

# REHABILITATION ASSESSMENT REPORT

## Brush Creek Watershed Site 15

Mercer County, West Virginia



**Project Sponsors:** Southern Conservation District  
Mercer County Commission  
Brush Creek Watershed Improvement District  
Green Valley-Glenwood Public Service District  
Cities of Princeton and Bluefield  
West Virginia Department of Highways  
West Virginia State Conservation Committee

**National Inventory of Dams (NID) ID: WV 05511**

**Total Failure Index: 170**

**Population at Risk: 1833**

**Total Risk Index: 12464**

**Hazard Classification: High**

**March 2011**

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MERCER COUNTY COMMISSION  
BRUSH CREEK WATERSHED IMPROVEMENT DISTRICT  
GREEN VALLEY-GLENWOOD PUBLIC SERVICE DISTRICT  
CITY OF PRINCETON  
CITY OF BLUEFIELD  
WEST VIRGINIA DEPARTMENT OF HIGHWAYS  
WEST VIRGINIA STATE CONSERVATION COMMITTEE

March 2011

Prepared for

WEST VIRGINIA NRCS  
MORGANTOWN, WEST VIRGINIA

Prepared by

GANNETT FLEMING, INC.  
HARRISBURG PENNSYLVANIA



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**Brush Creek Watershed Site 15**  
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Appendix A	Selected As-Built Drawings
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## **1. Introduction and Purpose**

The purpose of this report is to provide the West Virginia Natural Resources Conservation Service (NRCS) an assessment of Brush Creek Site 15, as authorized by contract dated May 24, 2010 for 41 Dam Assessments for various watersheds in West Virginia (Award No. AG-3D47-D-10-0008). The report provides a description of the dam, an assessment of the current conditions and status of operation and maintenance, and the scope of potential rehabilitation alternatives. In addition to assessing the overall integrity of the structure, available design information was reviewed to determine whether the structure meets current NRCS design criteria. This information is provided to assist the NRCS and local sponsor(s) in determining future actions concerning potential rehabilitation of the dam to extend the service life of the dam and meet current safety criteria.

The Watershed Protection and Flood Protection Act (Section 14 of PL-83-566, as amended) authorizes funding and technical assistance to rehabilitate aging flood control dams originally built with assistance of the USDA Watershed Programs. Sponsors of these dams may apply for assistance to extend the project service life and ensure that the facility meets applicable safety and performance standards. If the project is eligible for rehabilitation assistance, the NRCS may provide funding for 65 percent of the total rehabilitation project costs; the project sponsors are responsible for the remaining 35 percent. Technical assistance by NRCS for planning and design of the rehabilitation project is provided at no cost to project sponsors.

## **2. Project Setting and History**

The original Brush Creek Watershed Work Plan Agreement was signed on March 16, 1960. The Brush Creek Watershed was planned and constructed in accordance with provisions of PL-566, approved August 4, 1954. The project Work Plan was supplemented seven times: Supplemental Work Plan Agreement No. 1 signed September 10, 1963; Supplemental Work Plan Agreement No. 2 signed January 29, 1965; Supplemental Work Plan Agreement No. 3 signed June 22, 1967; Supplemental Work Plan Agreement No. 4 signed November 4, 1968; Supplemental Work Plan Agreement No. 5 signed August 13, 1969; Supplemental Work Plan Agreement No. 6 signed March 29, 1973; and Supplemental Work Plan Agreement No. 7 signed October 8, 1981. Local organizations sponsoring the project include the Southern Conservation District, the Mercer County Commission, Brush Creek Watershed Improvement District, Green Valley-Glenwood Public Service District, Princeton City, Bluefield City, the West Virginia State Conservation Committee, and the West Virginia Department of Highways.

The purpose of the plan for the Brush Creek Watershed was to outline land treatment and structural measures necessary to achieve the maximum practical erosion control and alleviate flood damage. Installation of planned structural measures were to assist in providing floodwater protection to dwellings, roads, fields, crops, and businesses, to permit more intensive land use by reducing damage to land in the flood regions, and also to make uplands more attractive and productive. A total of 10 floodwater retarding dams were constructed on tributaries within the Brush Creek Watershed.



Brush Creek Site 15 is located on North Fork of Brush Creek in Mercer County approximately 5.5 miles from Princeton, WV. The location of Brush Creek Site 15 is shown on the Project Map for the Brush Creek Watershed presented on Exhibit 1. An aerial photo and USGS quadrangle of Brush Creek Site 15 are presented on Figures 1 and 2, respectively.

Engineering design data and other reference data were collected and reviewed. The following is a list of data sources reviewed for this assessment report.

1. Original Work Plan and Subsequent Supplements (3/1960, 9/1963, 1/1965, 6/1967, 11/1968, 8/1969, 3/1973, 10/1981)
2. As-Built Drawings (1967)
3. Design Report Sections (Geology, Soil Mechanics, 1963) (Hydraulic Design, 1964)
4. Inspection Records (2008, 2009, 2010)
5. O&M Agreement and Amendment (6/1965, 8/2002)
6. Failure and Risk Index Spreadsheet (2011)
7. Brush Creek Watershed Map (1980)
8. Emergency Action Plan (09/22/2009)

Brush Creek Site 15 is a multi-purpose dam designed by the SCS (now NRCS), Morgantown, West Virginia. The dam and its appurtenances consist of a 692-foot long, zoned earthfill embankment with a maximum height of 75 feet above the invert of the principal spillway. The dam has two spillways; a single-stage principal spillway and an open channel vegetated auxiliary spillway. The auxiliary spillway crest is approximately 9.3 feet below the top of the dam. Both spillways are uncontrolled. All inflow is discharged through the principal spillway until the pool level reaches the level of the auxiliary spillway crest. A drawdown gate was provided to lower or drain the reservoir. The principal spillway conduit consists of a 24-inch diameter reinforced concrete, steel cylinder type pre-stressed pressure pipe conforming to AWWA-C301 standards. The principal spillway conduit was constructed with a concrete cradle with reinforced concrete anti-seep collars.

A summary of specific design data is presented in Table 1. Selected as-built drawings are presented in Appendix A.

### **3. Site Inspection Summary and Operation and Maintenance**

Paul Schweiger, P.E.; Gregory Richards, E.I.T.; and E.J. Barben, E.I.T. of Gannett Fleming, Inc. conducted a site inspection of Brush Creek Site 15 on October 19, 2010. The WV-ENG-105, Formal Dam Inspection Checklist was used to record findings and is presented in Appendix B. General photographs of the dam site (Photos 1-6) and photographs of deficiencies (Photos 7-14) noted during the site inspection are also presented in Appendix B. Additional photos taken during the field review are furnished in the Supporting Data Folder on a CD. With the exception of several ongoing maintenance items noted below, the dam was found to be in good condition

The grass cover on the upstream and downstream slope of the dam embankment was found to be adequate. However, there were several areas of erosion including some minor tire ruts on the crest on the dam and an erosion gully beginning to form in the left downstream



Figure 1. Aerial Photo of Brush Creek Site 15

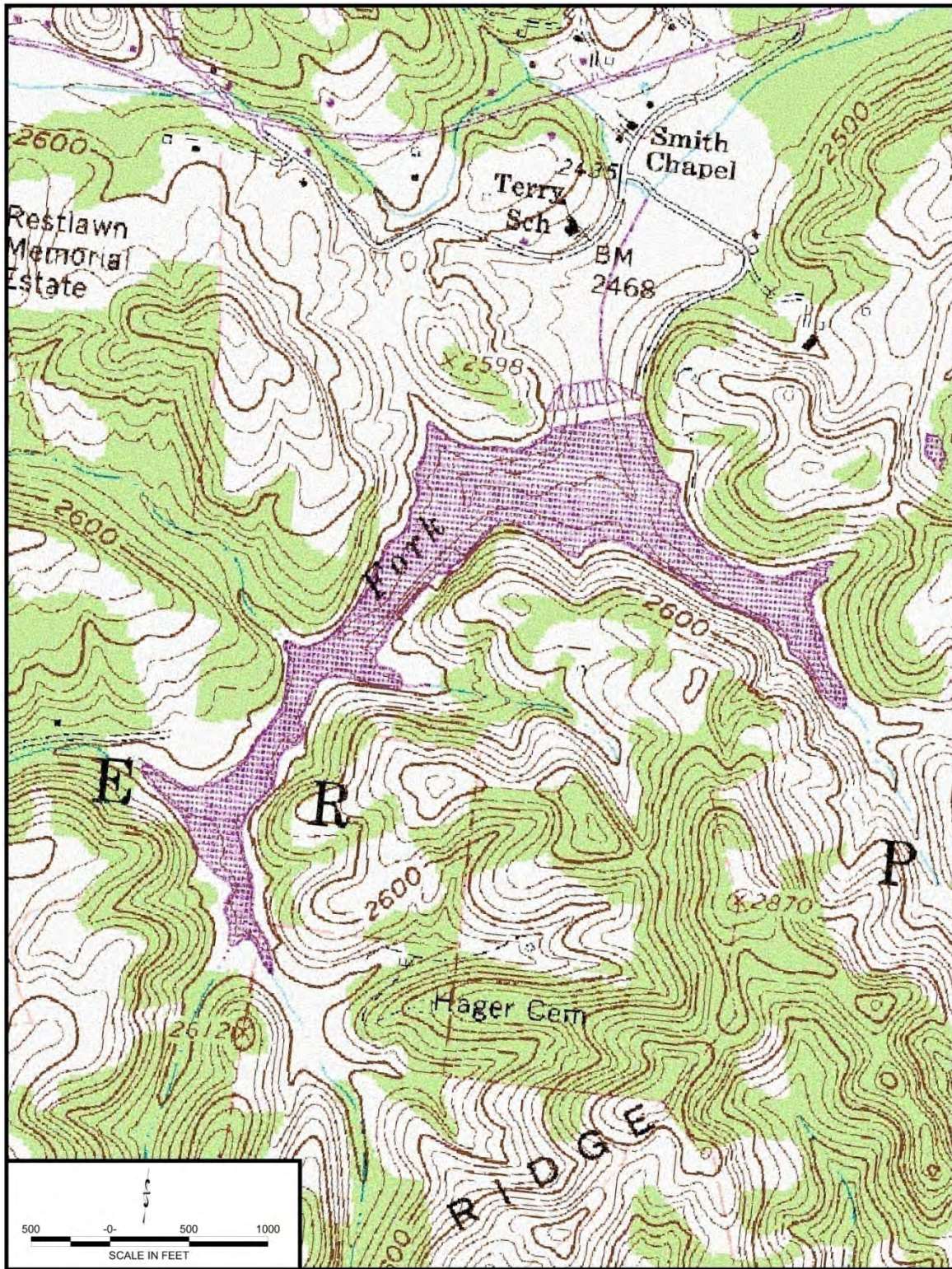


Figure 2. USGS Quadrangle of Brush Creek Site 15



**Table 1**  
**As-Built Design Data for Brush Creek Site 15**

Description	Value
<b>General Data</b>	
Year Designed	1964
Year Constructed	1967
Purpose	Flood Control, Water Supply
Original Hazard Classification	High (Class C)
Current Hazard Classification	High (Class C)
Design Life	50 years (2017)
Design Drainage Area	1,768 Acres (2.76 Mi <sup>2</sup> )
Dam Height (Along Centerline)	74 Feet
Maximum Dam Height	75 Feet
Embankment Length	692 Feet
Embankment Top Width	22 Feet
Embankment Upstream Slope	2.5H:1V
Embankment Downstream Slope	2.5H:1V
<b>Critical Elevations (MSL)</b>	
Top of Dam	2504.4 Feet
Auxiliary Spillway Crest	2495.1 Feet
PSW Weir	2488.1 Feet
Normal Pool (Water Supply Pool)	2488.1 Feet
PSW Conduit Outfall Invert	2429.36 Feet
PSW Outlet Channel Invert	2429.36 Feet
<b>Storage Capacities</b>	
Sediment Storage (50-Year Submerged & Aerated Sediment)	56.4 Acre-Feet
Normal Pool (Water Supply Pool)	1,583 Acre-Feet
Auxiliary Spillway Crest	2,138.2 Acre-Feet
Top of Dam	3,055 Acre-Feet
<b>Pool Surface Areas</b>	
Normal Pool	72 Acres
Auxiliary Spillway Crest	88 Acres
<b>Other Features</b>	
Principal Spillway Orifice Size	N/A
Principal Spillway Conduit Diameter	24 Inches
Principal Spillway Conduit Length	360.5 Feet
Principal Spillway Weir Crest Length	12-Feet (Total)
Auxiliary Spillway Width	125 Feet



abutment contact. There is also a significant amount of wave erosion along the upstream slope at normal pool level.

Wave erosion at normal pool level also extends into the upstream slope of the auxiliary spillway. A few bare areas within the upstream slope and training dike of the spillway were also observed.

The CMP drains located on either side of the principal spillway outlet conduit were both flowing at a combined flow of less than ½ gpm. A wet area was observed near the downstream toe and right gutter of the dam. Otherwise, no signs of embankment instability or seepage were observed.

The concrete principal spillway riser structure and stilling basin appear to be in good condition and operating as designed. No external evidence of cracking or deterioration was observed.

Items inaccessible for inspection include the submerged exterior of the riser structure, interior of the riser structure, sluice gate, interior of the principal spillway conduit and the interior of the CMP drain pipes.

In addition to the site inspection, video inspection of the principal spillway conduit as provided by the NRCS was reviewed. The ROVER inspection of the principal spillway conduit was performed on September 10, 2002 and revealed minor wear of the concrete lining throughout and slight joint separation at a joint located approximately 81 feet from the conduit outlet.

Items of deferred maintenance include seeding bare areas, repairing areas of wave erosion, and armoring the left downstream abutment contact. The wet area on the right side of the downstream slope should also be regularly monitored.

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. It is also 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. Continued care and inspection are necessary to detect unsafe conditions.

#### **4. Hydrologic and Hydraulic Analyses**

Hydraulic analyses were conducted to determine whether the dam meets NRCS and WVDEP current criteria. NRCS design precipitation and other hydrologic parameters have become more stringent since the dam was designed in the 1960s. As part of this assessment, updated hydrologic and hydraulic analyses using the NRCS SITES model were performed to determine the required auxiliary spillway crest and top of dam elevations. Structure geometry and reservoir storage inputs as well as watershed hydrologic characteristics for the model were obtained from as-built drawings and other design documents provided by the West Virginia NRCS. The SITES analyses involved evaluation of the top of dam elevation for both the short



duration (6-hour) storm and the long duration (24-hour) storm in accordance with procedures outlined in the latest version (July 2005) of TR-60. The elevation of the auxiliary spillway crest was also evaluated for the 100-year event. The SITES output for as-built, Class C (*high hazard*) criteria for the 6-hour and 24-hour duration storms and the auxiliary spillway crest elevation are presented in Appendix C. A side-by-side comparison of key SITES model input and output for the different scenarios analyzed is presented in Table 2.

**Table 2**  
**Side-By-Side Comparison of Key SITES Model Input and Output**

Parameter	Original Class C 1964 Design	100-Year ASW Crest	6-hr Class C Top of Dam	24-hr Class C Top of Dam
<b>Key Input Data</b>				
Watershed Area	1,768 Acres	1,768 Acres	1,768 Acres	1,768 Acres
Weighted Curve Number	80.0	80.0	80.0	80.0
Time of Concentration, T <sub>c</sub>	1.23 Hours	1.23 Hours	1.23 Hours	1.23 Hours
100-Year Rainfall (P-100)	- Inches	4.82 Inches	3.63 Inches	4.82 Inches
Freeboard Rainfall (P-FB)	28.35 Inches	-	28.7 Inches	37.0 Inches
<b>Key Output Data</b>				
ASW Crest Elevation	2495.1 Feet	<b>2492.84 Feet</b>	2495.10 Feet	2495.10 Feet
Top of Dam Elevation	2504.4 Feet	-	2505.09 Feet	2503.61 Feet
<b>Freeboard</b>	-	-	<b>-0.69 Feet</b>	<b>0.79 Feet</b>

The following can be concluded based on the analysis results summarized in Table 2:

1. The Auxiliary Spillway crest is 2.26 feet higher than necessary using the 100-year flood activation criteria.
2. For a Class C (*high hazard*) structure, the dam would be overtopped and would need to be raised 0.69 feet to pass the 6-hr Freeboard Hydrograph without overtopping.

## 5. Spillway Integrity Analyses

Preliminary auxiliary spillway integrity analyses were also performed as part of this assessment using the SITES program. Very little subsurface information is available from which to develop a representative geologic profile of the most erodible section through the auxiliary spillway. The assumed geologic profile of the auxiliary spillway was developed using as-built drawings, geology and soils design reports, and supplemental reports from the United States Geological Survey and the West Virginia Geological and Economic Survey.

The geology of the auxiliary spillway for the SITES integrity analysis was assumed to consist of shale from the crest of the spillway down to approximately elevation 2479 feet. An additional layer of shale extends down to approximately elevation 2439 feet. Siltstone is located below the shale down to the valley floor. The assumed material properties for the preliminary assessment of the spillway integrity are presented in Table 3. A schematic profile of the auxiliary spillway obtained from the SITES output is presented on Figure 3.



**Table 3**  
**Assumed Parameters for Auxiliary Spillway Integrity Analysis**

Material Description	Assumed ASW Material Erosion Parameters				
	Dry Density (lbs/ft <sup>3</sup> )	Headcut Index (K <sub>h</sub> )	Percent Clay	Plasticity Index	D <sub>75</sub> / Rep. Dia.(in)
Soil	100	0.28	16	8	0.002
Shale 1	120	1	0	0	4
Shale 2	121	10	0	0	10
Siltstone	124	10	0	0	6

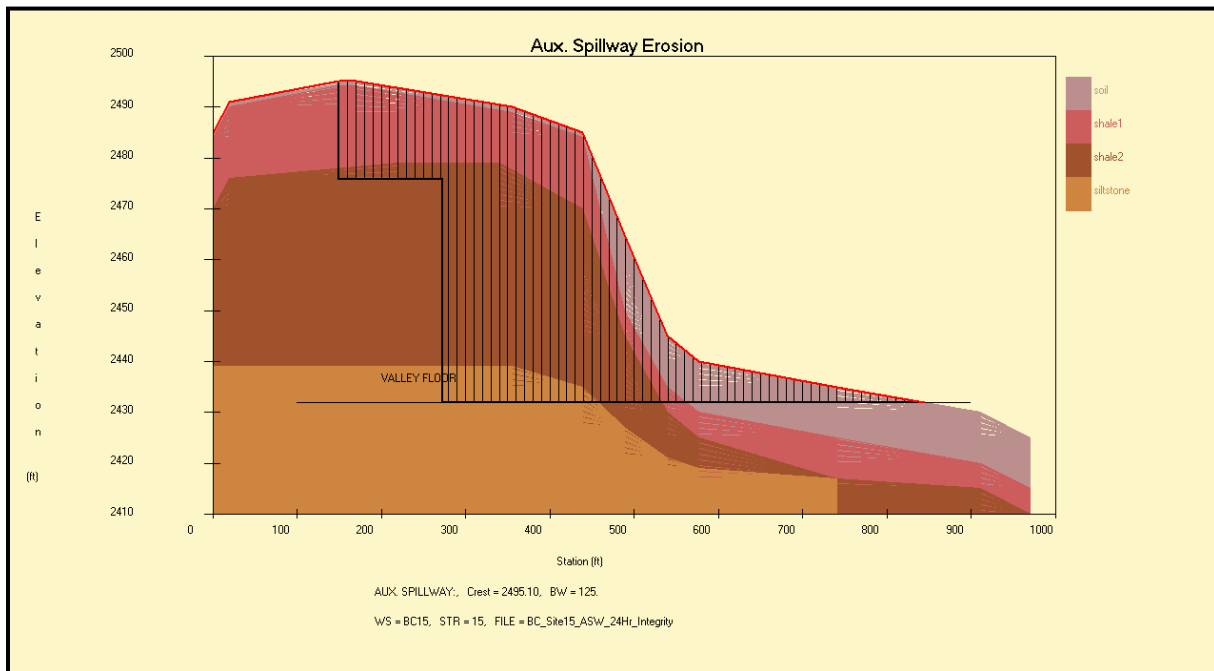


Figure 3. Plot of Auxiliary Spillway Profile and Extent of Erosion from Integrity Analysis for 24-hour Class C Freeboard Hydrograph (PMF) Obtained from SITES Model Output

The SITES auxiliary spillway analysis shows that the auxiliary spillway will completely breach during passage of the 6-hour FBH. For the long duration 24-hour storm, the analysis also shows complete breaching of the auxiliary spillway. The SITES output for both the 6-hour and 24-hour storms for as-built, Class C criteria are presented in Appendix C. The electronic input files for the SITES model are furnished in the Supporting Data Folder on a CD.



## **6. Breach Inundation Mapping and Hazard Classification Summary**

A dam breach hydraulic analysis was performed using the U.S. Army Corps of Engineers' HEC-RAS computer model in order to determine the downstream inundation limits of the flood wave created by a sudden breach of the dam. A field assessment of downstream structures located within the path of the flood wave was also made to verify the current hazard classification. The hazard classification evaluation consisted of evaluating the downstream area within the breach inundation zone. The dam was then classified according to West Virginia State Dam Safety definitions and NRCS definitions in NEM, Part 520, Subpart C – Dams.

