	Rapid Drawdown	1.57
Downstream	Steady Seepage	1.73

The recommended minimum allowable factors of safety in accordance with Corps of Engineers EM 1110-2-1902 are 1.2 for the upstream slope under rapid drawdown conditions and 1.5 for the downstream slope under steady seepage conditions.

It is noted that the stability analysis is based upon limited soil testing. It is also noted that the analysis was based upon an assumed embankment height of 48.3 feet rather than the actual maximum embankment height of 52 feet, and that the assumed embankment section was zoned differently than the as-built embankment. On the conservative side, however, the stabilizing upstream berm at elevation 494 was not considered in the analysis; the design high water level of elevation 524.3 was used instead of the highest principal spillway crest elevation of 512.8, as specified by current SCS criteria in TR-60; and relatively high factors of safety were computed. Therefore, overall it is concluded that the stability of the embankment is adequate.

Principal features of this structure were extracted from these drawings and calculations, and are located in Appendices E and D, respectively. Inspection reports prepared by the Department of Environmental Resources representatives and progress reports prepared for DER by the SCS resident engineer were not available for review. Construction documentation prepared by the SCS resident engineer reportedly no longer exists.

c. <u>Operating Records</u>. There are no operational records for this structure.

d. <u>Post-Construction Changes</u>. In or about 1969, it is reported that work totalling \$6,000 was performed. Details are unknown.

e. <u>Seismic Stability</u>. The dam is located in Seismic Zone 1. Normally it is considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake conditions. As the static stability analysis resulted in a minimum factor of safety of 1.57 under rapid drawdown conditions, the most critical loading conditions, it can be assumed that seismic stability requirements are satisfied.

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SECTION 7 ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment.

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a. <u>Evaluation</u>. Visual inspection and review of design documentation indicate that the embankment and appurtenant structures of SCS PA 477 are in good condition.

Hydrologic and hydraulic computations presented in Appendix D indicate the structure will pass the Probable Maximum Flood without overtopping. Therefore, the spillway systems of this structure are considered to be "Adequate". In the event that high flows are passed through the emergency spillway, significant property damage is still likely to occur downstream in the Borough of Hamburg. In the event the dam fails while retaining a significant quantity of water, extreme property damage and possible loss of life would be expected, thus justifying the "High" hazard classification.

b. <u>Adequacy of Information</u>. Information available for this investigation was sufficiently adequate to evaluate the structural and hydraulic aspects of the dam.

c. <u>Urgency</u>. It is recommended that the suggestions presented in Section 7.2 be implemented during routine maintenance of the structure.

7.2 <u>Remedial Measures</u>.

a. <u>Facilities</u>. It is recommended that the following steps be taken.

- 1. All saplings and woody vegetation should be removed from both the upstream and downstream slopes of the embankment.
- 2. The multiflora rose should be removed from the drainage swale between the embankment and the highway to prevent the spread of the multiflora rose to the embankment.
- 3. The growth of willows should be removed from the embankment shoreline. Cutting is not sufficient to prevent the growth of willows.
- 4. The access door from the top of the riser should be repaired or replaced, as necessary.

b. Operation and Maintenance Procedures. Because of the location of the dam and the potential for extreme property damage and possible loss of life in the event of failure, a formal procedure of observation and warning during periods of high precipitation should be developed and implemented. This procedure should include a method of warning downstream residents if high flows are expected and provisions for evacuating these people in the event of an emergency. In addition, an operation and maintenance procedure should also be developed to insure that all items are carefully inspected on a regular basis and maintained in the best possible condition.

The "Operations and Maintenance" manual prepared by SCS can form the basis for the specific procedures for SCS PA 476. It is recommended that operational procedures provide for a period of observation during and following impoundment of significant quantities of water behind the embankment. These observations should include monitoring discharge from the embankment drainage system and looking for sources of uncontrolled seepage. It is important that individuals responsible for the maintenance and operation of the dam are aware of the written procedures.