The inflow hydrograph, reservoir stage-storage relationship, and other inputs used to describe the dam in the HEC-RAS model were obtained from the 6-hour FBH SITES output and as-built drawings. The dam breach parameters, including the time to breach, breach bottom width and side slopes were determined by trial and error until the peak breach discharge criteria specified in TR-60 was satisfied. The minimum and maximum peak breach discharges using TR-60 criteria were computed to be 156,093 cfs and 189,291 cfs, respectively. Assuming a complete breach of the dam occurs within 36 minutes, a peak breach discharge of approximately 196,000 cfs was computed using the HEC-RAS model. The height of the breach flood wave at the dam site, from the top of the dam to the valley floor would be approximately 75 feet.

The HEC-RAS dam breach analysis and downstream unsteady flow modeling of the flood wave was performed using a three (3) meter Digital Elevation Model (DEM) and SAMB Orthophotos to obtain the cross sections and Manning's "n" values necessary for modeling the channel and flood plain. The HEC-RAS model of the downstream area at the confluence of Glady Fork with Brush Creek was treated as a junction so that the flood wave could be modeled as propagating both upstream and downstream of the junction. The additional storage attenuation of the flood wave within the reach immediately upstream of the junction can be an important feature of the hydraulic analysis. Without this feature, the downstream inundation limits can be overestimated.

The extent of the breach analysis was greater than that shown on the existing inundation map included in the Emergency Evacuation Plan for this structure. The breach analysis was based upon the FBH storm for a Class C dam with assumed failure occurring at the top of dam elevation. The FBH storm was only assumed to occur in the watershed upstream of the dam with normal base flow of approximately 100 cfs occurring downstream of the dam. Flood elevations were tracked downstream until they came largely within the stream bank or when the flow rate was less than 10 percent of the peak breach flow rate at the dam.

For Brush Creek Site 15, the inundation mapping was extended about 11.7 miles downstream of the city of Princeton (approximately 19.5 miles downstream of the dam) until the flood wave was largely within the banks of Brush Creek. According to the HEC-RAS dam breach model, the peak flow rate of the breach flow or flood wave at Princeton is approximately 5,600 cfs or 3 percent of the peak breach flow at the dam. The resulting inundation limits in the vicinity of Princeton were compared with the inundation limits shown on the existing detailed FEMA Flood Insurance maps for the same area for the 100-year and 500-year flood events. At Princeton, the peak 100-year and 500-year FEMA flood flows were estimated to be 1,380 cfs and 2,000 cfs, respectively. The peak FEMA 500-year flood elevation near the center of



Princeton was reported to be 2,393.3 feet. The peak dam breach flood elevation at the same location was computed to be 2,397.2 feet. A side by side comparison of the dam breach inundation mapping and FEMA Flood Insurance mapping at Princeton is presented in Figure 4.

Homes, businesses, road crossings, bridges, farms and commercial buildings, utilities and other structures located within the dam breach inundation limits were identified and photographed. All photographs were tagged electronically with their date, time, longitude and latitude using GPS. This information was used to create a GIS database to help quantify the flood impacts and persons at risk.

The limits of the maximum pool elevation and the downstream inundation were plotted in AutoCAD on both an orthophoto base map and a USGS Quadrangle base map, and are presented on Exhibits 2 and 3, respectively. The locations of all cross sections used in the HEC-RAS model are also shown Exhibits 2 and 3. All associated HEC-RAS, AutoCAD, and other supporting computer files are furnished in the Supporting Data Folder on a CD. A GIS database containing the downstream inundation limits and the photographs of all inundated features within the downstream inundation limits is also provided on a CD.

According to West Virginia State Dam Safety definitions and NRCS definitions in NEM, Part 520, Subpart C – Dams, *high hazard* dams (Class 1 or Class C) are those dams located where failure may cause loss of life or serious damage to homes, commercial or industrial buildings, main highways or railroads, or important public utilities. This classification must be used if failure may result in loss of human life. Existing and future downstream development including controls for future development must be considered when classifying the dam.

Brush Creek Site 15 was designed in 1964 as a *high hazard* (Class C) structure. Based on the inundation mapping presented on Exhibits 2 and 3, and the downstream reconnaissance of the area within the inundation zone, this classification is found to be appropriate. Sudden failure of Brush Creek Site 15 during the FBH event impacts considerable downstream dwellings, road crossings/bridges, commercial buildings and other structures, and meets both the loss of life and property damage criteria for a high hazard dam.

Six dwellings were identified within the downstream inundation zone that are less than 1,500 feet from the toe of the dam. Many other dwellings, including 128 mobile homes approximately 3.5 miles downstream, would clearly be impacted by a flood wave that overflowed the channel banks.

A total of approximately 733 dwellings were judged to experience flooding of the adjacent ground by a depth of more than 3 feet based on the aforementioned dam failure hydraulic analysis. The corresponding persons at risk (PAR) assuming an average of 2.5 persons per dwelling is 1833 persons.

It should be noted that according to the HEC-RAS model results, it will take over 7.5 hours for a flood wave created by a sudden failure of Brush Creek Site 15 to reach its peak flood level at Princeton. There is, therefore, a somewhat limited amount of warning time available which decreases the probability of survival for persons at risk that are located in the downstream reaches of the inundation area.

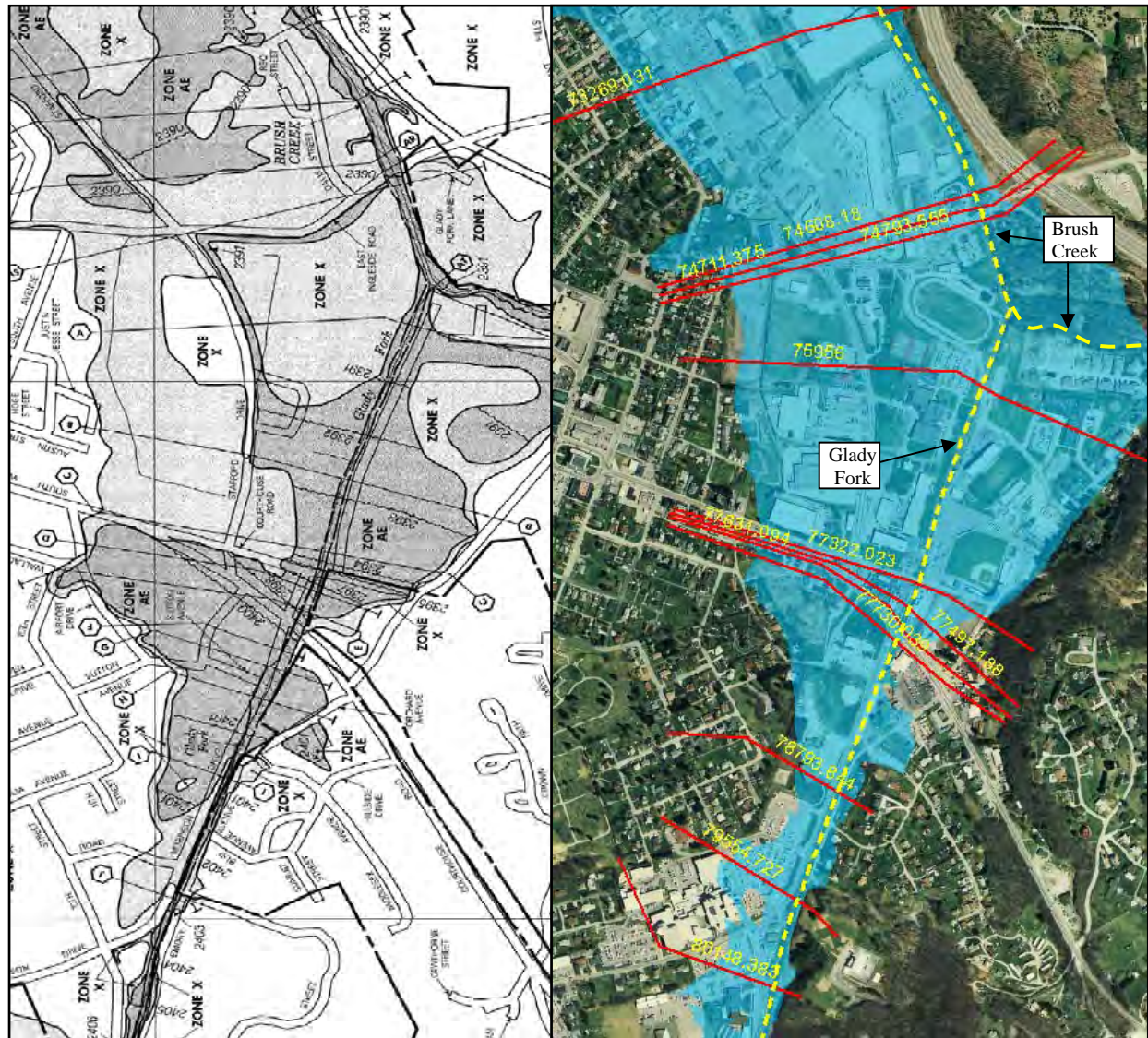


Figure 4. Side by Side Comparison of Floodplain Boundaries from the 2005 FEMA Flood Insurance Study (left) and the 2011 Gannett Fleming Dam Breach Study (right) at Princeton, West Virginia.

## 7. Review of Available Geotechnical Information

Available geotechnical information was reviewed with respect to items that are considered in the “*Evaluation of Potential Rehabilitation Projects-Priority Ranking Spreadsheet*”. This information included the Geology and Soils Reports (1963) and As-Built Drawings (1967).

The 1960’s time period for design and construction predates the full development of several current NRCS design criteria. Two important design criteria include drain/filter compatibility and seepage control for principal spillway conduits. The manuals that define these two design methodologies, Gradation Design of Sand and Gravel Filters and Filter Diaphragms, were first published in 1994 and 2007, respectively. The compatibility of adjacent embankment



zones is another design criterion that has developed since the 1960's and has become an essential step in the design process for earthen dams.

The existing embankment drain consists of a single, broadly graded aggregate with both sand and gravel sized particles. Current criteria would require the drain to have at least two components. The finer component (typically a sand) would be compatible with a range of embankment and foundation soils while the coarser component (typically a gravel) would have a higher permeability designed to adequately collect and convey seepage. One additional gradation characteristic of the existing drain that does not meet current criteria is a maximum particle size of three inches which is too large to prevent segregation. A filter compatibility analysis that would evaluate all the current design parameters is not possible without an additional subsurface investigation that would define the range of gradation and plasticity characteristics of the embankment and foundation soils. The design reports only contain recommendations for borrow areas and do not contain test results completed on fill placed during construction.

The drain configuration at the embankment toe that surrounds the principal spillway conduit and outlets to the stilling basin is similar to the current criteria for filter diaphragms. Current criteria require the minimum horizontal and vertical upward dimensions be three times the conduit diameter. The as-builts show that both the minimum horizontal and vertical dimensions are met. Another similarity is the use of two 8-inch diameter corrugated metal drainage pipe to convey seepage from the filter to the stilling basin. The use of corrugated metal pipes, which have been found to be susceptible to corrosion, is not recommended and the integrity of these pipes should be investigated by video inspection.

Another geotechnical design issue that can only be evaluated with an additional subsurface investigation is the compatibility between the embankment zones. The as-built drawings show three distinct zones. Transition zones are typically required by current design.

A slope stability analysis was performed as part of the original design. Shear strength parameters were based on laboratory testing of borrow area and auxiliary spillway excavation materials. The phreatic surface used in the analyses intersected the embankment/foundation interface well upstream of the downstream toe. This is an idealized design approach that assumes the cutoff trench is a completely effective foundation seepage barrier and that the filter trench is fully functioning. Seepage analyses were not contained in available design files. The dam has no instrumentation to monitor phreatic levels, seepage discharge, or surface movement.

Review comments related to the geotechnical factors in the "*Evaluation of Potential Rehabilitation Projects-Priority Ranking Spreadsheet*" are presented in Appendix D. Also included in the appendix is a copy of the spreadsheet as completed by the WV NRCS.

## **8. Failure and Risk Indexes**

The structure's risk of failure and the consequences of failure were evaluated by the WV NRCS by completing the "*Evaluation of Potential Rehabilitation Projects-Priority Ranking Spreadsheet*" (Exhibit 508.1 of the NRCS-National Watershed Manual) to determine whether the dam qualifies for rehabilitation as per Section 508 Subpart E of the National Watershed



Manual. Based on the completed spreadsheet, the total failure index computed by the NRCS for Brush Creek Site 15 is 170, with a total risk index of 12,464. A copy of the spreadsheet completed by the WV NRCS is included in Appendix D.

## 9. Discussion of Potential Rehabilitation Alternatives

Assuming the dam must satisfy Class C (*high hazard*) design criteria, current deficiencies include overtopping of the dam during the PMF event and potential breaching of the auxiliary spillway. Some design features within the embankment, particularly drain/filter compatibility, seepage control, and compatibility between adjacent embankment zones as discussed in Section 7 of this report, do not meet current NRCS design criteria. Full evaluation for compliance to current criteria cannot be confirmed without a subsurface investigation and subsequent analyses and are not included herein as deficiencies requiring rehabilitation.

Modifications modeled with the SITES program include lowering the auxiliary spillway, widening the auxiliary spillway, and armoring the embankment so that it could be overtopped without eroding. Table 4 provides a summary of the results of SITES runs where the elevation and width of the spillway were varied and the dam was armored so that it could be overtopped.

Regardless of the alternative selected, it was assumed that the auxiliary spillway would need to be modified to address the potential for breaching the spillway during passage of the Freeboard Hydrograph as determined by the preliminary SITES integrity analysis. Due to the high flow velocities and shear stress of the flow within the auxiliary spillway, the most favorable modification appears to be armoring the auxiliary spillway exit channel with roller-compacted concrete (RCC). Armoring the spillway with articulating concrete block mats (ACBs) was considered, however, the use of ACBs was dismissed because their performance has not been tested or otherwise proven for flow velocities and bed shear stresses in the range of those anticipated, even if the auxiliary spillway was widened. Armoring the embankment using ACBs to provide overtopping protection appears to be viable.

**Table 4**  
**Potential Modifications to Bring Brush Creek Site 15**  
**Into Compliance with NRCS Class C Structure Design Criteria**

Alternative	Alternative Description	Change in ASW Crest Elevation (Feet)	ASW Width (Feet)	Amount Dam would Need to be Raised (Feet)	Overtopping Depth (Feet)
1	Raise Dam	0	125	<b>0.69</b>	0
2	Lower ASW Crest <sup>(1)</sup>	<b>-1.00</b>	125	0	0
3	Widen ASW Crest	0	<b>155</b>	0	0
4	Armor Embankment	0	125	0	<b>0.38</b>

(1) Would result in loss of some flood control benefits. However, the ASW would still meet the 100-year flood activation criteria according to current design standards if lowered by 1.00 feet.



## 10. Cost Estimates for Rehabilitation Alternatives

Based on preliminary information, planning level cost estimates were prepared for the four alternatives listed in Table 4 and are presented in Table 5. Decommissioning or breaching the dam was included as an alternative in Table 5. All of the cost estimates, except the cost estimate for breaching the dam, include armoring the auxiliary spillway using RCC to prevent breaching the spillway. The cost estimates presented in Table 5 are based on approximate quantities and construction prices from similar projects.

Combinations and permutations of the alternatives presented in Table 4, and other alternatives can be explored and refined during subsequent planning phases for this project to obtain the most cost effective solution. For example, a combination of widening the auxiliary spillway and raising the dam to achieve a balance of materials can be evaluated. As an option to Alternative 2 (lower ASW crest), if it is desired that the current flood storage capacity of the existing dam and reservoir be maintained, fuse plugs or fuse gates could be incorporated into the lowered auxiliary spillway crest design. The fuse plugs or fuse gates could be divided into multiple individual bays such that they would be activated or eroded sequentially and only as needed.

**Table 5**  
**Planning-Level Cost Estimates for Modifications to Bring**  
**Brush Creek Site 15 into Compliance with NRCS Class C Design Criteria\***

Alternative	Alternative Description	Estimated Total Project Cost
1	Raise Dam & Armor ASW <sup>(1)</sup>	\$3,400,000
2	Lower ASW Crest & Armor ASW <sup>(2)</sup>	\$2,400,000
3	Widen ASW Crest & Armor ASW	\$2,900,000
4	Armor Embankment & ASW	\$5,900,000
5	Decommission/Breach Dam	\$1,800,000

\* *Some design features within the embankment may not meet current NRCS design criteria. Compliance of these features cannot be confirmed without further analysis and are not included herein as deficiencies requiring rehabilitation.*

(1) *This cost represents a standard approach to raising a dam and includes the installation of a filter, drains, and fill across the entire downstream slope. Because the dam needs to be raised by only 0.69 feet, less costly alternatives such as narrowing the crest, steepening the slopes, or the installation of a parapet wall should be investigated.*

(2) *Would result in loss of some flood control benefits. However, the ASW would still meet the 100-year flood activation criteria according to current design standards if lowered by 1.00 feet.*



## **11. Conclusions and Recommendations**

- 11.1 Operations and Maintenance.** Brush Creek Site 15 was observed to be in good condition with several maintenance deficiencies that need to be addressed. These include seeding bare areas, repairing areas of wave erosion, and armoring the left downstream abutment contact. The wet area on the right side of the downstream slope should also be regularly monitored.
- 11.2 Additional Studies.** Subsurface investigations to more accurately quantify conditions within the embankment, foundation, and auxiliary spillway are recommended. This information is important to confirm that the embankment meets current design criteria and to more accurately evaluate the integrity of the auxiliary spillway. Embankment slope stability should be evaluated based on the results of the subsurface investigations. Items not readily accessible for inspection such as the inside of the principal spillway conduit, riser structure, and embankment drains, and the submerged exterior of the riser and sluice gate should also be assessed.
- 11.3 Hazard Classification.** Based on the inundation mapping prepared as part of this study and the downstream reconnaissance of the area within the inundation zone, the classification of Brush Creek Site 15 as a high hazard structure is found to be appropriate. Sudden failure of Brush Creek Site 15 during the FBH event impacts considerable downstream dwellings, road crossings/bridges, commercial buildings and other structures, and meets both loss of life and property damage criteria for a high hazard dam.
- 11.4 Design Deficiencies.** Brush Creek Site 15 does not meet current NRCS design criteria for a Class C (*high hazard*) structure. Design deficiencies identified during this assessment include the necessity to raise the dam by 0.69 feet to avoid overtopping during passage of the freeboard hydrograph and breaching of the auxiliary spillway. Other deficiencies may exist related to geotechnical issues with the embankment or features that were not inspected.
- 11.5 Failure and Risk Indexes and Priority Ranking of Rehabilitation Project.** The total failure index for Brush Creek Site 15 as indicated in the spreadsheet prepared by the WV NRCS is 170, with a total risk index of 12,464.
- 11.6 Rehabilitation Project.** Major modifications to Brush Creek Site 15 are needed to bring the dam into compliance with current NRCS high hazard dam design criteria, for the known deficiencies. Of the alternatives listed in Table 5, a combination of lowering or widening the auxiliary spillway, and raising the dam appear to offer the best value. The excavation from the auxiliary spillway could be used to raise the dam. A blanket drain or other drainage and filter improvements could be added to the downstream slope as part of the design to raise the dam to address potential non-compliance issues associated with the embankment. A planning level total project cost to make structural modifications to the dam to meet current NRCS design criteria without compromising current flood control benefits is estimated at \$2,900,000. This estimate assumes that the auxiliary spillway will need to be armored with RCC to prevent spillway breaching and that major expenditures to address potential embankment deficiencies are not required, as discussed in Section 9 and Section 11.2.