APPENDIX

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	Sheet 1 of 11	sylvania 10 1 PA 00720 50's	Inspection 472.8± M.S.L.	kecorder	2 dtt.	
	CHECK LIST VISUAL FASPECTION PHASE I	County <u>Berks</u> State <u>Pemn</u> Nazard Category <u>High</u> ther <u>Portly cloudy</u> Temperature	494.6 M.S.L. Tailwater at Time of	aymond S. Lambert (Geologist) (12/11/79) Mary F. Beck	Vorristown, accompanied the inspection to re on site to operate the pond drain gat	
• •		Hame Dum SCS PA 477 type of Dam Earth Date(s) Inspection 10/26/79 Weat	punt Elevation at fime of Inspection	luspuction Personnel: Mary F. Beck (Hydrologist) Arthar H. Dvinoff nical (Civil) Vincent McKeever (Hydrologist)	kemarks: Mr. Gary Emmanuel, DER, N Two Borrough employees wer	
			and the second second second second	atter and and and and an include a start of the		

Sheet 2 of 11 REMARKS OR RECOMPENDATIONS ٠ ł CONCRETE/MASOHRY DAHS **OBSERVATIONS** N/A N/A N/AN/AN/AANY NOTICEABLE SEEPAGE VISUAL EXAMINATION OF SFRUCTURE TO ABUTHENT/EMBAHKMERT JUNCTTOMS MATER PASSAGES FUURIDATION DRAINS ۴ •

conry 1ams Sheet 3 of <u>Remarks or recommendations</u>					
CONCRETE/MAS	N/A	N/A	N/A	N/A	N/A
UTSTIAL EXAMINATION OF	SURFACE CRACKS CUNCRETE SURFACES	structural cracking	VERTICAL AND INNUZONTAL ALIGIMENT	MAROL ITH JOINTS	CONSTRUCTION JOINTS

	Sheet 4 of 11
I SUAL EXAMINATION OF	OBSERVATIONS REMARKS OR RECOMMENDATIONS
URFACE CRACKS	None observed. No ruts noted on crest. (In December, ruts observed in vegetation but not the embankment.)
DNISUAL MOVEMENT OR PRACKING AT OR BEYOND FILE TOE	None observed.
sloughing or erosion of erbangrent and abuthent slopes	Although foot traffic has worn path over embankment, no significant erosion has resulted.
VERTICAL AND INNRIZONTAL ALIGNMENT OF THE CREST	Alignment both vertically and laterlly is good.
RIPKAP FAILURES	None, riprap limited to the dike between embankment and emergency spillwav.

EMBANKMENT

	EMBANKMENT
VISIAL EXAMINATION OF	Sheet 5 of 11 OBSERVATIONS REMARKS OR RECOMMENDATIONS
VEGETATION	Although upstream and downstream slopes have generally a good cover of Crownvetch, brambles and wild roses are beginning to grow, and several three to four year old saplings. All should be removed. There are some spots of poor cover and weeds on the embankment. Willows are growing along the water line on the embankment; although these have been cut, they should be removed by a more positive method.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Good condition.
ANY NOTICEABLE SEEPAGE	Small amount of clear seepage entering below the water level from the right of the impact basin.
STAFF GAGE AND RECORDER	None
DKAINS	No water flowing from embankment drains outletting through impact basin walls.





SHEET 58 OF 11

FIELD OBSERVATION PROFILE SCS PA 477



Sec. 1

LOOKING DOWNSTREAM

	PRINCIPAL SPILLWAY OUTLET WORKS
SUAL EXAMINATION OF	OBSERVATIONS REMARKS OR RECOMMENDATIONS
icking and spalling of Icrete surfaces in Tet conduit	None observed; outlet conduit through dam could not be inspected.
AKE SIRUCTURE	Concrete appears in good condition. The hinge on access door through top of riser is rusted and door could be opened.
LET STRUCTURE	Concrete appears in good condition.
LET CIANNEL	Fairly good condition, although the channel is "weedy".
RGENCY GATE	Pond drain gate located outside of riser operates easily.

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Salar and the second
CONTROL SECTION Grass lined control section is in good condition. APPHONCI CLUMIEL In good condition, approach channel has thick "wet" type grass and at the time of inspection, uses wet with hilled seepage or standing ratinators. Same of the spillway use stored until it could be burned at the first snow. INSCRIMENT The discharge channel is in good condition.	VISIMI EXAMINATION OF	OBSERVATIONS REMARKS OR RECOMP
MPPHOACII CIMMIEL In good condition, approach channel has thick "wet" type grass and at the time of inspection, was wet with hillside seepage or standing rainwater. Sumac is growing on the right spillway slope above the elevation of top of dam. At the time of inspection, the brush pile at the entrance of the spillway was stored until it could be burned at the first snow. UISCUMMEE CINAME The discharge channel is in good condition. MINAL AND PIEMS None MINAL AND PIEMS None	CONTROL SECTION	Grass lined control section is in good condition.
DISCIMRGE CINIMIEL The discharge channel is in good condition. BRINGL AND PIEKS None None	APPROACH CHANNEL	In good condition, approach channel has thick "wet" type grass and at the time of inspection, was wet with hillside seepage or standi rainwater. Sumac is growing on the right spillway slope above the elevation of top of dam. At the time of inspection, the brush pill at the entrance of the spillway was stored until it could be burne at the first snow.
BRINGLAND PIEKS None	DISCIMRGE CIN:MEL	The discharge channel is in good condition.
	BRIDGL AND PIEKS	None