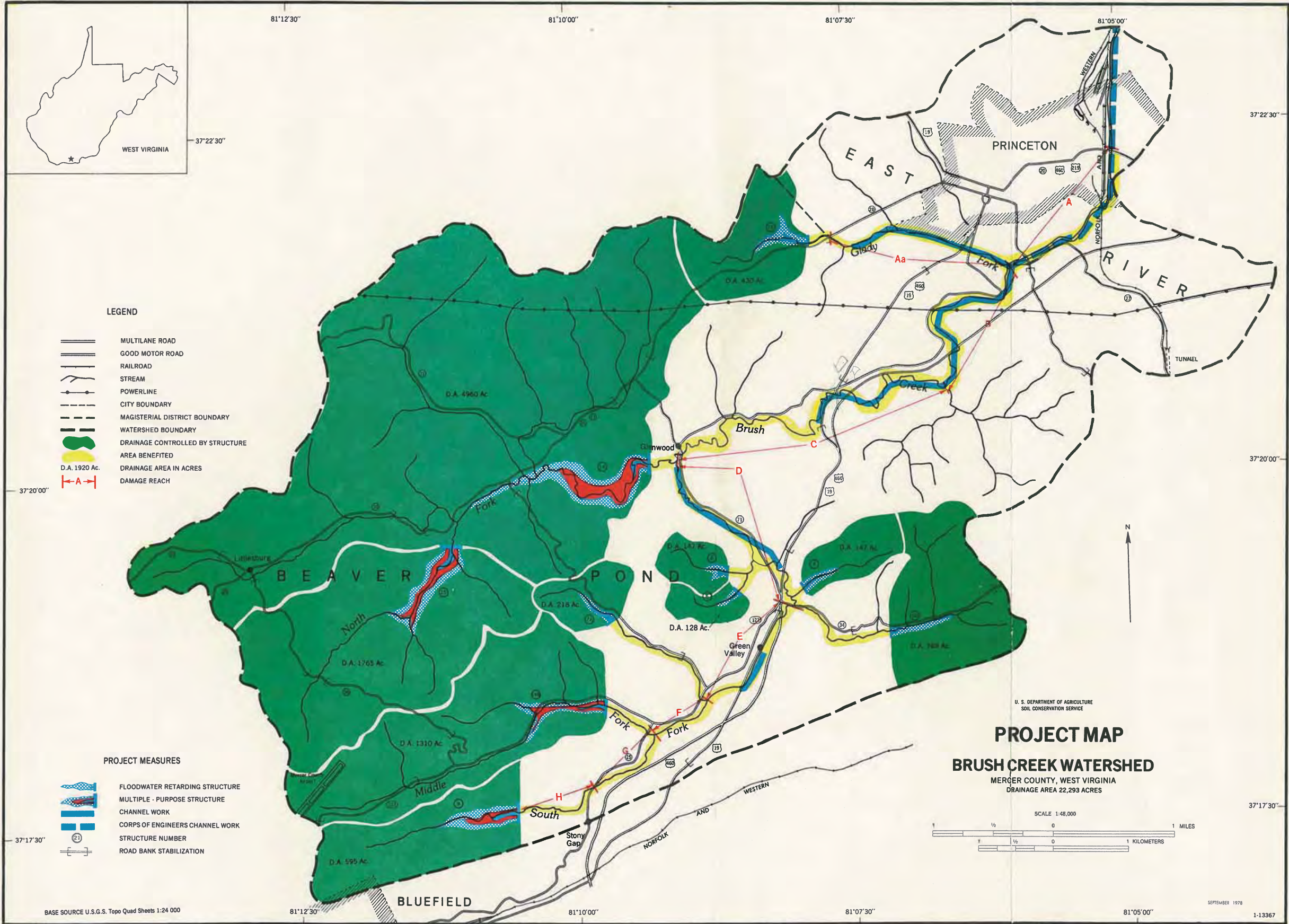


EXHIBIT 1

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Plot Date: 11/5/2011 7:25 AM Plotted By: Miller, Brian S.



**BRUSH CREEK  
SITE 15 DAM**

**GLENWOOD**

**MAPLE ACRE**

**PRINCETON**

**GARDNER**

**DAM BREACH INUNDATION MAP**

BRUSH CREEK SITE 15  
NIDID: WV 05511  
MERCER COUNTY, WEST VIRGINIA



**LEGEND**

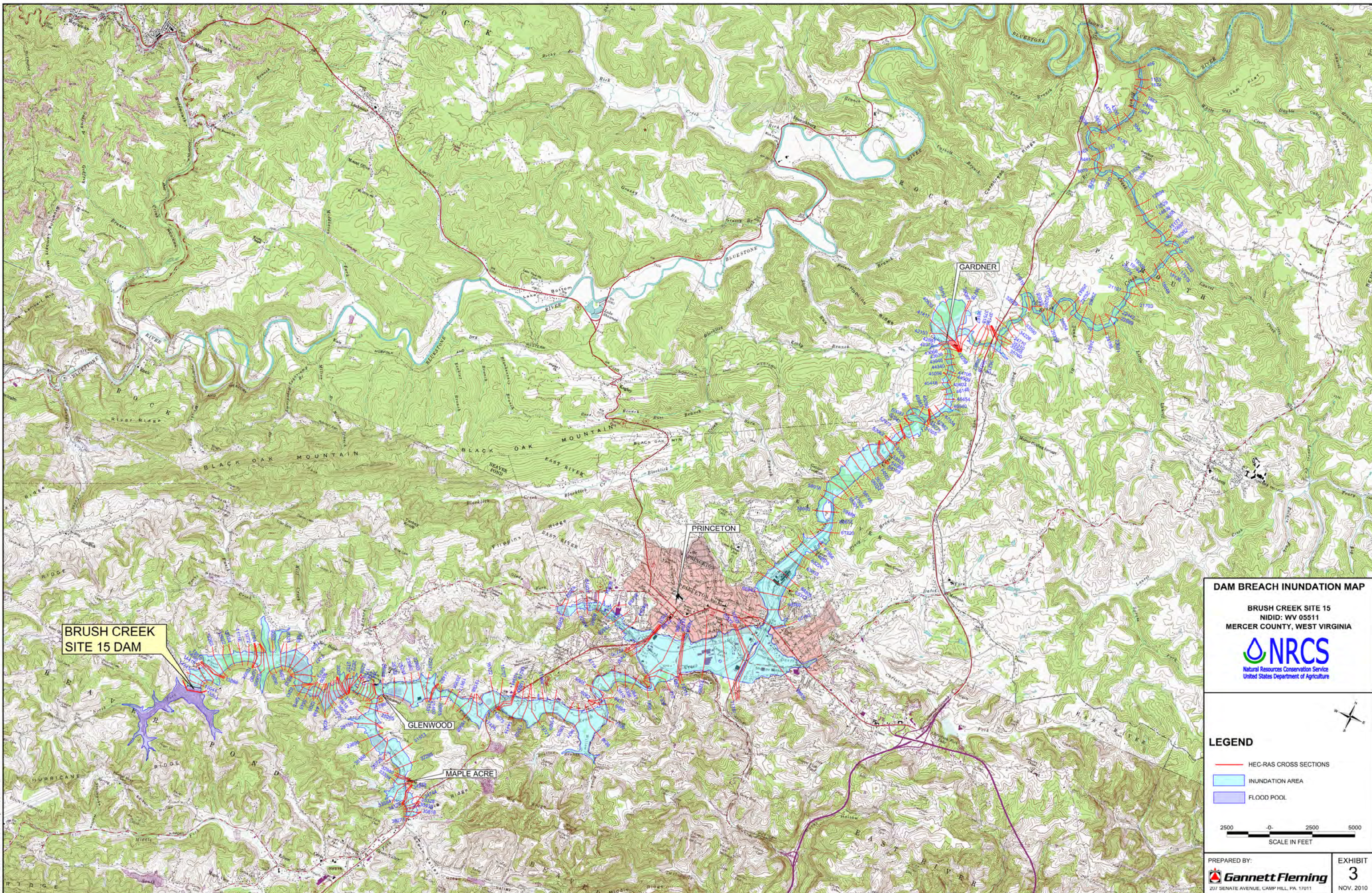
- HEC-RAS CROSS SECTIONS
- INUNDATION AREA
- FLOOD POOL



PREPARED BY:  
**Gannett Fleming**  
207 SENATE AVENUE, CAMP HILL, PA. 17011

EXHIBIT  
**2**  
NOV. 2010

W:\2016\active jobs\22299 - WV NRCS 2010 Contract05 Working\41 Dam Assessments\1 - CAD\Brush Creek Site 15 Inundation Map.dwg  
Plot Date: 11/20/2011 7:39 AM Plotted By: Miller, Brian S.



BRUSH CREEK  
SITE 15 DAM

GLENWOOD

MAPLE ACRE

PRINCETON

GARDNER

**DAM BREACH INUNDATION MAP**

BRUSH CREEK SITE 15  
NIDID: WV 05511  
MERCER COUNTY, WEST VIRGINIA



**LEGEND**

- HEC-RAS CROSS SECTIONS
- INUNDATION AREA
- FLOOD POOL



PREPARED BY:  
**Gannett Fleming**  
207 SENATE AVENUE, CAMP HILL, PA. 17011

EXHIBIT  
**3**  
NOV. 2010



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Appendix A  
Selected As-Built Drawings

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# BRUSH CREEK WATERSHED PROJECT

MULTIPLE PURPOSE DAM NO.15  
NORTH FORK OF BRUSH CREEK

WATER SUPPLY FOR THE CITY OF PRINCETON AND FLOOD PREVENTION

DRAINAGE AREA	1768 Acres
FLOOD STORAGE TO EMERGENCY SPILLWAY CREST	558 Acre Ft.
WATER SURFACE AREA AT PERMANENT POOL	72 Acres
HEIGHT OF DAM	74 Feet
VOLUME OF FILL	236,100 Cubic Yards

BUILT UNDER THE WATERSHED PROTECTION AND  
FLOOD PREVENTION ACT

by

BRUSH CREEK WATERSHED IMPROVEMENT DISTRICT  
MERCER COUNTY COURT AND CITY OF PRINCETON

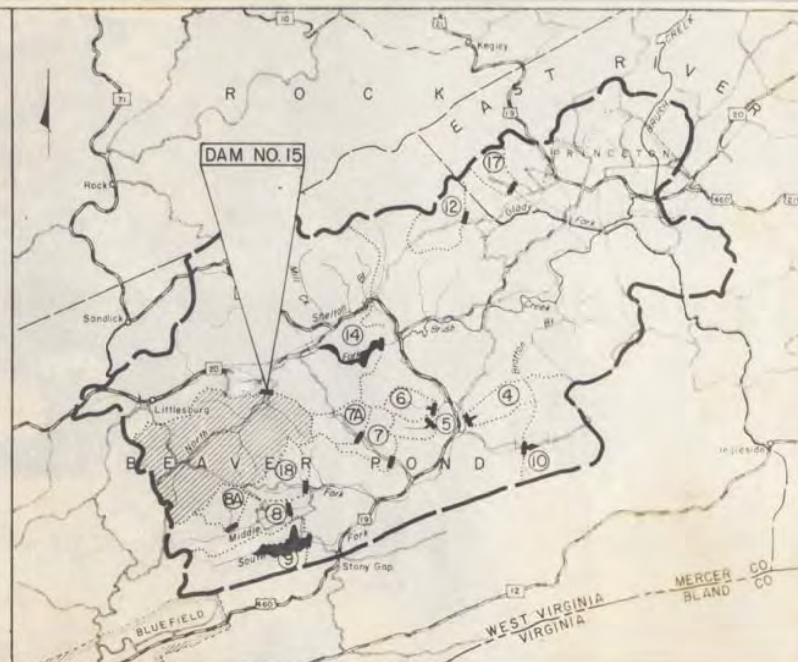
with the assistance of the  
SOIL CONSERVATION SERVICE

of the  
U.S. DEPARTMENT OF AGRICULTURE  
1964

## "AS BUILT"

### INDEX

SHEET 1 - COVER SHEET	SHEET 10 - PLAN - PROFILE OF PRINCIPAL SPILLWAY
SHEET 2 - PLAN OF DAMSITE AND STORAGE AREAS	SHEET 11 - LOGS OF TEST PITS
SHEET 3 - PLAN OF BORROW AND STORAGE AREAS	SHEET 12 - LOGS OF DRILL HOLES
SHEET 4 - PLAN OF BORROW AND STORAGE AREAS	SHEET 13 - LOGS OF DRILL HOLES
SHEET 5 - PLAN OF BORROW AND STORAGE AREAS	SHEET 14 - RISER - STRUCTURAL DETAILS
SHEET 6 - PLAN OF BORROW AND STORAGE AREAS	SHEET 15 - RISER - REINF. STEEL DETAILS
SHEET 7 - PROFILES	SHEET 16 - RISER - REINF. STEEL DETAILS
SHEET 8 - EMERGENCY SPILLWAY DETAILS	SHEET 17 - TRASH RACKS, LADDER AND MISC. DETAILS
SHEET 9 - SEEPAGE DRAIN DETAILS	SHEET 18 - CRADLE, COLLAR, AND STEEL SCHEDULE
	SHEET 19 - IMPACT BASIN DETAILS



LOCATION MAP  
SCALE = 1:62500

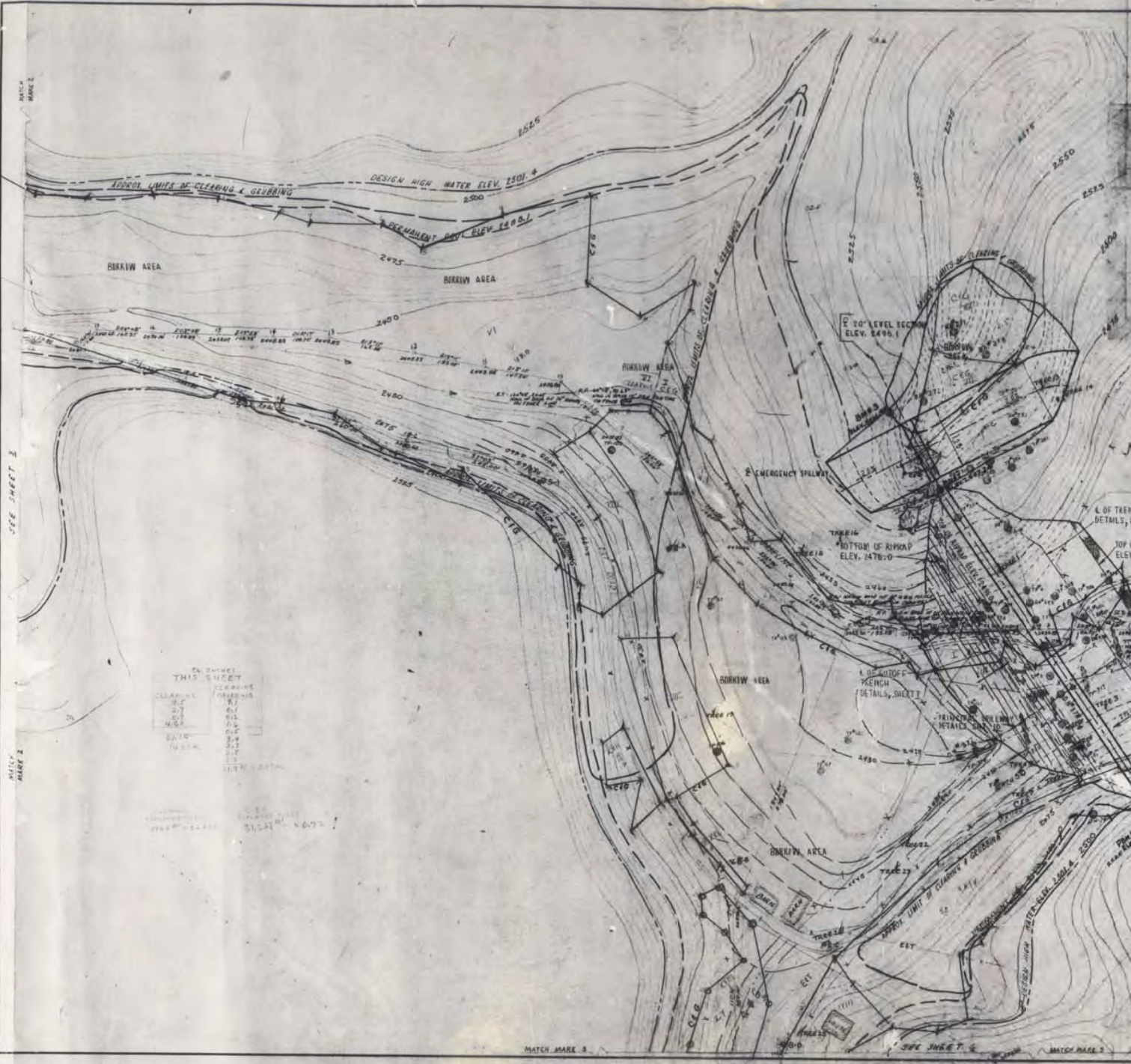
## "AS BUILT"

*1967*

BRUSH CREEK WATERSHED PROJECT	
MULTIPLE PURPOSE DAM NO. 15 PRINCETON, MERCER COUNTY, WEST VIRGINIA	
COVER SHEET	
U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	
Prepared by F. N. FARMER	DATE JULY 64
Checked by M. NIKOLICH	DATE AUG. 64
Drawn by F. M. WYSONG	DATE AUG. 64
HEAD, E. & W. UNIT	
STATE CONSERVATION ENGINEER	
WV - 470 - P	

**GENERAL NOTES**

1. All fill shall be compacted with a 450 psi tamping roller, minimum drum diameter 60".
2. Topsoil for the emergency spillway only will be salvaged and stockpiled. This topsoil will be spread on the back slopes and bottom of the emergency spillway after completion of excavation.
3. Other surface soil, after clearing and grubbing operations, will be placed in the water 25 feet of the downstream slope and paid for as compacted fill.
4. All fences in work area will be removed and salvaged.
5. Sidings and utility lines will be preserved by others.
6. Road will be relocated by others. However, during the entire period of construction of the dam the contractor shall make satisfactory provision for the maintenance of traffic along this road.
7. Narrow areas upstream from the permanent pool will be left in such condition that normal streamflow will be confined to a definite channel.
8. Areas shown as clearing and grubbing below permanent pool elevation which are used for borrow will be cleared and grubbed and areas not used for borrow will be cleared only.
9. Excavate a minimum of 100,000 cubic yards below elevation 2486.



ENGINEER J. B. HARKIN

NOTE: SEE SHEET 6 FOR DETAILED LAYOUT FOR DAM AND EMERGENCY SPILLWAY.

EXCAVATE OUTLET CHANNEL APPROX. 600' W. BOTTOM WIDTH, 3:1 SIDE SLOPES, BOTTOM SLOPE 0.002' IN'

**LEGEND**

- ELECT. TR. LINE ———— E ————
- TELEPHONE LINE ———— T ————
- DIRT ROAD ———— D ————
- FIELD ROAD ———— F ————
- STREAM ———— S ————
- STREAM TRIBUTARY ———— ST ————
- FENCE ———— X ————
- BEACH MARK ———— B ————
- CLEARING & GRUBBING ———— CG ————

AS BUILT NOTE:  
THE CENTERLINE OF DAM IS 2.0 FEET UPSTREAM FROM THAT SHOWN ON LAYOUT SHEET

E. OF DAM  
TOP WIDTH 22'  
ELEV. 2505.4

56 SHEETS  
THIS SHEET

CLEARING	GRUBBING
2.1	0.1
2.2	0.1
2.3	0.1
2.4	0.1
2.5	0.1
2.6	0.1
2.7	0.1
2.8	0.1
2.9	0.1
3.0	0.1
3.1	0.1
3.2	0.1
3.3	0.1
3.4	0.1
3.5	0.1
3.6	0.1
3.7	0.1
3.8	0.1
3.9	0.1
4.0	0.1

# "AS BUILT"

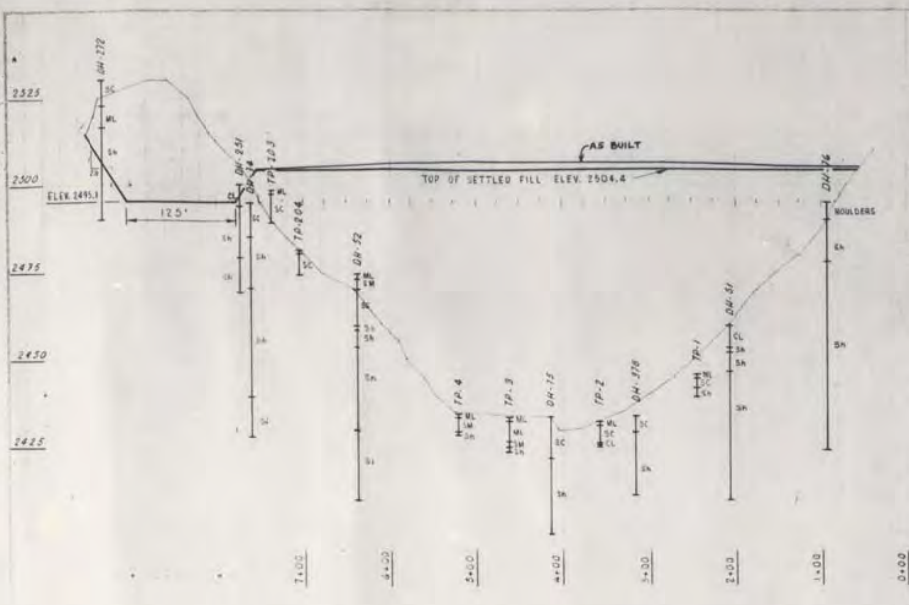
**BRUSH CREEK WATERSHED PROJECT**  
 MULTIPLE PURPOSE DAM NO. 15  
 PRINCETON, MERCER COUNTY, WEST VIRGINIA  
**PLAN OF DAMSITE AND STORAGE AREAS**  
 U. S. DEPARTMENT OF AGRICULTURE  
 SOIL CONSERVATION SERVICE

Designed by F. R. GORNER 1-2-52	Checked by H. A. GARDNER 1-2-52	Drawn by J. B. HARKIN 1-2-52	Approved by H. A. GARDNER 1-2-52
Title Plan of Damsite and Storage Areas		Sheet No. 2 of 2	
Drawing No. WV-470-1		Date 1-19-52	

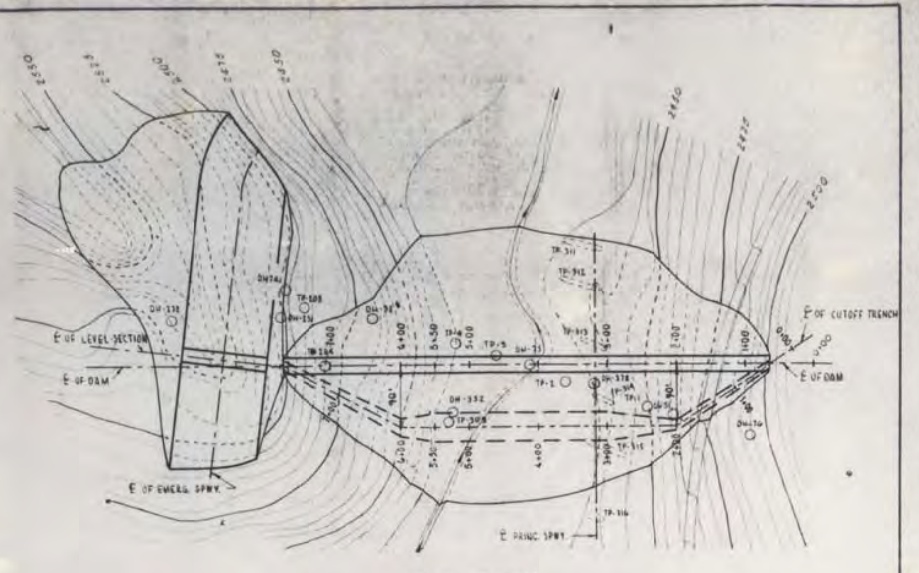
MATCH MARK 3

SEE SHEET 7

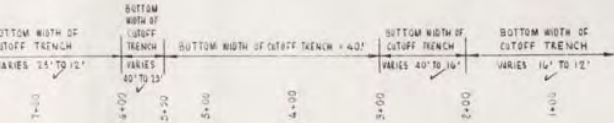
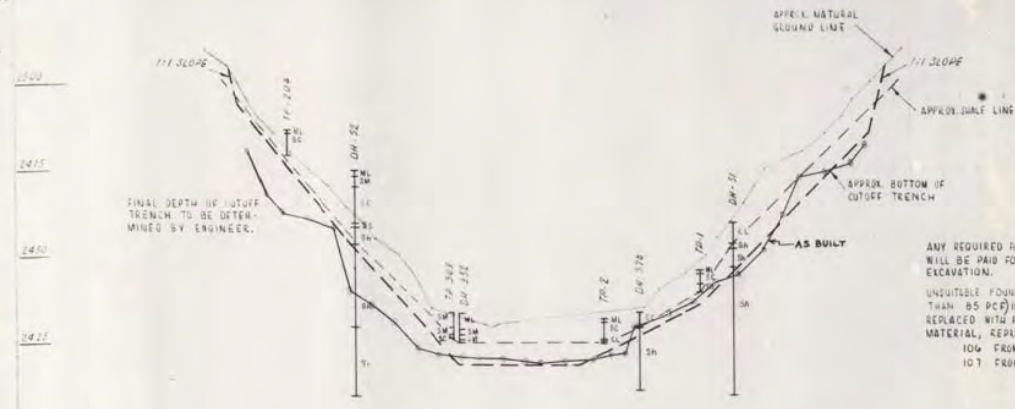
MATCH MARK 2



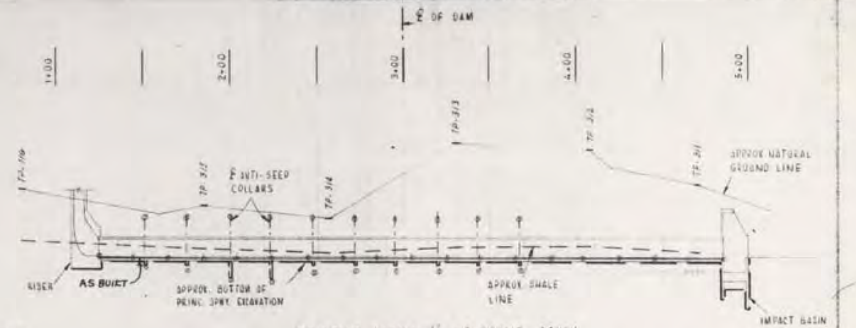
PROFILE ALONG E OF DAM & LEVEL SECTION OF EMERGENCY SPILLWAY  
(LOOKING DOWNSTREAM)



PLAN OF DAM  
SHOWING LOCATION OF CUTOFF TRENCH



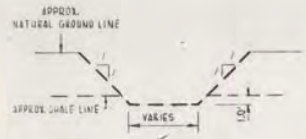
PROFILE ALONG E OF CUTOFF TRENCH (LOOKING DOWNSTREAM)



PROFILE ALONG E OF PRINC. SPWY.

ANY REQUIRED FOUNDATION EXCAVATION WILL BE PAID FOR AS CUTOFF TRENCH EXCAVATION.

UNSATURABLE FOUNDATION SOIL (DRY DENSITY LESS THAN 95 PCF) IS TO BE EXCAVATED AND REPLACED WITH FINE GRAINED, CLAYEY (CL) MATERIAL, REPRESENTED BY TEST HOLES 10' FROM 1' TO 7' & 10' FROM 2' TO 8'.



TYPICAL SECTION OF CUTOFF TRENCH EXCAVATION

# "AS BUILT"

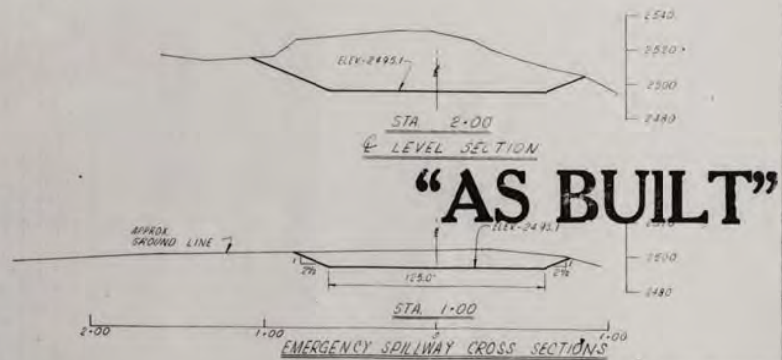
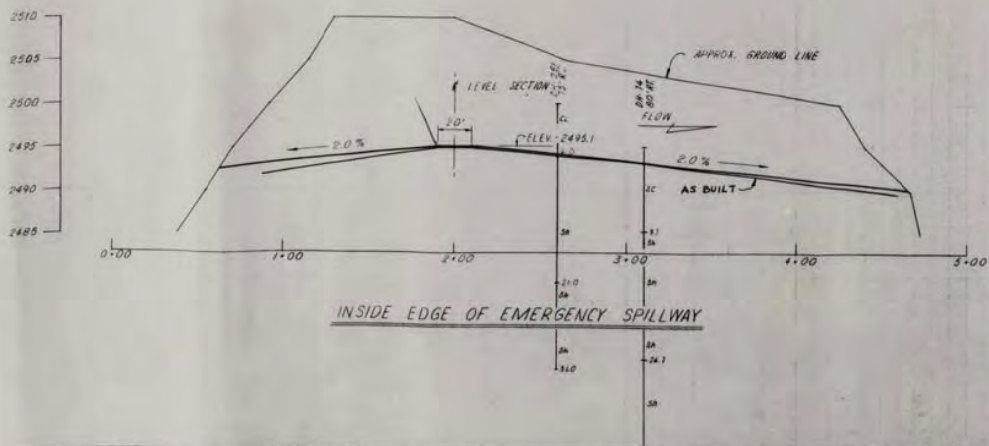
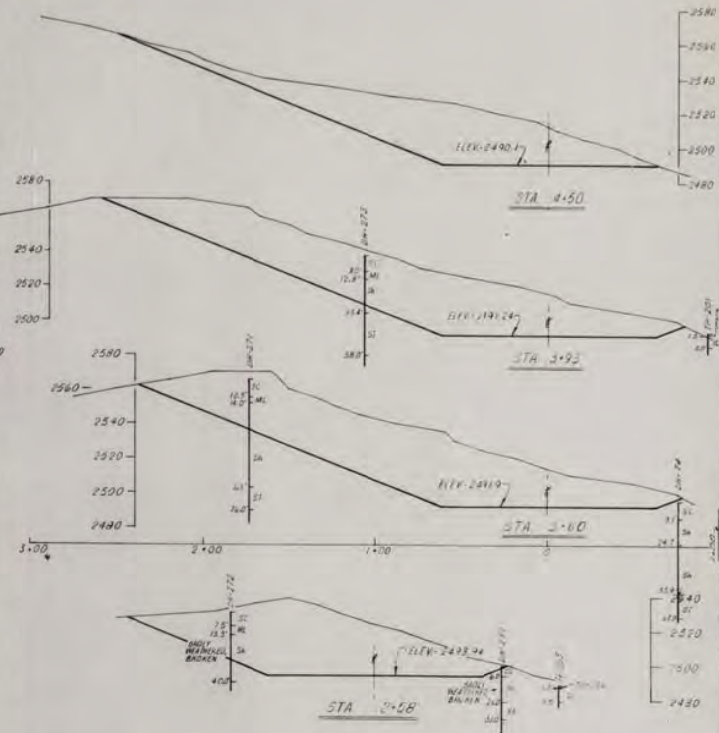
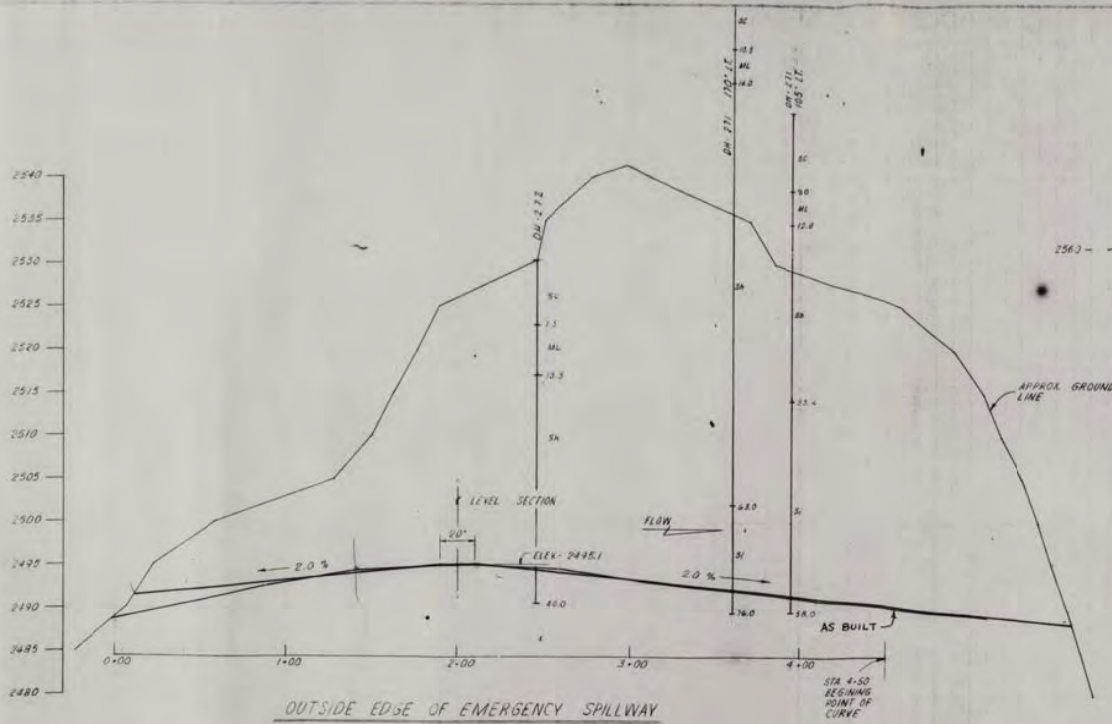
NOTE:  
TEST PITS SHOWN ARE EXPLORATORY ONLY & ARE NOT LOGGED.  
SEE SHEETS 1, 15 & 16 FOR LOGS OF TEST PITS AND DRILL HOLES.

TYPICAL SECTION OF PRINC. SPWY EXCAVATION

BRUSH CREEK WATERSHED PROJECT  
MULTIPLE PURPOSE DAM NO 15  
PRINCETON, MERCER COUNTY, WEST VIRGINIA  
PROFILES

U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE

DESIGNED BY	T. B. FARMER	JULY '64
CHECKED BY	W. T. BROWNING, JR.	JULY '64
DATE	AUG '64	7/19
PROJECT NO.	WV-470-P	



**"AS BUILT"**

NOTE:  
SEE SHEETS 4, 12 & 13  
FOR LOGS OF TEST PITS  
AND DRILL HOLES.

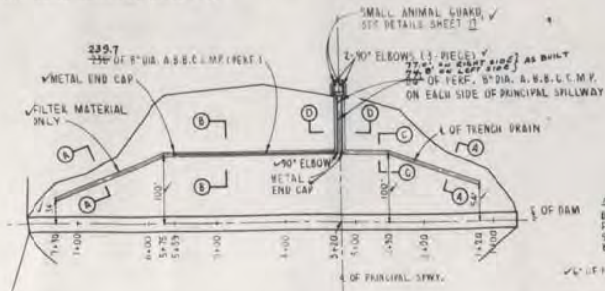
BRUSH CREEK WATERSHED PROJECT  
MULTIPLE PURPOSE DAM NO. 15  
PRINCETON, MERICER COUNTY, WEST VIRGINIA  
EMERGENCY SPILLWAY DETAILS

DESIGNED BY: [Signature]  
CHECKED BY: [Signature]

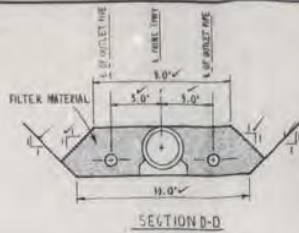
T. R. FARMER JR. SA  
C. SPOND ASB

T. M. WYSONG AUG '84 8 19 WV-470-P

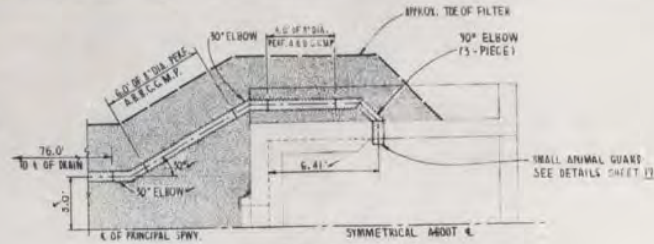
**NOTE:**  
THE SEEPAGE DRAIN PIPES SHALL BE 8" DIA. PERFORATED ANNULAR OR SPIRAL 16 GAUGE ASBESTOS BONDED BITU-MINIOUS COATED CORRUGATED METAL PIPE.



PLAN OF SEEPAGE DRAIN



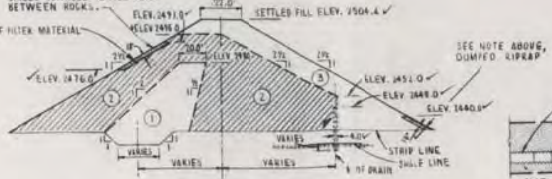
SECTION D-D



PLAN OF OUTLET DRAIN PIPE  
AS BUILT  
IN PLACE MEASUREMENT Right side = 18.2'  
Left side = 18.6'

**NOTE - DUMPED RIPRAP**

DUMPED RIPRAP SHALL BE WELL SORTED FROM A MAX. SIZE OF 18" TO 2' OR SMALLER SIZES SUITABLE TO FILL VOIDS BETWEEN ROCKS.



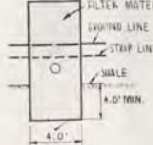
TYPICAL SECTION OF DAM

**PLACEMENT OF FILL**

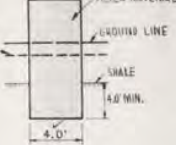
- SECTION 1 - COMPACTED FILL, CLASS B-1 FINE GRAINED CLAYEY (LL) MATERIAL REPRESENTED BY TEST HOLES 106 FROM 1'-7" AND 107 FROM 1'-5" (NO. 000 YDS BORROW 8")
- SECTION 2 - COMPACTED FILL, CLASS K-1 CLAYEY AND SILTY SAND (SC, ML, CL) REPRESENTED BY THE FOLLOWING TEST HOLES: 104, 30' TO 7.0', 101, 1.0' TO 8.0', 102, 1.0' TO 8.0', 105, 1.0' TO 7.5', 104, 3.0' TO 3.0', 103, 1.0' TO 7.5', 103, 8.0' TO 10.0', 104, 1.0' TO 5.0', AND 105, 1.0' TO 4.0' (NO. 000 YDS. EMERGENCY SPILLWAY AND BORROW 8")
- SECTION 3 - CLASS 1-C FILL - SHALE AND SILTSTONE REPRESENTED BY DRILL HOLE 273, 10.0 TO 21.0' AND 45.0 TO 50.0' (COMPACT TO OBTAIN A MINIMUM REL. DENSITY OF 100 LB./FT<sup>3</sup>) FOR MATERIAL FINER THAN 1/4" # 100 (30% - EMERGENCY SPILLWAY).



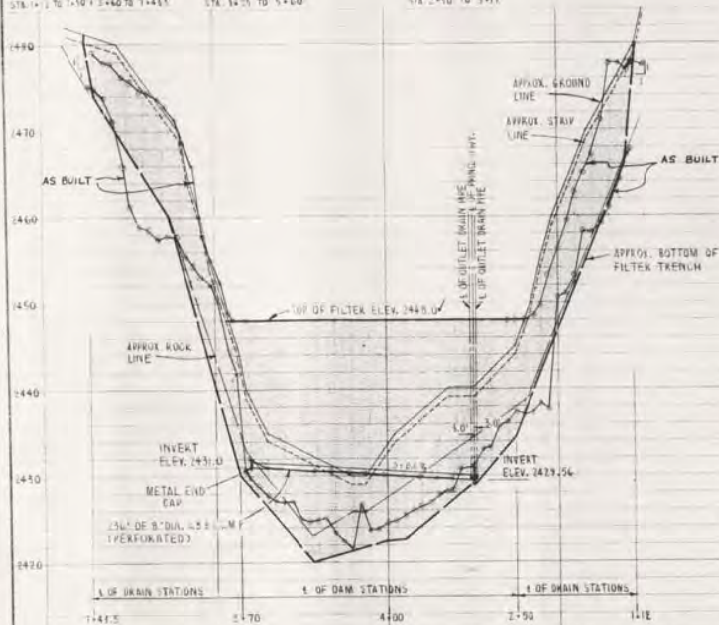
SECTION A-A



SECTION B-B



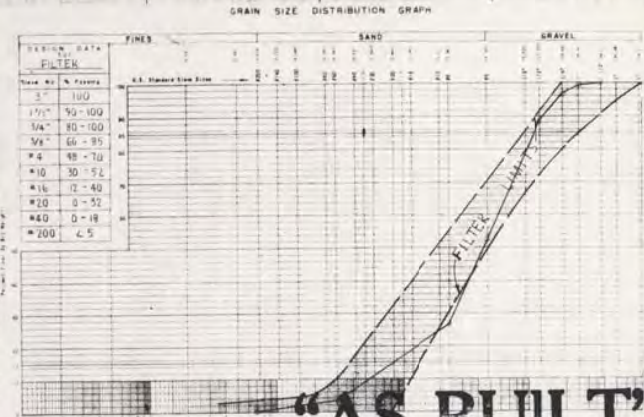
SECTION C-C



PROFILE ALONG 1/2 OF SEEPAGE DRAIN (LOOKING DOWNSTREAM)

BILL OF MATERIALS	
-	241 30° ELBOWS
-	42 90° ELBOWS (3 PIECE)
-	11 90° ELBOW (2 PIECE)
-	2 METAL END CAPS
-	216 8" DIA. PERFORATED A.B.C.C.M.P.
-	2 SMALL ANIMAL GUARDS
-	216 18" DIA. FILTER MATERIAL

**NOTE:**  
IF FILTER GRADATION REQUIREMENTS ARE SUCH THAT SAND MUST BE MIXED WITH GRAVEL TO MEET THE LIMITS SHOWN ON THESE PLANS, THE FILTER MATERIAL WILL BE THOROUGHLY MIXED & THEN DAMPENED WITH WATER, PRIOR TO PLACEMENT.



**"AS BUILT"**

**BRUSH CREEK WATERSHED PROJECT**  
MULTIPLE PURPOSE DAM NO. 15  
PRINCETON, MERCER COUNTY, WEST VIRGINIA  
**SEEPAGE DRAIN DETAILS**  
U.S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE

Designed by <b>J. ZURLO</b>	Date <b>AUG 64</b>	Approved by <b>W. H. MORGAN</b>	Date <b>AUG 64</b>
Checked by <b>F. M. RYSONG</b>	Date <b>AUG 64</b>	Project No. <b>WV-470-P</b>	Sheet No. <b>19</b>

JOINT	DISTANCE FROM RIVER WALL	INVERT ELEV. OF 24" DIA. PIPE
J-1	0.55	2430.20
J-2	20.55	2430.15
J-3	40.55	2430.11
J-4	60.55	2430.06
J-5	80.55	2430.01
J-6	100.55	2429.97
J-7	120.55	2429.93
J-8	140.55	2429.89
J-9	160.55	2429.85
J-10	180.55	2429.81
J-11	200.55	2429.77
J-12	220.55	2429.73
J-13	240.55	2429.69
J-14	260.55	2429.65
J-15	280.55	2429.61
J-16	300.55	2429.57
J-17	320.55	2429.53
J-18	340.55	2429.49
J-19	360.55	2429.45

NOTE: ABOVE DIMENSIONS FOR LENGTHS OF PIPE ARE BASED ON NOMINAL LENGTHS AND DO NOT INCLUDE GREEP.