ALL STREET

GATED SPILLMAY

And the second

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	Sheet 8 of
VISUML EXAMINATION OF CONCRETE SILL	OBSERVATIONS REMARKS OR RECOMPLINIATIONS N/A
APPRUACH CHARMEL	N/A
IN SCHARGE CHANNEL	N/A
DIRJOCH AND PIERS	N/A
CATES A.4D OPERALION	N/A

INSTRUMENTATION

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		Sheet 9 of 11
VISUM. EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
HIMALMENTATION/SHRVEYS	None	
OBSERVATION MELLS	None	
WE IKS	None	
PIE 20METERS	Norue	
OTHER	None	

RESERVOIR Shee VISUAL EXAMINATION OF OBSERVATIONS REMARKS OR RECOM	SLUNES The reservoir slopes are moderate and well vegetated to water's edge with grass and trees.	SENIMENIATION A small pond at the upper end of the reservoir traps sediment entering the reservoir from the stream. Sedimentation has no effect on flood storage capacity.	
	1410 TS	SEDI	

MULFION About 750 feer (UBSTRUCTIONS, About 750 feer (UBSTRUCTIONS, Through a 16.4 UFBRIS, ETC.) The channel is slopes.	downstream of the dam, the cha foot wide and 11 foot high culi about five feet wide and four	mel passes under U.S. Route 22 vert, see Photograph No. 10. feet deep with 2:5H: IV side
0rts The valley gro	dient is about 0.02.	
PROXIMATE NO. NORN'S AND HALATION Pear the strea graph No. 12.	t below the dam, the stream joir 2 miles, there is a pumping stat n before Mill Creek enters Hambu	is the outlet stream from SCS Pl ion and a sevage treatment plan rrg and passes under homes. See

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محسرة سمة تحصم ستريما الأولاء وسيطله بعا

APPENDIX

5.15

NAME OF DAM <u>SCS PA 477</u> 1710H ID # <u>PA 00720</u>	Sheet 1 of 4		dix E.	.2, paragraph g of text.				
CHECK LIST ENGLAEERING JATA DESIGA, CONSTRUCTION, OPLNA	REMARKS	Yes, see Appendix E.	Yes, see Plate 1, Appen	Limited, see Section 1.	Yes, see Appendix E.	See Appendix E.	See Appendix D. None available	
	Ξ	BUILT DRAWINGS	SIONAL VICINITY MAP	4STRUCTION HISTORY	PICAL SECTIONS OF DAM	JTLETS - PLAN DETAILS CONSTRAINTS	DISCHARGE RATINGS AINFALL/RESERVOIR RECORDS	

Sheet 2 of 4 Data is presented Yes, complete SCS design package is located in SCS State Office, Harrisburg, Pennsylvania. A final crest profile survey was performed. on Plate 4, Appendix E. Yes, see Appendix F and SCS design folder. Almost all data in SCS design folder. Data located on SCS drawings. See SCS design folder REMARKS POST-CONSTRUCTION SURVEYS OF DAM MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD DESIGN CUMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES GEOLOGY REPORTS BORROW SOURCES DESIGN REPORTS **ITEM**

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	Sheet 3 of 4
(TEM	REMARKS
AUNITURING SYSTEMS	None
0DIFICATIO:IS	In or about 1969, work totalling \$6,000.00 was performed. Details are unknown.
HIGH POOL RECORDS	
	None
POST COMSTRUCTION ENGINEERING STUDIES A.4D REPORTS	
	Rone
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None
MA INTENANCE OPERAT ION RECORDS	None

Sheet 4 of 4

REMARKS	see Appendix E.		See Appendix E.	
TEM	SPILLWAY PLAN SECTIONS	DETAILS	OPERATING EQUIPMENT PLANS & DETAILS	

S design folder located in SCS State Office.	rrisburg, Pennsy warvu. 2 sheet set of dravings prepared by SCS and	tamped "As-Built".
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APPENDIX

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PHOTOGRAPH NO.