JOINT	DISTANCE FROM RIVER WALL	INVERT ELEV. OF 24" DIA. PIPE
J-1	0.55	2430.20
J-2	16.55	2430.16
J-3	36.55	2430.12
J-4	40.55	2430.11
J-5	56.55	2430.07
J-6	72.55	2430.03
J-7	88.55	2429.99
J-8	104.55	2429.95
J-9	120.55	2429.91
J-10	136.55	2429.87
J-11	152.55	2429.83
J-12	168.55	2429.79
J-13	184.55	2429.75
J-14	200.55	2429.71
J-15	216.55	2429.67
J-16	232.55	2429.63
J-17	248.55	2429.59
J-18	264.55	2429.55
J-19	280.55	2429.51
J-20	296.55	2429.47
J-21	312.55	2429.43
J-22	328.55	2429.39
J-23	344.55	2429.35
J-24	360.55	2429.31

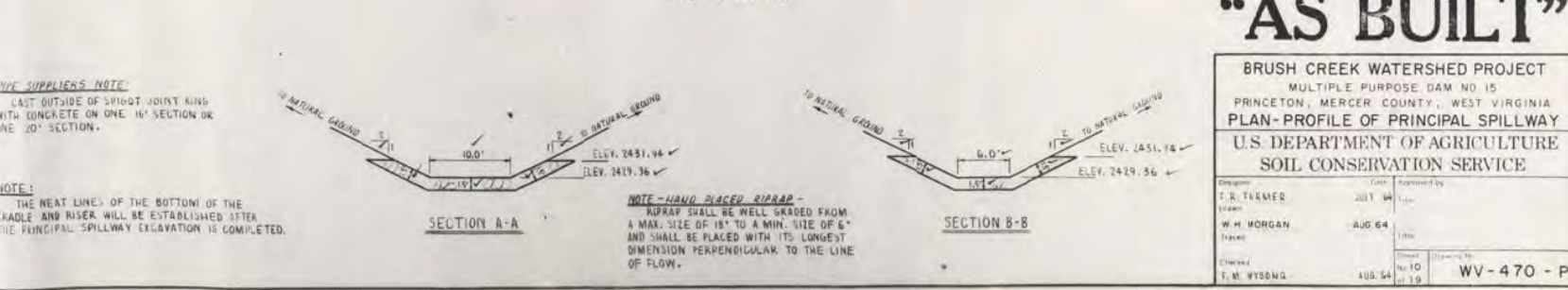
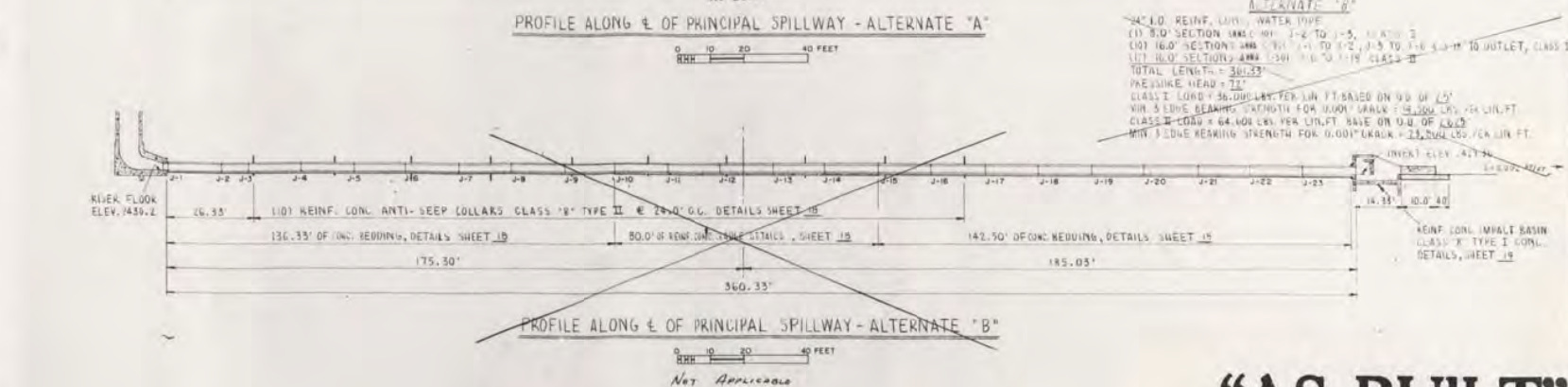
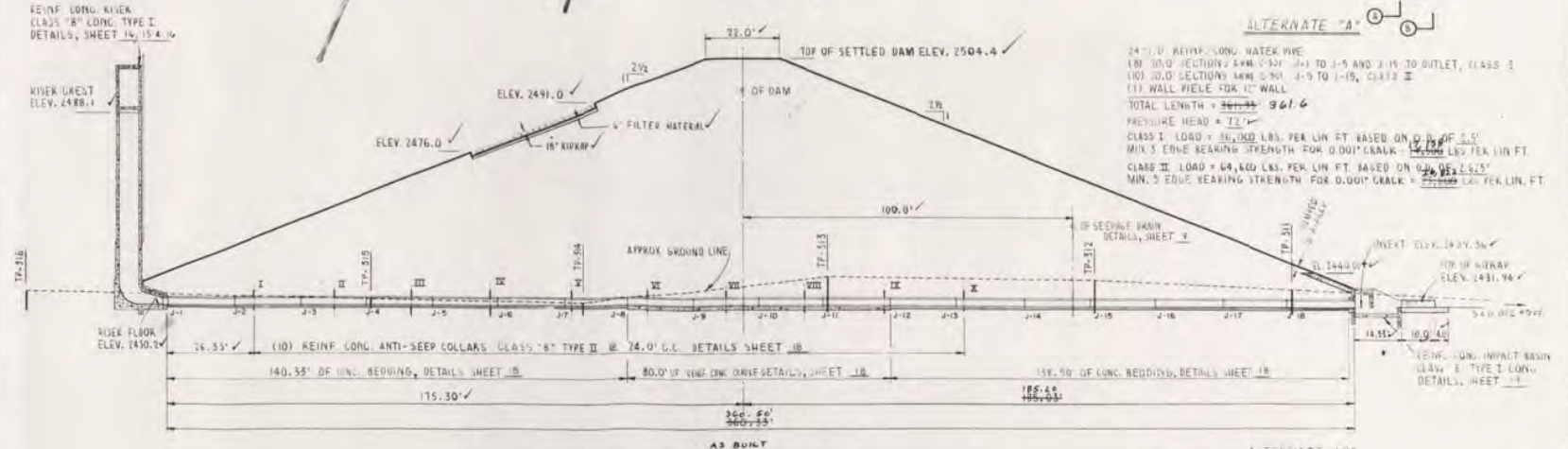
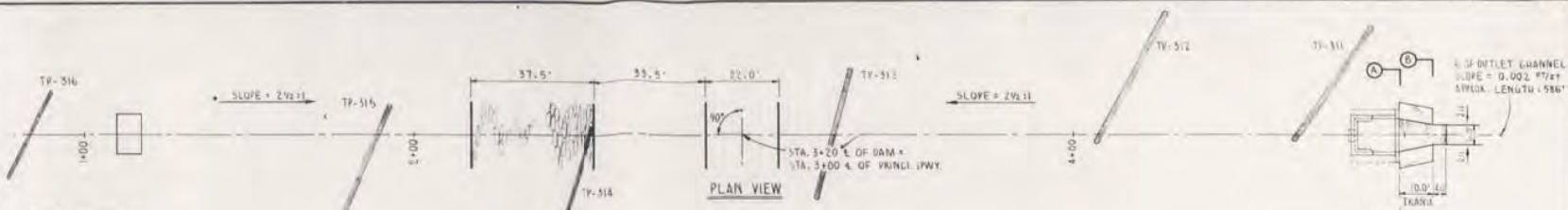
NOTE: ABOVE DIMENSIONS FOR LENGTHS OF PIPE ARE BASED ON NOMINAL LENGTHS AND DO NOT INCLUDE GREEP.

JOINT	DISTANCE FROM RIVER WALL	INVERT ELEV. OF 24" DIA. PIPE
I	20.55	2430.14
II	50.55	2430.08
III	74.55	2430.03
IV	78.55	2429.97
V	121.55	2429.91
VI	146.55	2429.85
VII	170.55	2429.80
VIII	194.55	2429.75
IX	218.55	2429.69
X	241.55	2429.64

JOINT	INVERT ELEV. OF 24" DIA. PIPE	GAP TOP	GAP BOTTOM
J-8	2430.20	-	-
J-1	2430.20	1.0	0.0
J-2	2430.15	1.5	0.5
J-3	2430.11	4.0	4.0
J-4	2430.06	1.5	2.0
J-5	2430.01	2.0	2.0
J-6	2429.97	0.0	1.0
J-7	2429.93	1.0	0.0
J-8	2429.89	1.0	0.0
J-9	2429.85	1.0	0.0
J-10	2429.81	1.5	0.0
J-11	2429.77	2.0	2.0
J-12	2429.73	0.0	0.0
J-13	2429.69	1.0	0.0
J-14	2429.65	0.0	0.0
J-15	2429.61	4.0	4.0
J-16	2429.57	1.0	0.0
J-17	2429.53	1.0	1.5
J-18	2429.49	0.0	1.0
WATER	2429.36	-	-

**PIPE SUPPLIERS NOTE:**  
CAST OUTSIDE OF SPIGOT JOINT KING WITH CONCRETE ON ONE 16" SECTION OR ONE 20" SECTION.

**NOTE:**  
THE NEAT LINES OF THE BOTTOM OF THE CHADLE AND RISER WILL BE ESTABLISHED AFTER THE PRINCIPAL SPILLWAY EXCAVATION IS COMPLETED.



**ALTERNATE "A"**

24" Ø REINFP. LONG. WATER PIPE  
 (8) 20.0' SECTIONS AMN. 5'-30" J-1 TO J-5 AND J-15 TO OUTLET, CLASS I  
 (10) 10.0' SECTIONS AMN. 0'-30" J-5 TO J-15, CLASS II  
 (1) WALL PIECE FOR 12" WALL  
 TOTAL LENGTH = 360.55'  
 PRESSURE HEAD = 72.1'

CLASS I LOAD = 36,000 LBS. PER LIN. FT. BASED ON 9/8 OF 2.5" MIN. 3" EDGE BEARING STRENGTH FOR 0.001" CRACK = 18,000 LBS. PER LIN. FT.  
 CLASS II LOAD = 64,800 LBS. PER LIN. FT. BASED ON 9/8 OF 2.5" MIN. 3" EDGE BEARING STRENGTH FOR 0.001" CRACK = 32,400 LBS. PER LIN. FT.

**ALTERNATE "B"**

24" Ø REINFP. LONG. WATER PIPE  
 (11) 8.0' SECTIONS AMN. 0'-30" J-2 TO J-5, CLASS I  
 (10) 16.0' SECTIONS AMN. 0'-30" J-1 TO J-2, J-13 TO J-16, 4'-30" TO OUTLET, CLASS I  
 (1) WALL PIECE FOR 12" WALL  
 TOTAL LENGTH = 360.55'  
 PRESSURE HEAD = 72.1'

CLASS I LOAD = 36,000 LBS. PER LIN. FT. BASED ON 9/8 OF 2.5" MIN. 3" EDGE BEARING STRENGTH FOR 0.001" CRACK = 18,000 LBS. PER LIN. FT.  
 CLASS II LOAD = 64,800 LBS. PER LIN. FT. BASED ON 9/8 OF 2.5" MIN. 3" EDGE BEARING STRENGTH FOR 0.001" CRACK = 32,400 LBS. PER LIN. FT.

# "AS BUILT"

**BRUSH CREEK WATERSHED PROJECT**  
 MULTIPLE PURPOSE DAM NO. 15  
 PRINCETON, MERCER COUNTY, WEST VIRGINIA

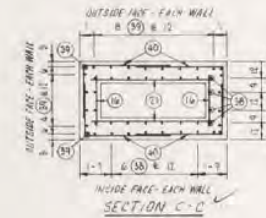
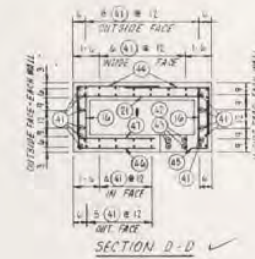
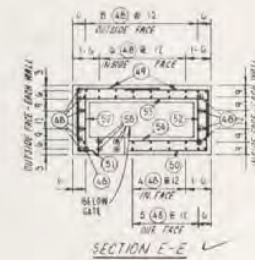
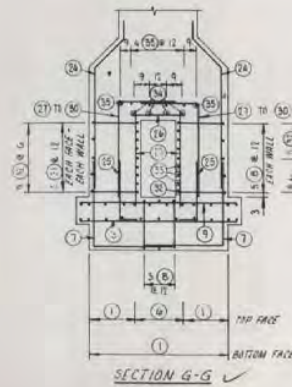
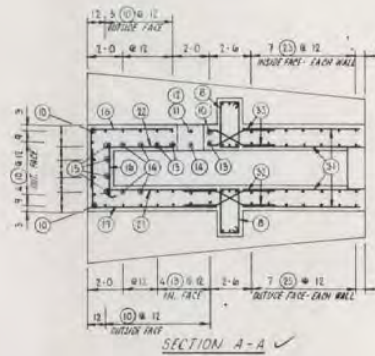
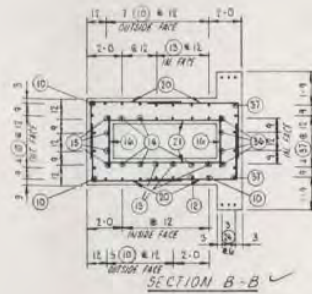
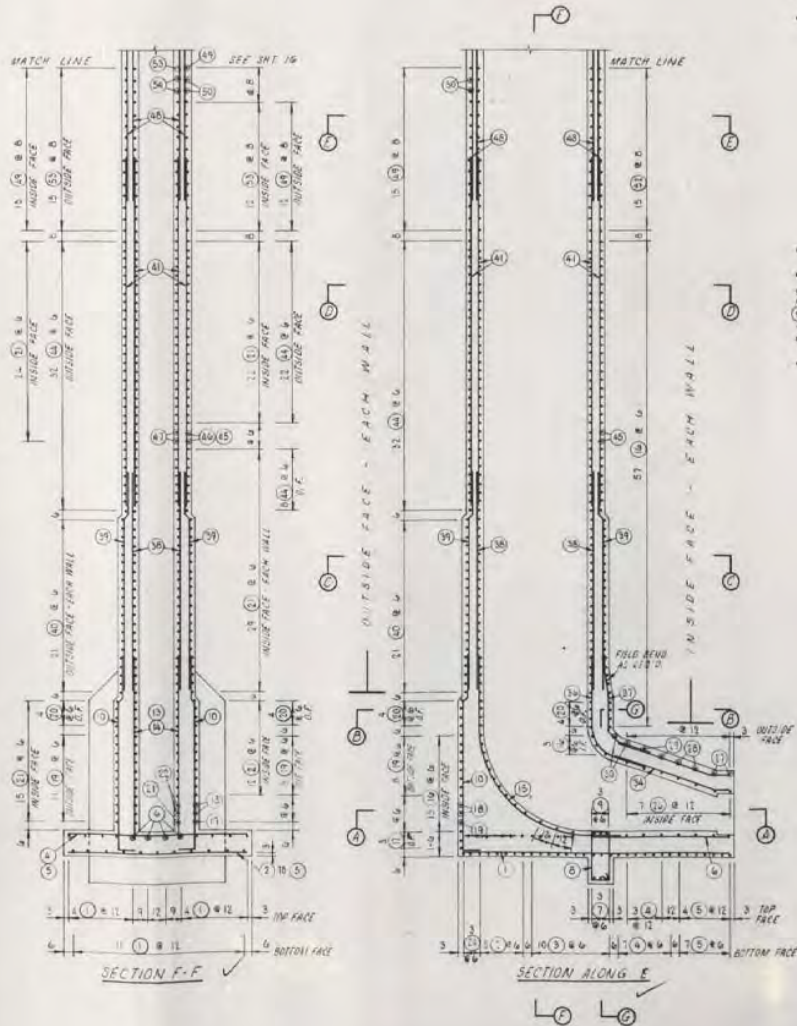
**PLAN - PROFILE OF PRINCIPAL SPILLWAY**

U.S. DEPARTMENT OF AGRICULTURE  
 SOIL CONSERVATION SERVICE

Designer F. R. FARMER	Date JULY 64	Approved by W. H. MORGAN
Drawn E. M. WYSONG	Date AUG 64	Checked AUG 64

Project No. 10  
 Drawing No. 19  
**WV-470-P**





NOTE:  
BAR TYPES, REIN. STEEL SCHEDULE,  
SEE SHEET 10.

# "AS BUILT"

BRUSH CREEK WATERSHED PROJECT  
MULTIPLE PURPOSE DAM NO. 15  
PRINCETON, MERCER COUNTY, WEST VIRGINIA  
RISER-REIN. STEEL DETAILS  
U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE

Designer F. R. FARMER	Date JULY 68	Checked by M. NIKOLICH	Date AUG 68
Drawn M. NIKOLICH	Traced T. B. FARMER	Checked by T. B. FARMER	Date SEPT 68

Sheet No. 15 of 19  
Drawing No. WV-470-P



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Appendix B  
Site Inspection Checklist and Photos

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**WATERSHED** Brush Creek  
**COUNTY** Mercer  
**OWNER** \_\_\_\_\_  
**ADDRESS** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**SITE NUMBER** 15  
**NID #** 05511      **HAZARD CLASS** C  
**PURPOSE OF DAM** Flood Control; Water Supply  
**INSPECTION DATE** 10/19/10  
**WEATHER** Sunny, 50° F

ITEM	Y	N	N/A	REMARKS
<b>1. General Conditions</b>				
a. Alterations to dam?		X		
b. Grass cover adequate?	X			
c. Settlements, misalignments or cracks?		X		
d. Vehicle ruts or animal trails?	X			Minor tire ruts on dam crest.
e. Fencing adequate?			X	
f. Recent high water marks?		X		elevation
g. Development in flood pool?		X		
h. Development in downstream floodplain?	X			New houses immediately downstream of dam.
i. Development in upstream watershed?		X		
<b>2. Upstream Slope</b>				
a. Erosion?	X			Wave erosion at normal water level.
b. Trees?	X			Tree stumps in embankment.
c. Rodent holes?		X		
d. Cracks, settlements or bulges?	X			Wave erosion at normal water level.
e. Adequate and sound riprap?	X			
<b>3. Downstream Slope</b>				
a. Erosion?		X		
b. Trees?		X		
c. Rodent holes?		X		
d. Cracks, settlements, & bulges?		X		
e. Drains or wells flowing?	X			estimated gpm Both drains flowing (combined flow less than 1/2 gpm)
f. Seepage or boils?	X			estimated gpm Wet area observed near right gutter and toe
<b>4. Intake Structure</b> concrete X metal				water surface elevation
a. Spalling, cracking, & scaling?				None observed. Interior not accessed.
b. Exposed reinforcement?				None observed. Interior not accessed.
c. Corrosion present?				None observed on visible portion.
d. Manhole cover?			X	
e. Leakage?				estimated gpm None observed. Interior not accessed.
f. Trash rack adequate?	X			
g. Inlet obstructed?		X		
h. Drawdown operative? closed ___ open ___				Not accessed. Unknown.
i. Ladder intact?	X			
j. Pedestal securely fastened?				Not accessed. Unknown.
k. Floodgates operational?				Not accessed. Unknown.
l. Stem bent?				Visible portion not bent.
m. Stem guides operational?				Not accessed. Unknown.
n. Stem handwheel present?		X		
o. Do metal parts require painting?		X		
<b>5. Abutment Contacts</b>				
a. Erosion, cracks, or slides?	X			Erosion gully beginning to form in left downstream abutment contact.
b. Seepage?		X		
c. Gutters intact?	X			
<b>6. Auxiliary Spillway</b>				
a. Obstructions?		X		
b. Erosion?	X			At normal pool level and on auxiliary spillway training dike.
c. Rodent holes?		X		
d. Low areas?		X		
e. Slips?		X		

ITEM	Y	N	N/A	REMARKS
<b>7. Conduit &amp; Outlet</b> concrete <input checked="" type="checkbox"/> metal				tailwater elevation/flow
a. Spalling, cracking, & scaling?				None observed. See Note 1.
b. Exposed reinforcement?				None observed. See Note 1.
c. Joints displaced or offset?				None observed. See Note 1.
d. Joint material lost?				None observed. See Note 1.
e. Leakage?				None observed. See Note 1.
f. Earth erosion?				None observed. See Note 1.
g. Conduit misaligned?				Not observed. See Note 1.
h. Outlet channel obstructed?		<input checked="" type="checkbox"/>		
<b>8. Stilling Basin <input checked="" type="checkbox"/> Plunge Pool</b>				
a. Spalling, cracking, & scaling?		<input checked="" type="checkbox"/>		Concrete shows signs of weathering
b. Exposed reinforcement?		<input checked="" type="checkbox"/>		
c. Joints displaced or offset?		<input checked="" type="checkbox"/>		
d. Joint material lost?		<input checked="" type="checkbox"/>		
e. Joints leak?		<input checked="" type="checkbox"/>		
f. Rock adequate?	<input checked="" type="checkbox"/>			
g. Dissipater deteriorating?		<input checked="" type="checkbox"/>		Minor weathering
h. Dissipater clean of debris?	<input checked="" type="checkbox"/>			
i. Toe drains visible?	<input checked="" type="checkbox"/>			
j. Toe drains flowing?	<input checked="" type="checkbox"/>			
k. Toe drain animal guards in place?	<input checked="" type="checkbox"/>			
<b>9. Reservoir</b>				
a. Buildings in floodpool?		<input checked="" type="checkbox"/>		
b. Slides or erosion on banks?		<input checked="" type="checkbox"/>		
c. Debris?	<input checked="" type="checkbox"/>			Some floatable debris on right abutment contact
d. Unsecured boats/docks?		<input checked="" type="checkbox"/>		
e. Sediment deposits?		<input checked="" type="checkbox"/>		
<b>10. Instruments</b>				
a. Structure instrumented?		<input checked="" type="checkbox"/>		
b. Monitoring performed?			<input checked="" type="checkbox"/>	
<b>11. Development</b>				
a. New development upstream of dam?		<input checked="" type="checkbox"/>		
b. New development downstream of dam?	<input checked="" type="checkbox"/>			New houses immediately downstream of dam.
c. EAP plan and mapping adequate?				To be determined by others.
<b>12. Hazard Classification Correct?</b>	<input checked="" type="checkbox"/>			

- REMARKS:**
- There are minor tire ruts on the dam crest.
  - New houses have been constructed immediately downstream of the dam.
  - Wave erosion was observed at normal water level.
  - A wet area was observed near the right gutter and toe.
  - An erosion gully is beginning to form in the left downstream abutment contact.
  - Some erosion and bare areas were observed at normal pool level and on training dike of the auxiliary spillway.

Note 1: The conduit and outlet were inspected from the downstream end. A comprehensive inspection of the conduit has not been performed as part of this inspection.

ENGINEER Paul Schweiger

DATE 12/27/2010

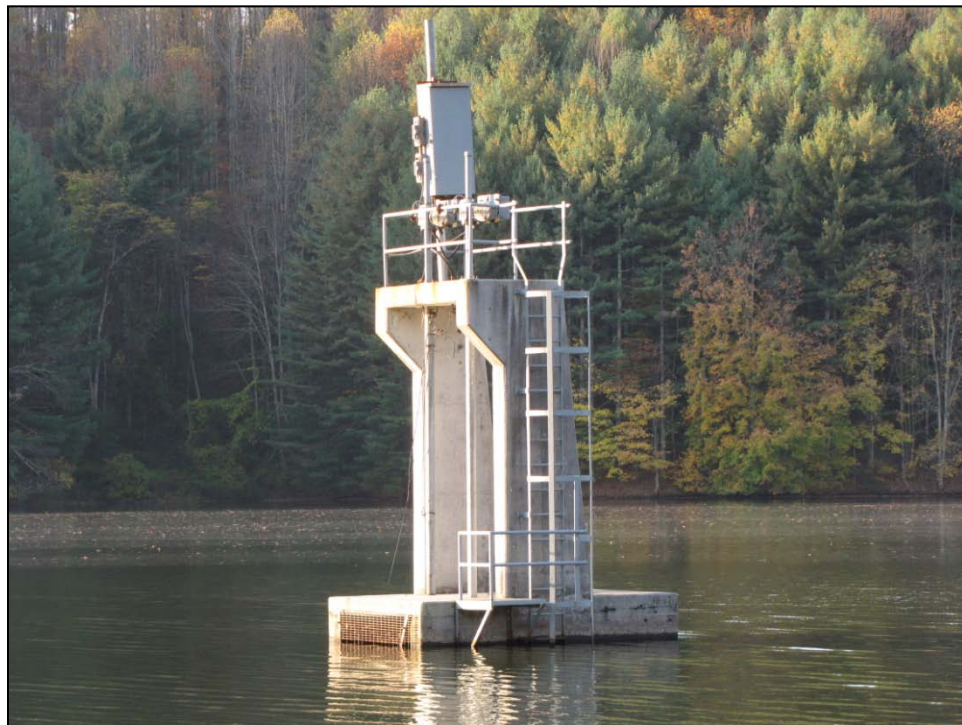
SIGNATURE Paul Schweiger  
Engineer

PROFESSIONAL ENGINEER SEAL

## GENERAL



1. General overview of dam from left side of auxiliary spillway.



2. Principal spillway riser structure.

GENERAL



3. Upstream embankment slope.



4. Downstream embankment slope.

GENERAL



5. Outlet channel and stilling basin.



6. Outlet conduit.

**OBSERVED DEFICIENCIES**



7. Tire ruts along crest of dam.



8. Wet area observed on right side of downstream slope.

**OBSERVED DEFICIENCIES**



9. Erosion gully forming in left downstream abutment contact.



10. Bare area near inlet of auxiliary spillway.

## OBSERVED DEFICIENCIES



11. Wave erosion on upstream slope of embankment and auxiliary spillway.



12. Recently constructed house and other buildings immediately downstream of dam.

**OBSERVED DEFICIENCIES**



13. Tree stumps in upstream slope of embankment.



14. CMP drains.



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Appendix C  
SITES Output

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## SITES Output

Brush Creek Site 15 – ASW Crest Criteria

---

# Brush Creek Site 15 – ASW Crest Criteria

```

1*****
SITES XEQ 02/11/2011  WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM
VER 2005.1.04          (USER MANUAL - DATED DECEMBER 2005)
TIME 09:04:04
  
```

\*\*\*\*\* 80-80 LIST OF INPUT DATA \*\*\*\*\*

```

SITES      01/01/2005BC15      Brush Creek Site 15      2.76      A1
SAVMOV     0      101
SAVMOV     101  1
STRUCTURE  15

                2430                0
                2435                13.6
                2440                50.4
                2445                113.8
                2450                189.5
                2455                266.3
                2460                360.7
                2465                478.9
                2470                630.4
                2475                825
                2480                1068.2
                2485                1363.6
                2490                1717.7
                2495                2128.9
                2500                2594.2
                2505                3117.8
                2510                3700
                2515                4346.4
                2530                6400

ENDTABLE
WSDATA     2C 15      80      2.76      1.23      7.5
BASEFLOW   1.12
PDIRECT    1.42      4.82      7.62
POOLDATA   ELEV      2488.1      2439      SC
PSINLET    0.75      12
PSDATA     1      360.5      24      0.013      2430.36
GRAPHICS   I
GO,DESIGN  LN
SAVMOV     2      101  1      15
ENDJOB
  
```

\*\*\*\*\*

```

1SITES -----
XEQ 02/11/2011      Brush Creek Site 15      WSID= BC15
VER 2005.1.04      SUBW= 15
TIME 09:04:04      SITE = 15      PASS= 1      PART= 1
  
```

```

***** BASIC DATA *****
HUMID- SUBHUMID CLIMATE AREA      DESIGN CLASS C
  
```

STORM DISTRIBUTION PSH..10 DAY NRCS DESIGN STORM (CHAPTER 21, NEH4 & TR-60).

STORM DISTRIBUTION USED FOR AUXILIARY SPILLWAY IS;  
NRCS DESIGN STORM RAINFALL DISTRIBUTION (CHAPTER 21, NEH4 & TR-60).

```

PRECIP. - P-PS,1-DAY      P-PS,10-DAY      Q-SD      Q-FB
                4.82      7.62      0.00      0.00

WSDATA -      CN      DA-SM      TC/L      -/H      QRF
                80.00      2.76      1.23      0.00      7.50

SITEDATA- PERM POOL      CREST PS      FP SED      VALLEY FL      378?
                0.00      2488.10      2439.00      0.00      NO
  
```



## Brush Creek Site 15 – ASW Crest Criteria

	FEET	CFS	CFS	CFS	AC-FT	ACRE
1	2488.10	0.00	0.00	0.00	1583.15	0.00
2	2488.51	9.73	9.73	0.00	1612.11	0.00
3	2488.92	27.52	27.52	0.00	1641.07	0.00
4	2489.33	50.55	50.55	0.00	1670.03	0.00
FULL CONDUIT FLOW, ELEV = 2489.74 FT						
5	2489.74	77.82	77.82	0.00	1698.99	0.00
6	2494.77	81.06	81.06	0.00	2109.87	0.00
7	2499.80	84.17	84.17	0.00	2575.73	0.00
8	2504.83	87.17	87.17	0.00	3100.47	0.00
9	2509.87	90.07	90.07	0.00	3684.56	0.00
10	2514.90	92.87	92.87	0.00	4333.52	0.00
11	2519.93	95.60	95.60	0.00	5021.81	0.00
12	2524.97	98.25	98.25	0.00	5710.85	0.00
13	2530.00	100.83	100.83	0.00	6399.90	0.00

```

1SITES -----
XEQ 02/11/2011           Brush Creek Site 15           WSID= BC15
VER 2005.1.04           SUBW= 15
TIME 09:04:04           SITE = 15           PASS= 1           PART= 3
  
```

```

AUX. CREST      2492.84 FT      1950.9 ACFT      0.00 AC      79.8 CFS

      PS STORAGE      367.8 ACFT,  BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

START ELEV      2488.76 FT      1630.0 ACFT      0.00 AC      20.7 CFS

ELEVATION OF LOW POINT IS ZERO.  NO CRITERIA CHECK MADE FOR
STRUCTURE CLASSIFICATION.
  
```

```

***** MESSAGE - NO INPUT DATA GIVEN FOR AUXILIARY SPILLWAY CREST AND/OR
                  BOTTOM WIDTH.  NO AUXILIARY SPILLWAY ROUTINGS PERFORMED.
  
```

```

-----
Inflow Hyd 1 PSH-Peak =           79.81 CFS  at  124.02 hrs.,  Location Point
HYDOUT  1      15
  
```

```

1SITES....JOB NO.  1 COMPLETE.
-----
  
```

```

BC15           Brush Creek Site 15

      0 SUBWATERSHED(S) ANALYZED.

      1 STRUCTURE(S) ANALYZED.

      1 HYDROGRAPHS ROUTED AT LOWEST SITE.

      0 TRIALS TO OBTAIN BOTTOM WIDTH FOR SPECIFIED STRESS OR VELOCITY.

*****
  
```

# Brush Creek Site 15 – ASW Crest Criteria

SITES.....COMPUTATIONS COMPLETE

1 SUMMARY TABLE 1 SITES VERSION 2005.1.04  
 ----- DATED 01/01/2005

WATERSHED ID		RUN DATE				RUN TIME			
-----		-----				-----			
BC15		02/11/2011				09:04:04			
>>>	SITE ID	SUBWS ID	SUBWS DA (SQ MI)	CURVE NO.	TC (HRS)	TOTAL DA (SQ MI)	TYPE DESIGN	STRUC CLASS	<<<
	-----	-----	-----	-----	-----	-----	-----	-----	
	15	15	2.76	80.	1.23	2.76	TR60	C	
PASS NO.	DIA./ WIDTH (IN/FT)	AUX.CREST ELEV (FT)	BTM. WIDTH (FT)	MAX. HP (FT)	MAX. ELEV (FT)	EMB. VOL. (CY)	INTEGR.* DIST. (FT)	EXIT* VEL. (FT/SEC)	TYPE HYD
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

SITES.....SUMMARY TABLE 1 COMPLETED.

NRCS SITES VERSION 2005.1.04 ,01/01/2005  
 BC15 FILES

INPUT = W:\426\Active Jobs\52299 - WV NRCS 2010 Contract\05 Working\41 Dam Assessments\Brush Creek Site 15\BC15 SITES Model\BrC15\BC\_Site15\_Estimating\_ASW\_Crest.D2C  
 OUTPUT = W:\426\Active Jobs\52299 - WV NRCS 2010 Contract\05 Working\41 Dam Assessments\Brush Creek Site 15\BC15 SITES Model\BrC15\BC\_Site15\_Estimating\_ASW\_Crest.OUT  
 DATED 02/11/2011 09:04:04

## GRAPHICS FILES GENERATED

OPTION "L" = W:\426\Active Jobs\52299 - WV NRCS 2010 Contract\05 Working\41 Dam Assessments\Brush Creek Site 15\BC15 SITES Model\BrC15\BC\_Site15\_Estimating\_ASW\_Crest.DRG  
 DATED 02/11/2011 09:04:04

OPTION "P" = W:\426\Active Jobs\52299 - WV NRCS 2010 Contract\05 Working\41 Dam Assessments\Brush Creek Site 15\BC15 SITES Model\BrC15\BC\_Site15\_Estimating\_ASW\_Crest.DHY  
 DATED 02/11/2011 09:04:04

OPTION "E" = W:\426\Active Jobs\52299 - WV NRCS 2010 Contract\05 Working\41 Dam Assessments\Brush Creek Site 15\BC15 SITES Model\BrC15\BC\_Site15\_Estimating\_ASW\_Crest.DEM  
 DATED 02/11/2011 09:04:04



---

## SITES Output

Brush Creek Site 15 – Top of Dam (6-hr)

---

# Brush Creek Site 15 – Top of Dam (6-hr)

```

1*****
SITES XEQ 02/11/2011   WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM
VER 2005.1.04         (USER MANUAL - DATED DECEMBER 2005)
TIME 09:04:31
  
```

\*\*\*\*\* 80-80 LIST OF INPUT DATA \*\*\*\*\*

```

SITES      01/01/2005BC15      Brush Creek Site 15      2.76      C2
SAVMOV     0      101
SAVMOV     101  1
STRUCTURE  15

                2430                0
                2435                13.6
                2440                50.4
                2445                113.8
                2450                189.5
                2455                266.3
                2460                360.7
                2465                478.9
                2470                630.4
                2475                825
                2480                1068.2
                2485                1363.6
                2490                1717.7
                2495                2128.9
                2500                2594.2
                2505                3117.8
                2510                3700
                2515                4346.4
                2530                6400

ENDTABLE
WSDATA     2C 15      80      2.76      1.23
BASEFLOW
PDIRECT
POOLDATA   ELEV      2488.1    2488.1    2439    2430    2431.94    SC
PSINLET
PSDATA     1      360.5    24      0.013    2430.36
ASSPRFL    41
            -25.8    2485     5      2490    11.7    2491.534
            190    2495.1    210    2495.1    574    2487.82
            585    2480

ENDTABLE
ASSURFACE  41      574      0.1
            -25.8    5      0.02    0.5    1      1
            5      11.7    0.035   0.5    1      1
            11.7    190    0.035   0.5    1      1
            190    210    0.035   0.5    1      1
            210    574    0.035   0.5    1      1
            574    585    0.035   0.5    1      1

ENDTABLE
ASDATA     41
BTMWIDTH   FEET      125
GRAPHICS   I
GO,DESIGN  HL      6      2488.1
SAVMOV     2      101  1      15
ENDJOB
  
```

\*\*\*\*\*

\*\*\*\*\* MESSAGE - AUXILIARY SPILLWAY CREST ELEVATION IS SET TO 2495.10  
FROM THE ASSPRFL RECORDS.

```

1SITES -----
XEQ 02/11/2011      Brush Creek Site 15      WSID= BC15
VER 2005.1.04      SUBW= 15
TIME 09:04:31      SITE = 15      PASS= 1      PART= 1
  
```



## Brush Creek Site 15 – Top of Dam (6-hr)

1	2488.10	0.00	0.00	0.00	1583.15	0.00
2	2488.51	9.73	9.73	0.00	1612.11	0.00
3	2488.92	27.52	27.52	0.00	1641.07	0.00
4	2489.33	50.55	50.55	0.00	1670.03	0.00
FULL CONDUIT FLOW, ELEV = 2489.74 FT						
5	2489.74	77.82	77.82	0.00	1698.99	0.00
6	2494.77	81.06	81.06	0.00	2109.87	0.00
7	2499.80	84.17	84.17	0.00	2575.73	0.00
8	2504.83	87.17	87.17	0.00	3100.47	0.00
9	2509.87	90.07	90.07	0.00	3684.56	0.00
10	2514.90	92.87	92.87	0.00	4333.52	0.00
11	2519.93	95.60	95.60	0.00	5021.81	0.00
12	2524.97	98.25	98.25	0.00	5710.85	0.00
13	2530.00	100.83	100.83	0.00	6399.90	0.00

```

1SITES -----
XEQ 02/11/2011           Brush Creek Site 15           WSID= BC15
VER 2005.1.04                                     SUBW= 15
TIME 09:04:31           SITE = 15           PASS= 1           PART= 3
  
```

```

AUX. CREST      2495.10 FT    2138.2 ACFT    0.00 AC    81.3 CFS

  PS STORAGE    555.1 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

START ELEV      2488.23 FT    1592.3 ACFT    0.00 AC    3.1 CFS

EFFECTIVE HEIGHT(H)= 65.1 FEET, PRODUCT= 139198. (H * STORAGE AT CREST AUX.).

INPUT DESIGN CLASS = C

NRCS-SDH        D= 6.00 HR    P= 10.10 IN    Q= 7.62 IN    DA= 2.76 SM
                TC= 1.23 HR    CN= 80.00     VOL= 1123.6 ACFT

  PEAK =        6252.1 CFS, AT    3.1 HRS.

NRCS-FBH        D= 6.00 HR    P= 28.70 IN    Q= 25.90 IN    DA= 2.76 SM
                TC= 1.23 HR    CN= 80.00     VOL= 3815.5 ACFT

  PEAK =        21220.7 CFS, AT    3.1 HRS.
  
```

```

*****
RATING TABLE DEVELOPED, SITE = 15 :
BY PROGRAM FOR PS AND AUX. SPILLWAYS
AUX. RATING USED WSPVRT METHOD.
  
```

RATING TABLE NUMBER 2

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	2488.10	0.00	0.00	0.00	1583.15	0.00
2	2488.51	9.73	9.73	0.00	1612.11	0.00
3	2488.92	27.52	27.52	0.00	1641.07	0.00
4	2489.33	50.55	50.55	0.00	1670.03	0.00
FULL CONDUIT FLOW, ELEV = 2489.74 FT						
5	2489.74	77.82	77.82	0.00	1698.99	0.00
6	2490.41	78.27	78.27	0.00	1751.11	0.00
7	2491.08	78.71	78.71	0.00	1806.26	0.00
8	2491.75	79.14	79.14	0.00	1861.42	0.00
9	2492.42	79.57	79.57	0.00	1916.57	0.00
10	2493.09	80.00	80.00	0.00	1971.73	0.00
11	2493.76	80.43	80.43	0.00	2026.88	0.00
12	2494.43	80.85	80.85	0.00	2082.04	0.00
13	2495.10	81.27	81.27	0.00	2138.28	0.00
14	2496.85	809.73	82.36	727.37	2300.62	0.00
15	2498.59	2285.35	83.43	2201.91	2462.99	0.00
16	2501.73	6504.74	85.33	6419.41	2775.47	0.00
17	2505.57	13750.16	87.60	13662.56	3184.18	0.00



## Brush Creek Site 15 – Top of Dam (6-hr)

EXIT CHANNEL FLOW SUPERCRITICAL: MAX VELOCITY= 17.1 FT/SEC  
 EXIT SLOPE = 0.020 FT/FT  
 FLOW DEPTH = 5.3 FT

Inflow Hyd 1 SDH-Peak = 1533.55 CFS at 5.68 hrs., Location Point  
 Inflow Hyd 1 FBH-Peak = 12756.96 CFS at 3.77 hrs., Location Point  
 HYDOUT 1 15

1SITES....JOB NO. 1 COMPLETE.

-----  
 BC15 Brush Creek Site 15  
 0 SUBWATERSHED(S) ANALYZED.  
 1 STRUCTURE(S) ANALYZED.  
 2 HYDROGRAPHS ROUTED AT LOWEST SITE.  
 0 TRIALS TO OBTAIN BOTTOM WIDTH FOR SPECIFIED STRESS OR VELOCITY.  
 \*\*\*\*\*

SITES.....COMPUTATIONS COMPLETE

1 SUMMARY TABLE 1 SITES VERSION 2005.1.04  
 ----- DATED 01/01/2005

WATERSHED ID		RUN DATE				RUN TIME			
-----		-----				-----			
BC15		02/11/2011				09:04:31			
>>>	SITE ID	SUBWS ID	SUBWS DA (SQ MI)	CURVE NO.	TC (HRS)	TOTAL DA (SQ MI)	TYPE DESIGN	STRUC CLASS	<<<
	-----	-----	-----	-----	-----	-----	-----	-----	
	15	15	2.76	80.	1.23	2.76	TR60	C	
PASS NO.	DIA./ WIDTH (IN/FT)	AUX.CREST ELEV (FT)	BTM. WIDTH (FT)	MAX. HP (FT)	MAX. ELEV (FT)	EMB. VOL. (CY)	INTEGR.* DIST. (FT)	EXIT* VEL. (FT/SEC)	TYPE HYD
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
1	24.0	2495.1	125.0	10.0	2505.1	0.	0.	17.1	NRCS-FBH

\* INTEGRITY DIST. AND EXIT VEL. VALUES ARE BASED ON THE ROUTED HYDROGRAPH SHOWN UNDER TYPE HYD.