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EMERGENCY SPILLWAY LOOKING UPSTREAM



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VIEW OF SHORELINE SHOWING WILLOW TREES.

PHOTOGRAPH NO. 6



VIEW OF CREST AS IT APPEARED IN DECEMBER. LITTLE OR NO DAMAGE TO THE EMBANKMENT ITSELF.

¥'

Clark Chiefe

13.



A ST LEAD

Same and

Star Strack



2 19 190

TOP OF EMBANKMENT. NOTE MULTIFLORA ROSE TO THE RIGHT OF THE PATH.

PHOTOGRAPH NO. 8









APPENDIX

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Sheet 1 of 11

SCS PA 477 CHECK LIST HYDROLOGIC AND HYDRAULIC ENGINEERING DATA

A. 4 .

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DRAINAGE AREA CHARACTERISTICS: About 60 percent wooded, remainder open/farm land
ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): <u>494.0 feet (10. Acre-Feet)</u>
ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): <u>524.3 feet (371 Acre-Feet)</u>
ELEVATION MAXIMUM DESIGN POOL: 524.3 feet.
ELEVATION TOP DAM:524.3 feet.
EMERGENCY SPILLWAY
a. Elevation 516.3 feet.
b. Type Trapezodial channel excavated through rock.
c. Width 150 feet.
d. Length About 550 feet.
e. Location Spillover Right abutment.
f. Number and Type of Gates <u>None</u>
PRINCIPAL SPILLWAY
a. Type Drop inlet riser, 30-inch conduit and impact basin.
b. Location <u>Dam station 15+45 (through west leg of dam)</u>
c. Entrance invertsOrfice at 494.0 feet, riser weirs at 512.8 feet,
d. Exit inverts 472.38 fast.
e. Emergency draindown facilities Pond drain inlet at 430.5 feet
HYDROMETEOROLOGICAL GAGES:
a. Type Rain gage
b. Location Treatment plant about 0.75 mile southwest of dam
c. Records A National Weather Service reporting station since 1978
MAXIMUM NON-DAMAGING DISCHARGE:Not determined.

SHEET 2 of 11

HEC-1, REVISED FLOOD HYDROGRAPH PACKAGE

The original "Flood Hydrograph Package" (HEC-1), developed by the Hydrologic Engineering Center, Corps of Engineers, has been modified for use under the National Dam Inspection Program. The "Flood Hydrograph Package (HEC-1), Dam Safety Version", hereinafter referred to as, HEC-1, Rev., has been modified to require less detailed input and to include a dam breach analysis. The required input is obtained from the field inspection of a dam, any available design/evaluation data, relatively simple hydraulic calculations, or information from the USGS Quandrangle maps. The input format is flexible in order to reflect any unique characteristics of an individual dam.

HEC-1, Rev. computes a reservoir inflow hydrograph based on individual watershed characteristics such as: area, percentage of impervious surface area, watershed shape, and hydrograph characteristics determined from regional correlation studies by the Corps of Engineers, Baltimore District. The inflow is routed through the reservoir using spillway discharge data obtained from the field inspection or design data. Flood storage capacity is determined from USGS maps or design information and verified by the field inspection. In the event a spillway cannot discharge 0.5 PMF without overtopping and failure of the dam, downstream channel characteristics obtained from the field inspection and USGS maps are inputed and flows are routed downstream to the damage center and a dam breach analysis is performed.

Included in this Appendix are the HEC-1, Rev. pertinent input values and a summary print-out tables.