## Brush Creek Site 15 – Top of Dam (6-hr)

SITES.....SUMMARY TABLE 1 COMPLETED.

NRCS SITES VERSION 2005.1.04 ,01/01/2005  
BC15 FILES

INPUT = W:\426\Active Jobs\52299 - WV NRCS 2010 Contract\05 Working\41 Dam  
Assessments\Brush Creek Site 15\BC15 SITES Model\BrC15\BC\_Site15\_Estimating\_TOD\_Crest.D2C  
OUTPUT = W:\426\Active Jobs\52299 - WV NRCS 2010 Contract\05 Working\41 Dam  
Assessments\Brush Creek Site 15\BC15 SITES Model\BrC15\BC\_Site15\_Estimating\_TOD\_Crest.OUT  
DATED 02/11/2011 09:04:31

### GRAPHICS FILES GENERATED

OPTION "L" = W:\426\Active Jobs\52299 - WV NRCS 2010 Contract\05 Working\41 Dam  
Assessments\Brush Creek Site 15\BC15 SITES Model\BrC15\BC\_Site15\_Estimating\_TOD\_Crest.DRG  
DATED 02/11/2011 09:04:31

OPTION "P" = W:\426\Active Jobs\52299 - WV NRCS 2010 Contract\05 Working\41 Dam  
Assessments\Brush Creek Site 15\BC15 SITES Model\BrC15\BC\_Site15\_Estimating\_TOD\_Crest.DHY  
DATED 02/11/2011 09:04:31

OPTION "E" = W:\426\Active Jobs\52299 - WV NRCS 2010 Contract\05 Working\41 Dam  
Assessments\Brush Creek Site 15\BC15 SITES Model\BrC15\BC\_Site15\_Estimating\_TOD\_Crest.DEM  
DATED 02/11/2011 09:04:31



---

## SITES Output

Brush Creek Site 15 – Top of Dam (24-hr)

---

# Brush Creek Site 15 – Top of Dam (24-hr)

```

1*****
SITES XEQ 02/11/2011  WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM
VER 2005.1.04          (USER MANUAL - DATED DECEMBER 2005)
TIME 09:04:59
  
```

\*\*\*\*\* 80-80 LIST OF INPUT DATA \*\*\*\*\*

SITES	01/01/2005BC15	Brush Creek Site 15	2.76	C2		
SAVMOV	0 101					
SAVMOV	101 1				1	
STRUCTURE	15					
	2430			0		
	2435			13.6		
	2440			50.4		
	2445			113.8		
	2450			189.5		
	2455			266.3		
	2460			360.7		
	2465			478.9		
	2470			630.4		
	2475			825		
	2480			1068.2		
	2485			1363.6		
	2490			1717.7		
	2495			2128.9		
	2500			2594.2		
	2505			3117.8		
	2510			3700		
	2515			4346.4		
	2530			6400		
ENDTABLE						
WSDATA	2C 15	80	2.76	1.23		
BASEFLOW		1.12				
RAINTABLE	15	24				
	0	0.008	0.0162	0.0246	0.0333	
	0.0425	0.0524	0.063	0.0743	0.0863	
	0.099	0.1124	0.1265	0.142	0.1595	
	0.18	0.205	0.255	0.345	0.437	
	0.53	0.603	0.633	0.66	0.684	
	0.705	0.724	0.742	0.759	0.775	
	0.79	0.8043	0.818	0.8312	0.8439	
	0.8561	0.8678	0.879	0.8898	0.9002	
	0.9103	0.9201	0.9297	0.9391	0.9483	
	0.9573	0.9661	0.9747	0.9832	0.9916	
	1					
ENDTABLE						
PDIRECT			13.20	37.00		
POOLDATA	ELEV	2488.1	2488.1	2439	2430	2431.94 SC
PSINLET		0.75	12			
PSDATA	1	360.5	24		0.013	2430.36
ASSPRFL	41					
	-25.8	2485	5	2490	11.7	2491.534
	190	2495.1	210	2495.1	574	2487.82
	585	2480				
ENDTABLE						
ASSURFACE	41	574	0.1			
	-25.8	5	0.02	0.5	1	1
	5	11.7	0.035	0.5	1	1
	11.7	190	0.035	0.5	1	1
	190	210	0.035	0.5	1	1
	210	574	0.035	0.5	1	1
	574	585	0.035	0.5	1	1
ENDTABLE						
ASDATA	41			2.5		2
BTMWIDTH	FEET	125				
GRAPHICS	I					
GO,DESIGN	HL	15	24		2488.1	

## Brush Creek Site 15 – Top of Dam (24-hr)

SAVMOV 2 101 1 15  
 ENDJOB

\*\*\*\*\*

\*\*\*\*\* MESSAGE - AUXILIARY SPILLWAY CREST ELEVATION IS SET TO 2495.10  
 FROM THE ASSPRFL RECORDS.

1SITES -----  
 XEQ 02/11/2011 Brush Creek Site 15 WSID= BC15  
 VER 2005.1.04 SUBW= 15  
 TIME 09:04:59 SITE = 15 PASS= 1 PART= 1

\*\*\*\*\* BASIC DATA \*\*\*\*\*  
 HUMID- SUBHUMID CLIMATE AREA DESIGN CLASS C

STORM DISTRIBUTION AUX. -

PRECIP. - Q-PS,1-DAY	Q-PS,10-DAY	P-SD	P-FB	
0.00	0.00	13.20	37.00	
WSDATA - CN	DA-SM	TC/L	-/H	QRF
80.00	2.76	1.23	0.00	0.00
SITEDATA- PERM POOL	CREST PS	FP SED	VALLEY FL	378?
2488.10	2488.10	2439.00	2431.94	NO
BASEFLOW	INITIAL EL	EXTRA VOL	SITE TYPE	
1.12	0.00	0.00	DESIGN	
PSDATA - NO. COND	COND L	DIA/W	-/H	
1.00	360.50	24.00	0.00	
PS N	KE	WEIR L	TW EL	
0.013	0.75	12.00	2430.36	
2ND STG	ORF H	ORF L	START AUX.	
0.00	0.00	0.00	2488.10	
ASCRESTS - AUX.1	AUX.2	AUX.3	AUX.4	AUX.5
2495.10	0.00	0.00	0.00	0.00
AUX.DATA - REF.NO.	RETARD. Ci	TIE STATION	INLET LENGTH	
41	0.00	210.00	0	
AUX.DATA - INLET N	SIDE SLOPE	EXIT N	EXIT SLOPE	ACTUAL AUX?
0.035	2.50	0.035	0.020	NO
BTM WIDTH - BW1	BW2	BW3	BW4	BW5
ft 125.00	0.00	0.00	0.00	0.00

AUXILIARY SPILLWAY RATING DEVELOPED USING WSPVRT.

1SITES -----  
 XEQ 02/11/2011 Brush Creek Site 15 WSID= BC15  
 VER 2005.1.04 SUBW= 15  
 TIME 09:04:59 SITE = 15 PASS= 1 PART= 2

PERM POOL	2488.10 FT	1583.1 ACFT	0.00 AC	0.0 CFS
CREST PS	2488.10 FT	1583.1 ACFT	0.00 AC	0.0 CFS
SED ACCUM	2488.10 FT	1583.1 ACFT	0.00 AC	0.0 CFS
BASEFLOW	2488.23 FT	1592.4 ACFT	0.00 AC	3.1 CFS





## Brush Creek Site 15 – Top of Dam (24-hr)

```

PEAK - CFS          Q-PS          Q-AUX.          Q-TOT.
DISCHARGE =        86.          9912.          9998.

                CRITICAL  CRITICAL  CRITICAL  25% OF Q
                DEPTH    VELOCITY  SLOPE-Sc   Sc
AUXILIARY       FT      FT/SEC    FT/FT      FT/FT
SPILLWAY ---    5.58    12.78    0.011     0.014

AUXILIARY SPILLWAY DURATION FLOW =      24.2 HOURS
ATTACK, OE/B =      34.4 ACFT/FT
  
```

```

EXIT CHANNEL FLOW SUPERCRITICAL: MAX VELOCITY= 15.7 FT/SEC
EXIT SLOPE = 0.020 FT/FT
FLOW DEPTH = 4.6 FT
  
```

```

Inflow Hyd 1 SDH-Peak =      1305.40 CFS at 11.99 hrs., Location Point
Inflow Hyd 1 FBH-Peak =      9998.25 CFS at 10.55 hrs., Location Point
HYDOUT 1      15
  
```

1SITES....JOB NO. 1 COMPLETE.

```

-----
BC15          Brush Creek Site 15

0 SUBWATERSHED(S) ANALYZED.

1 STRUCTURE(S) ANALYZED.

2 HYDROGRAPHS ROUTED AT LOWEST SITE.

0 TRIALS TO OBTAIN BOTTOM WIDTH FOR SPECIFIED STRESS OR VELOCITY.

*****
  
```

SITES....COMPUTATIONS COMPLETE

```

1              SUMMARY TABLE 1              SITES VERSION 2005.1.04
              -----                      DATED 01/01/2005
  
```

WATERSHED ID		RUN DATE				RUN TIME			
-----		-----				-----			
BC15		02/11/2011				09:04:59			
>>>	SITE ID	SUBWS ID	SUBWS DA (SQ MI)	CURVE NO.	TC (HRS)	TOTAL DA (SQ MI)	TYPE DESIGN	STRUC CLASS	<<<
	15	15	2.76	80.	1.23	2.76	TR60	C	
PASS NO.	DIA./ WIDTH (IN/FT)	AUX. CREST ELEV (FT)	BTM. WIDTH (FT)	MAX. HP (FT)	MAX. ELEV (FT)	EMB. VOL. (CY)	INTEGR.* DIST. (FT)	EXIT* VEL. (FT/SEC)	TYPE HYD
1	24.0	2495.1	125.0	8.5	2503.6	0.	0.	15.7	NRCS-FBH

\* INTEGRITY DIST. AND EXIT VEL. VALUES ARE BASED ON THE ROUTED HYDROGRAPH SHOWN UNDER TYPE HYD.

## Brush Creek Site 15 – Top of Dam (24-hr)

SITES.....SUMMARY TABLE 1 COMPLETED.

NRCS SITES VERSION 2005.1.04 ,01/01/2005  
BC15 FILES

INPUT = W:\426\Active Jobs\52299 - WV NRCS 2010 Contract\05 Working\41 Dam  
Assessments\Brush Creek Site 15\BC15 SITES  
Model\BrC15\BC\_Site15\_Estimating\_TOD\_Crest\_24Hr.D2C  
OUTPUT = W:\426\Active Jobs\52299 - WV NRCS 2010 Contract\05 Working\41 Dam  
Assessments\Brush Creek Site 15\BC15 SITES  
Model\BrC15\BC\_Site15\_Estimating\_TOD\_Crest\_24Hr.OUT  
DATED 02/11/2011 09:04:59

GRAPHICS FILES GENERATED

OPTION "L" = W:\426\Active Jobs\52299 - WV NRCS 2010 Contract\05 Working\41 Dam  
Assessments\Brush Creek Site 15\BC15 SITES  
Model\BrC15\BC\_Site15\_Estimating\_TOD\_Crest\_24Hr.DRG DATED 02/11/2011 09:04:59

OPTION "P" = W:\426\Active Jobs\52299 - WV NRCS 2010 Contract\05 Working\41 Dam  
Assessments\Brush Creek Site 15\BC15 SITES  
Model\BrC15\BC\_Site15\_Estimating\_TOD\_Crest\_24Hr.DHY DATED 02/11/2011 09:04:59

OPTION "E" = W:\426\Active Jobs\52299 - WV NRCS 2010 Contract\05 Working\41 Dam  
Assessments\Brush Creek Site 15\BC15 SITES  
Model\BrC15\BC\_Site15\_Estimating\_TOD\_Crest\_24Hr.DEM DATED 02/11/2011 09:04:59



---

## SITES Output

Brush Creek Site 15 – ASW Integrity (6-hr)

---

# Brush Creek Site 15 – ASW Integrity (6-hr)

```

1*****
SITES XEQ 02/11/2011  WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM
VER 2005.1.04      (USER MANUAL - DATED DECEMBER 2005)
TIME 09:03:12
  
```

\*\*\*\*\* 80-80 LIST OF INPUT DATA \*\*\*\*\*

SITES	01/01/2005BC15	Brush Creek Site 15	2.76	C2		
SAVMOV	0 101					
SAVMOV	101 1				1	
STRUCTURE	15					
	2430			0		
	2435			13.6		
	2440			50.4		
	2445			113.8		
	2450			189.5		
	2455			266.3		
	2460			360.7		
	2465			478.9		
	2470			630.4		
	2475			825		
	2480			1068.2		
	2485			1363.6		
	2490			1717.7		
	2495			2128.9		
	2500			2594.2		
	2505			3117.8		
	2510			3700		
	2515			4346.4		
	2530			6400		
ENDTABLE						
WSDATA	2C 15	80	2.76	1.23		
BASEFLOW		1.12				
PDIRECT				10.10	28.70	
POOLDATA	ELEV	2488.1	2488.1	2439	2430	2431.94 SC
PSINLET		0.75	12			
PSDATA	1	360.5	24		0.013	2430.36
ASSURFACE	41	438.3	0.1			
	0	20	0.02	0.5	1	1
	20	438.3	0.035	0.5	1	1
	438.3	969.6	0.035	0.5	1	1
ENDTABLE						
ASDATA	41			2.5		1
BTMWIDTH	FEET	125				
ASMATERIAL						
	1	8	0.002	16	100	0.28
	2	0	4	0	120	1
	3	0	10	0	121	10
	4	0	6	0	124	10
ENDTABLE						
ASCOORD	1	Soil	Y			
	0	2485	20	2491	150	2495.1
	170	2495.1	355.6	2490	438.3	2485
	489.00	2465	539	2445	576.6	2440
	740.5	2435	910.6	2430	969.6	2425.00
ENDTABLE						
ASCOORD	2	Shale1				
	0	2484	20	2490	150	2494.1
	170	2494.1	355.6	2489	438.3	2484
	489.00	2450	539	2435	576.6	2430
	740.5	2425	910.6	2420	969.6	2415
ENDTABLE						
ASCOORD	3	Shale2				
	0	2470	20	2476	220	2479
	340	2479	438.3	2470	489.00	2445
	539	2430	576.6	2425	740.5	2417
	910.6	2415	969.6	2410		

## Brush Creek Site 15 – ASW Integrity (6-hr)

```

ENDTABLE
ASCOORD   4          Siltstone
           0          2439      355.6      2439      438.3      2435
           489.00     2427      539       2421      576.6      2419
           740.5     2416.99  740.5     2410
    
```

```

ENDTABLE
GRAPHICS  I
GO,DESIGN L          6          2488.1
SAVMOV   2    101  1          15
ENDJOB
    
```

\*\*\*\*\*

\*\*\*\* MESSAGE - DEFAULT TOPSOIL FILL MATERIAL PARAMETERS USED.

\*\*\*\* MESSAGE - AUXILIARY SPILLWAY CREST ELEVATION IS SET TO 2495.10  
FROM THE ASCOORD RECORDS.

```

1SITES -----
XEQ 02/11/2011          Brush Creek Site 15          WSID= BC15
VER 2005.1.04          SUBW= 15
TIME 09:03:12          SITE = 15          PASS= 1          PART= 1
    
```

```

***** MATERIAL PROPERTIES *****
          DRY          PERCENT          DETACH.          REP.
MATERIAL  PI  DENSITY  Kh          CLAY          RATE          DIAMETER
          lbs/CuFt          (Ft/H)/(lb/SqFt)  inches
Soil      8.   100.    0.28    16.0    --    0.00200
Shale1    0.   120.    1.00     0.0    --    4.00000
Shale2    0.   121.   10.00     0.0    --   10.00000
Siltstone 0.   124.   10.00     0.0    --    6.00000
TS_FILL   0.   100.    0.05     0.0    --    0.05000
GEN_FILL  8.   100.    0.28    16.0    --    0.00200
    
```

```

***** BASIC DATA *****
HUMID- SUBHUMID CLIMATE AREA          DESIGN CLASS  C
    
```

STORM DISTRIBUTION USED FOR AUXILIARY SPILLWAY IS;  
NRCS DESIGN STORM RAINFALL DISTRIBUTION (CHAPTER 21, NEH4 & TR-60).

```

PRECIP. - Q-PS,1-DAY    Q-PS,10-DAY    P-SD          P-FB
           0.00          0.00          10.10         28.70

WSDATA -   CN          DA-SM          TC/L          -/H          QRF
           80.00         2.76          1.23          0.00         0.00

SITEDATA- PERM POOL    CREST PS          FP SED          VALLEY FL          378?
           2488.10     2488.10         2439.00         2431.94           NO

          BASEFLOW    INITIAL EL          EXTRA VOL          SITE TYPE
           1.12         0.00          0.00          DESIGN

PSDATA -  NO. COND          COND L          DIA/W          -/H
           1.00         360.50         24.00          0.00

          PS N          KE          WEIR L          TW EL
           0.013         0.75         12.00         2430.36

          2ND STG          ORF H          ORF L          START AUX.
           0.00         0.00          0.00         2488.10

ASCRESTS -  AUX.1          AUX.2          AUX.3          AUX.4          AUX.5
           2495.10         0.00          0.00          0.00         0.00

AUX.DATA -  REF.NO.    RETARD. Ci    TIE STATION    INLET LENGTH
           41           0.00         170.00         0
    
```

## Brush Creek Site 15 – ASW Integrity (6-hr)

AUX.DATA - INLET N	SIDE SLOPE	EXIT N	EXIT SLOPE	ACTUAL AUX?
0.035	2.50	0.035	0.027	YES
BTM WIDTH - BW1	BW2	BW3	BW4	BW5
ft 125.00	0.00	0.00	0.00	0.00

AUXILIARY SPILLWAY RATING DEVELOPED USING WSPVRT.

```

1SITES -----
XEQ 02/11/2011           Brush Creek Site 15           WSID= BC15
VER 2005.1.04           SUBW= 15
TIME 09:03:12           SITE = 15           PASS= 1           PART= 2
  
```

PERM POOL	2488.10 FT	1583.1 ACFT	0.00 AC	0.0 CFS
CREST PS	2488.10 FT	1583.1 ACFT	0.00 AC	0.0 CFS
SED ACCUM	2488.10 FT	1583.1 ACFT	0.00 AC	0.0 CFS
BASEFLOW	2488.23 FT	1592.4 ACFT	0.00 AC	3.1 CFS
START ELEV	2488.23 FT	1592.3 ACFT	0.00 AC	3.1 CFS

\*\*\*\*\*  
 RATING TABLE DEVELOPED, SITE = 15 :  
 BY PROGRAM FOR PS AND AUX. SPILLWAYS  
 AUX. RATING USED WSPVRT METHOD.

RATING TABLE NUMBER 1						
	ELEV.	Q-TOTAL	Q-PS	Q-AUX.	VOLUME	AREA
	FEET	CFS	CFS	CFS	AC-FT	ACRE
1	2488.10	0.00	0.00	0.00	1583.15	0.00
2	2488.51	9.73	9.73	0.00	1612.11	0.00
3	2488.92	27.52	27.52	0.00	1641.07	0.00
4	2489.33	50.55	50.55	0.00	1670.03	0.00
					FULL CONDUIT FLOW, ELEV = 2489.74 FT	
5	2489.74	77.82	77.82	0.00	1698.99	0.00
6	2494.77	81.06	81.06	0.00	2109.87	0.00
7	2499.80	84.17	84.17	0.00	2575.73	0.00
8	2504.83	87.17	87.17	0.00	3100.47	0.00
9	2509.87	90.07	90.07	0.00	3684.56	0.00
10	2514.90	92.87	92.87	0.00	4333.52	0.00
11	2519.93	95.60	95.60	0.00	5021.81	0.00
12	2524.97	98.25	98.25	0.00	5710.85	0.00
13	2530.00	100.83	100.83	0.00	6399.90	0.00

```

1SITES -----
XEQ 02/11/2011           Brush Creek Site 15           WSID= BC15
VER 2005.1.04           SUBW= 15
TIME 09:03:12           SITE = 15           PASS= 1           PART= 3
  
```

AUX. CREST	2495.10 FT	2138.2 ACFT	0.00 AC	81.3 CFS
PS STORAGE 555.1 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.				
START ELEV	2488.23 FT	1592.3 ACFT	0.00 AC	3.1 CFS
EFFECTIVE HEIGHT(H)= 65.1 FEET, PRODUCT= 139198. (H * STORAGE AT CREST AUX.).				
INPUT DESIGN CLASS = C				

NRCS-SDH	D= 6.00 HR	P= 10.10 IN	Q= 7.62 IN	DA= 2.76 SM
	TC= 1.23 HR	CN= 80.00	VOL= 1123.6 ACFT	

# Brush Creek Site 15 – ASW Integrity (6-hr)

PEAK = 6252.1 CFS, AT 3.1 HRS.