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PA-83 1/13/59 F SEBOARD C- stire SHEET SOF 11 HYDROGRAPH COMPUTATION FORM Watershed KAERCHER CREEK State PA Borts Co. Structure Site or Sub-area P_{A-477} Storm Distribution Curve $_$ B^{\prime} Storm Distribution Curve 3^{\prime} Hydrograph Family 1^{\prime} D. A. 1.59 sq. mi., Pt. Rainfall 29.0^{-5} inches, Aerial Rainfall 27.6^{-5} inches R. O. Condition TT, R. O. Curve No. 77, Storm Duration or Freq. 6 HR $T_c = 1.15 \text{ hrs.}, Q = 24.3 \text{ inches, } T_p = D_r \frac{688}{6.7} T_c = 0.605$, $T_0 = 5.73 \mu^2$. $\frac{T_0}{T_p}$ used: $\frac{6}{5}$ T_0 Computed = <u>7.08</u> Revised $T_p = 0.55$ hq. 484 A qp x Q = <u>19683</u> c.f.s. c.f.s. Rev. T T (column) = $\frac{t}{T}$ x Rev. T_p $q (column) = \frac{q_c}{q_p} (q_p)$ qp Check: $Q = \frac{(3t)(2q)}{695 A}$ Table 3. 21-7 (sheet____of___) Line Line T t q_c q_p P qc. t c. f. s. c.f.s. $\overline{\mathbf{t}}_{\mathbf{p}}$ hours hours No. No. to q. 6.50 1 1.00 0.00 2.005 <u>م/ 5 م</u> 21 9, 2 0.001 Λ 2 0.42 59 22 1.003 9.24 F. 7.2 n 44 1,003 1,013 23 1.24 0.80 7.56 9 % 1,692 9.20 39 4 24 RU7 2.61 1,32 1.041 125 10. 12 20 0.001 5 67 1.76 0.024 !1.53 25 145 10.03 L 1.000 0 Ż.09 24% 6 11.176 26 2.21 7 27 n: 3R C 51 8 28 97RZ 3.0R N.49 9 29 3.52 10 30 335 3.96 3.76 REF:-0.Z58 11 4.40 4. IR 31 SCS DESIGN FOLDER 12 1,202 4.60 4, R 4 297/ 32 13 33 C 02 14 34 43 736 5 15 35 16 6.60 IDN z7 36 17 n.060 37 7.04 6 18 7.48 1.033 650 38 19 0.018 7,52 39 7.92 354 20 0.009 40

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Flow Constants
Flow Constants
Orifice (1'x 1'-6")
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$$\sqrt{29h}$$

Q = 0.6 x 1.5 x 8.03 $h^{\frac{1}{2}}$
Q = 7.23 $h^{\frac{1}{2}}$
Weir (2 - $7^{\frac{1}{2}}$ sides)
Q = CL $H^{\frac{3}{2}}$
Q = 51 $H^{\frac{3}{2}}$

$$\frac{P_{IPP}P_{IPP} = 30'' D_{IA} C_{ChC}}{230' D_{IA} P_{P}} = \sqrt{\frac{2g H_{P} A_{P}^{2}}{1 + kr + k_{P}P_{P} + k_{C} l_{r} \left(\frac{A_{P}}{A_{r}}\right)^{2}}} \qquad A_{P} = \frac{4.91}{kr = 0.5} \\
C_{P} = \sqrt{\frac{2g H_{P}^{2}}{1 + kr + k_{P}P_{P} + k_{C} l_{r} \left(\frac{A_{P}}{A_{r}}\right)^{2}}} \qquad K_{C} l_{r} \left(\frac{A_{P}}{A_{r}}\right)^{2} = 0$$

$$Cp = \frac{8.03 \times 7.77}{\sqrt{1+6.5 + 1.8 + 0}}$$

$$Cp = \frac{39.427}{1.81} = 21.8^{-17}$$

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Q = 21.8H²

REF:-SCS DESIGN FOLDER

Ale 11/1 4-11-63

SH. 7 OF 11 (7)

**************************** FLOOD HYDROGRAPH PACKAGE (HEC-1) JULY 1978 ****************** . LAST MODIFICATION 26 FEB 79 **BAN SAFETY VERSION**

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DATE* 79/12/28. TIME* 05.28.52. RUN

SCS PA 477 NDI PA 00720 DER NO. 6-457 Overtopping Analysis

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SUB-AREA RUNOFF COMPUTATION

FREEBOARD HYDROGRAPH COMPUTED BY SCS

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HYDROGRAPH ROUTING

OUTFLOU HYDROGRAPH

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PEAK FLOU AND STORAGE (END DF PERIDD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS Flous in cubic feet per second (cubic meters per second) Area in souare miles (souare kilumeters)

or 11 SHEET 10

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SITE GEOLOGY SCS PA 477

SCS PA 477 Dam is located in the Great Valley Section adjacent to the Appalachian Mountain Section of the Valley and Ridge Physiographic Province. As shown in Plate F-1, the dam is constructed upon the Hamburg Formation of Ordovician age. Rocks of this formation consist primarily of shale and graywacke (impure sandstone). Information contained in the SCS files describes the interbedded sandstone, siltstone and shale striking N60-70E and dipping southward at about 45 degrees but that rock attitudes also vary over short distances. The rock is characteristically fractured and has a weathered zone extending to approximately 15 feet in which water apparently moves quite rapidly. Bedrock is relatively shallow in the stream channel. The shallow fractured and broken nature of the bedrock along with its variability in attitude could lead to the possibility of future leakage.