NRCS-FBH D= 6.00 HR P= 28.70 IN Q= 25.90 IN DA= 2.76 SM  
 TC= 1.23 HR CN= 80.00 VOL= 3815.5 ACFT

PEAK = 21220.7 CFS, AT 3.1 HRS.

\*\*\*\*\*  
 RATING TABLE DEVELOPED, SITE = 15 :  
 BY PROGRAM FOR PS AND AUX. SPILLWAYS  
 AUX. RATING USED WSPVRT METHOD.

RATING TABLE NUMBER 2

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	2488.10	0.00	0.00	0.00	1583.15	0.00
2	2488.51	9.73	9.73	0.00	1612.11	0.00
3	2488.92	27.52	27.52	0.00	1641.07	0.00
4	2489.33	50.55	50.55	0.00	1670.03	0.00
FULL CONDUIT FLOW, ELEV = 2489.74 FT						
5	2489.74	77.82	77.82	0.00	1698.99	0.00
6	2490.41	78.27	78.27	0.00	1751.11	0.00
7	2491.08	78.71	78.71	0.00	1806.26	0.00
8	2491.75	79.14	79.14	0.00	1861.42	0.00
9	2492.42	79.57	79.57	0.00	1916.57	0.00
10	2493.09	80.00	80.00	0.00	1971.73	0.00
11	2493.76	80.43	80.43	0.00	2026.88	0.00
12	2494.43	80.85	80.85	0.00	2082.04	0.00
13	2495.10	81.27	81.27	0.00	2138.28	0.00
14	2496.85	836.32	82.36	753.96	2300.62	0.00
15	2498.59	2359.86	83.43	2276.43	2462.99	0.00
16	2501.73	6659.54	85.33	6574.21	2775.47	0.00
17	2505.57	14039.40	87.60	13951.80	3184.18	0.00
18	2512.55	34320.46	91.57	34228.89	4029.67	0.00
19	2521.27	68951.96	96.31	68855.65	5205.48	0.00
20	2530.00	115326.40	100.83	115225.57	6400.00	0.00

\*\*\*\*\*

SUMMARY OF AUXILIARY SPILLWAY SURFACE CONDITIONS USED IN COMPUTATIONS BY REACH

REACH	FROM STA (ft)	TO STA (ft)	SLOPE (%)	RETARDANCE CURVE INDEX@	VEGETAL COVER FACTOR	MAINT. CODE +	ROOTING DEPTH (ft)	REACH LOCATION *
1	0.	20.	-30.0	0.020	**	**	**	INLET
2	20.	150.	-3.2	0.035	**	**	**	INLET
3	150.	170.	0.0	0.035	**	**	**	CREST
4	170.	356.	2.7	0.035	0.50	1	1.0	EXIT !
5	356.	438.	6.0	0.035	0.50	1	1.0	EXIT
6	438.	489.	39.4	0.035	0.50	1	1.0	exit
7	489.	539.	40.0	0.035	0.50	1	1.0	exit
8	539.	577.	13.3	0.035	0.50	1	1.0	exit
9	577.	740.	3.1	0.035	0.50	1	1.0	exit
10	740.	845.	2.9	0.035	0.50	1	1.0	exit

@ The program interprets retardance curve index entries of less than 1 as Manning's n values.  
 + The minimum maintenance code value of 2 is used in INTEGRITY computations (the program changes values of 1 to 2 during computation).  
 \* Upper case indicates a reach of constructed spillway channel.  
 \*\* The program does not use vegetal cover factor, maintenance code, and rooting depth for inlet and crest reaches in computations.  
 ! Reach 4 used in computing exit channel velocities.  
 \*\*\*\*\*

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
NRCS-SDH	125.0	2497.66	2376.8	0.0	2.56	238.5

## Brush Creek Site 15 – ASW Integrity (6-hr)

PEAK - CFS            Q-PS            Q-AUX.            Q-TOT.  
DISCHARGE =            83.            1469.            1551.

	CRITICAL DEPTH	CRITICAL VELOCITY	CRITICAL SLOPE-Sc	25% OF Q Sc
AUXILIARY SPILLWAY ---	FT	FT/SEC	FT/FT	FT/FT
	1.61	7.08	0.015	0.021

AUXILIARY SPILLWAY DURATION FLOW =            10.4 HOURS

EXIT CHANNEL FLOW SUPERCRITICAL: MAX VELOCITY=    8.4 FT/SEC  
EXIT SLOPE = 0.027 FT/FT  
FLOW DEPTH =    1.4 FT

\*\*\*\*\*

EROSIONALLY EFFECTIVE STRESS FOR STABILITY ANALYSIS OF AUX. EXIT CHANNEL  
(Refer to Ag. Handbook 667, Chapt. 3, for allowable stresses.)

Aux. Spillway Discharge =    1469. cfs;    Bottom Width =    125. ft

REACH NO.	FROM STA	TO STA	SLOPE %	MANNING`S n	VELOCITY ft/s	TOTAL STRESS lb/ft^2	EFFECTIVE STRESS lb/ft^2	
4	170.	356.	2.75	0.035	8.45	2.32	0.289	
5	356.	438.	6.05	0.035	10.75	4.04	0.502	max.

\*\*\*\*\*

ROUTED RESULTS NRCS-FBH	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
	125.0	2505.01	3118.7	0.0	9.91	980.5

PEAK - CFS            Q-PS            Q-AUX.            Q-TOT.  
DISCHARGE =            87.            12770.            12858.

	CRITICAL DEPTH	CRITICAL VELOCITY	CRITICAL SLOPE-Sc	25% OF Q Sc
AUXILIARY SPILLWAY ---	FT	FT/SEC	FT/FT	FT/FT
	6.56	13.76	0.010	0.013

INTEGRITY ANALYSIS - REACH SURFACE PERFORMANCE SUMMARY  
(The auxiliary spillway began flow at time =    2.5 hours  
and peaked at time =    3.8 hours.)

REACH 4: FROM STATION    170. TO    356. ON    2.7% SLOPE.  
Vegetal cover failed and concentrated flow developed  
at time =    4.6 hours.

REACH 5: FROM STATION    356. TO    438. ON    6.0% SLOPE.  
Vegetal cover failed and concentrated flow developed  
at time =    3.4 hours.

REACH 6: FROM STATION    438. TO    489. ON    39.4% SLOPE.  
Vegetal cover failed and concentrated flow developed  
at time =    2.8 hours.

REACH 7: FROM STATION    489. TO    539. ON    40.0% SLOPE.  
Vegetal cover failed and concentrated flow developed  
at time =    2.8 hours.

REACH 8: FROM STATION    539. TO    577. ON    13.3% SLOPE.  
Vegetal cover failed and concentrated flow developed  
at time =    2.8 hours.

REACH 9: FROM STATION    577. TO    740. ON    3.1% SLOPE.

# Brush Creek Site 15 – ASW Integrity (6-hr)

Vegetal cover failed and concentrated flow developed  
at time = 3.0 hours.

REACH 10: FROM STATION 740. TO 845. ON 2.9% SLOPE.  
Vegetal cover failed and concentrated flow developed  
at time = 4.5 hours.

## INTEGRITY ANALYSIS - HEADCUT EROSION DAMAGE SUMMARY

The headcut BREACHED the spillway crest at  
time equal approximately 6.5 hours.  
Computations terminated at that point!

The most upstream headcut began at station 170.  
and progressed upstream to station 150.  
The final height of the headcut was 17.1 ft.

The headcut having the maximum final overfall height began  
at station 356. and progressed upstream to station 304.  
The final height of the headcut was 59.5 ft.

THE HYDROGRAPH WAS NOT ADJUSTED FOR THE EFFECTS OF EROSION.

	DURATION	ATTACK	DIST. FROM MOST U/S
	FLOW	OE/B	HEADCUT TO U/S EDGE
AUXILIARY	HRS	ACFT/FT	AUX. CREST, FT
SPILLWAY----	12.6	25.4	>>>BREACH<<<
			Depth = 17.1 ft

EXIT CHANNEL FLOW SUPERCRITICAL: MAX VELOCITY= 19.0 FT/SEC  
EXIT SLOPE = 0.027 FT/FT  
FLOW DEPTH = 4.9 FT

Inflow Hyd 1 SDH-Peak = 1551.42 CFS at 5.60 hrs., Location Point  
Inflow Hyd 1 FBH-Peak = 12857.72 CFS at 3.77 hrs., Location Point  
HYDOUT 1 15

1SITES....JOB NO. 1 COMPLETE.

-----  
BC15 Brush Creek Site 15

0 SUBWATERSHED(S) ANALYZED.

1 STRUCTURE(S) ANALYZED.

2 HYDROGRAPHS ROUTED AT LOWEST SITE.

0 TRIALS TO OBTAIN BOTTOM WIDTH FOR SPECIFIED STRESS OR VELOCITY.

\*\*\*\*\*

# Brush Creek Site 15 – ASW Integrity (6-hr)

SITES.....COMPUTATIONS COMPLETE

1 SUMMARY TABLE 1 SITES VERSION 2005.1.04  
 ----- DATED 01/01/2005

WATERSHED ID		RUN DATE					RUN TIME		
-----		-----					-----		
BC15		02/11/2011					09:03:12		
>>>	SITE ID	SUBWS ID	SUBWS DA (SQ MI)	CURVE NO.	TC (HRS)	TOTAL DA (SQ MI)	TYPE DESIGN	STRUC CLASS	<<<
	-----	-----	-----	-----	-----	-----	-----	-----	
	15	15	2.76	80.	1.23	2.76	TR60	C	
PASS NO.	DIA./ WIDTH (IN/FT)	AUX.CREST ELEV (FT)	BTM. WIDTH (FT)	MAX. HP (FT)	MAX. ELEV (FT)	EMB. VOL. (CY)	INTEGR.* DIST. (FT)	EXIT* VEL. (FT/SEC)	TYPE HYD
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
1	24.0	2495.1	125.0	9.9	2505.0	0.<BREACH>	19.0	NRCS-FBH	

\* INTEGRITY DIST. AND EXIT VEL. VALUES ARE BASED ON THE ROUTED HYDROGRAPH SHOWN UNDER TYPE HYD.

SITES.....SUMMARY TABLE 1 COMPLETED.

NRCS SITES VERSION 2005.1.04 ,01/01/2005  
 BC15 FILES

INPUT = W:\426\Active Jobs\52299 - WV NRCS 2010 Contract\05 Working\41 Dam Assessments\Brush Creek Site 15\BC15 SITES Model\BrC15\BC\_Site15\_ASW\_6Hr\_Integrity.D2C  
 OUTPUT = W:\426\Active Jobs\52299 - WV NRCS 2010 Contract\05 Working\41 Dam Assessments\Brush Creek Site 15\BC15 SITES Model\BrC15\BC\_Site15\_ASW\_6Hr\_Integrity.OUT  
 DATED 02/11/2011 09:03:12

### GRAPHICS FILES GENERATED

OPTION "L" = W:\426\Active Jobs\52299 - WV NRCS 2010 Contract\05 Working\41 Dam Assessments\Brush Creek Site 15\BC15 SITES Model\BrC15\BC\_Site15\_ASW\_6Hr\_Integrity.DRG  
 DATED 02/11/2011 09:03:12

OPTION "P" = W:\426\Active Jobs\52299 - WV NRCS 2010 Contract\05 Working\41 Dam Assessments\Brush Creek Site 15\BC15 SITES Model\BrC15\BC\_Site15\_ASW\_6Hr\_Integrity.DHY  
 DATED 02/11/2011 09:03:12

OPTION "E" = W:\426\Active Jobs\52299 - WV NRCS 2010 Contract\05 Working\41 Dam Assessments\Brush Creek Site 15\BC15 SITES Model\BrC15\BC\_Site15\_ASW\_6Hr\_Integrity.DEM  
 DATED 02/11/2011 09:03:12

AUX.GRAPHICS = W:\426\Active Jobs\52299 - WV NRCS 2010 Contract\05 Working\41 Dam Assessments\Brush Creek Site 15\BC15 SITES Model\BrC15\BC\_Site15\_ASW\_6Hr\_Integrity.DG\*  
 DATED 02/11/2011 09:03:12



---

## SITES Output

Brush Creek Site 15 - ASW Integrity (24-hr)

---

# Brush Creek Site 15 – ASW Integrity (24-hr)

```

1*****
SITES XEQ 02/11/2011  WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM
VER 2005.1.04      (USER MANUAL - DATED DECEMBER 2005)
TIME 09:03:39
  
```

\*\*\*\*\* 80-80 LIST OF INPUT DATA \*\*\*\*\*

SITES	01/01/2005BC15	Brush Creek Site 15	2.76	C2		
SAVMOV	0 101					
SAVMOV	101 1				1	
STRUCTURE	15					
	2430			0		
	2435			13.6		
	2440			50.4		
	2445			113.8		
	2450			189.5		
	2455			266.3		
	2460			360.7		
	2465			478.9		
	2470			630.4		
	2475			825		
	2480			1068.2		
	2485			1363.6		
	2490			1717.7		
	2495			2128.9		
	2500			2594.2		
	2505			3117.8		
	2510			3700		
	2515			4346.4		
	2530			6400		
ENDTABLE						
WSDATA	2C 15	80	2.76	1.23		
BASEFLOW		1.12				
RAINTABLE	15	24				
		0	0.008	0.0162	0.0246	0.0333
		0.0425	0.0524	0.063	0.0743	0.0863
		0.099	0.1124	0.1265	0.142	0.1595
		0.18	0.205	0.255	0.345	0.437
		0.53	0.603	0.633	0.66	0.684
		0.705	0.724	0.742	0.759	0.775
		0.79	0.8043	0.818	0.8312	0.8439
		0.8561	0.8678	0.879	0.8898	0.9002
		0.9103	0.9201	0.9297	0.9391	0.9483
		0.9573	0.9661	0.9747	0.9832	0.9916
		1				
ENDTABLE						
PDIRECT				13.20	37.00	
POOLDATA	ELEV	2488.1	2488.1	2439	2430	2431.94
PSINLET		0.75	12			SC
PSDATA	1	360.5	24		0.013	2430.36
ASSURFACE	41	438.3	0.1			
	0	20	0.02	0.5	1	1
	20	438.3	0.035	0.5	1	1
	438.3	969.6	0.035	0.5	1	1
ENDTABLE						
ASDATA	41			2.5		1
BTMWIDTH	FEET	125				
ASMATERIAL						
	1	8	0.002	16	100	0.28
	2	0	4	0	120	1
	3	0	10	0	121	10
	4	0	6	0	124	10
ENDTABLE						
ASCOORD	1	Soil	Y			
	0	2485	20	2491	150	2495.1
	170	2495.1	355.6	2490	438.3	2485
	489.00	2465	539	2445	576.6	2440

## Brush Creek Site 15 – ASW Integrity (24-hr)

```

740.5    2435    910.6    2430    969.6    2425.00
ENDTABLE
ASCOORD  2      Shale1
0        2484    20        2490    150      2494.1
170     2494.1  355.6    2489    438.3    2484
489.00  2450     539     2435    576.6    2430
740.5    2425    910.6    2420    969.6    2415
ENDTABLE
ASCOORD  3      Shale2
0        2470    20        2476    220      2479
340     2479    438.3    2470    489.00   2445
539     2430    576.6    2425    740.5    2417
910.6    2415    969.6    2410
ENDTABLE
ASCOORD  4      Siltstone
0        2439    355.6    2439    438.3    2435
489.00  2427    539     2421    576.6    2419
740.5    2416.99  740.5    2410
ENDTABLE
GRAPHICS I
GO,DESIGN L          15      24          2488.1
SAVMOV  2    101  1          15
ENDJOB

```

\*\*\*\*\*

\*\*\*\*\* MESSAGE - DEFAULT TOPSOIL FILL MATERIAL PARAMETERS USED.

\*\*\*\*\* MESSAGE - AUXILIARY SPILLWAY CREST ELEVATION IS SET TO 2495.10  
FROM THE ASCOORD RECORDS.

```

1SITES -----
XEQ 02/11/2011          Brush Creek Site 15          WSID= BC15
VER 2005.1.04          SUBW= 15
TIME 09:03:39          SITE = 15          PASS= 1          PART= 1

```

```

***** MATERIAL PROPERTIES *****
          DRY          PERCENT          DETACH.          REP.
MATERIAL  PI  DENSITY  Kh  CLAY  RATE  DIAMETER
          lbs/CuFt  (Ft/H)/(lb/SqFt) inches
Soil      8.   100.   0.28  16.0  --    0.00200
Shale1    0.   120.   1.00   0.0  --    4.00000
Shale2    0.   121.   10.00  0.0  --    10.00000
Siltstone 0.   124.   10.00  0.0  --    6.00000
TS_FILL   0.   100.   0.05   0.0  --    0.05000
GEN_FILL  8.   100.   0.28  16.0  --    0.00200

```

```

***** BASIC DATA *****
HUMID- SUBHUMID CLIMATE AREA          DESIGN CLASS C

```

STORM DISTRIBUTION AUX. -

```

PRECIP. - Q-PS,1-DAY  Q-PS,10-DAY  P-SD          P-FB
          0.00          0.00          13.20         37.00

WSDATA -   CN          DA-SM          TC/L          -/H          QRF
          80.00         2.76          1.23          0.00         0.00

SITEDATA- PERM POOL  CREST PS      FP SED        VALLEY FL     378?
          2488.10     2488.10     2439.00     2431.94       NO

          BASEFLOW  INITIAL EL    EXTRA VOL     SITE TYPE
          1.12       0.00         0.00         DESIGN

PSDATA - NO. COND    COND L        DIA/W          -/H
          1.00       360.50       24.00         0.00

```

## Brush Creek Site 15 – ASW Integrity (24-hr)

	PS N 0.013	KE 0.75	WEIR L 12.00	TW EL 2430.36	
	2ND STG 0.00	ORF H 0.00	ORF L 0.00	START AUX. 2488.10	
ASCRESTS -	AUX.1 2495.10	AUX.2 0.00	AUX.3 0.00	AUX.4 0.00	AUX.5 0.00
AUX.DATA -	REF.NO. 41	RETARD. Ci 0.00	TIE STATION 170.00	INLET LENGTH 0	
AUX.DATA -	INLET N 0.035	SIDE SLOPE 2.50	EXIT N 0.035	EXIT SLOPE 0.027	ACTUAL AUX? YES
BTM WIDTH -	BW1 ft 125.00	BW2 0.00	BW3 0.00	BW4 0.00	BW5 0.00

AUXILIARY SPILLWAY RATING DEVELOPED USING WSPVRT.

```

1SITES -----
XEQ 02/11/2011           Brush Creek Site 15           WSID= BC15
VER 2005.1.04           SUBW= 15
TIME 09:03:39           SITE = 15           PASS= 1           PART= 2
  
```

PERM POOL	2488.10 FT	1583.1 ACFT	0.00 AC	0.0 CFS
CREST PS	2488.10 FT	1583.1 ACFT	0.00 AC	0.0 CFS
SED ACCUM	2488.10 FT	1583.1 ACFT	0.00 AC	0.0 CFS
BASEFLOW	2488.23 FT	1592.4 ACFT	0.00 AC	3.1 CFS
START ELEV	2488.23 FT	1592.3 ACFT	0.00 AC	3.1 CFS

\*\*\*\*\*  
RATING TABLE DEVELOPED, SITE = 15 :  
BY PROGRAM FOR PS AND AUX. SPILLWAYS  
AUX. RATING USED WSPVRT METHOD.

RATING TABLE NUMBER 1						
	ELEV.	Q-TOTAL	Q-PS	Q-AUX.	VOLUME	AREA
	FEET	CFS	CFS	CFS	AC-FT	ACRE
1	2488.10	0.00	0.00	0.00	1583.15	0.00
2	2488.51	9.73	9.73	0.00	1612.11	0.00
3	2488.92	27.52	27.52	0.00	1641.07	0.00
4	2489.33	50.55	50.55	0.00	1670.03	0.00
FULL CONDUIT FLOW, ELEV = 2489.74 FT						
5	2489.74	77.82	77.82	0.00	1698.99	0.00
6	2494.77	81.06	81.06	0.00	2109.87	0.00
7	2499.80	84.17	84.17	0.00	2575.73	0.00
8	2504.83	87.17	87.17	0.00	3100.47	0.00
9	2509.87	90.07	90.07	0.00	3684.56	0.00
10	2514.90	92.87	92.87	0.00	4333.52	0.00
11	2519.93	95.60	95.60	0.00	5021.81	0.00
12	2524.97	98.25	98.25	0.00	5710.85	0.00
13	2530.00	100.83	100.83	0.00	6399.90	0.00

```

1SITES -----
XEQ 02/11/2011           Brush Creek Site 15           WSID= BC15
VER 2005.1.04           SUBW= 15
TIME 09:03:39           SITE = 15           PASS= 1           PART= 3
  
```

AUX. CREST	2495.10 FT	2138.2 ACFT	0.00 AC	81.3 CFS
------------	------------	-------------	---------	----------

## Brush Creek Site 15 – ASW Integrity (24-hr)

PS STORAGE 555.1 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

START ELEV 2488.23 FT 1592.3 ACFT 0.00 AC 3.1 CFS

EFFECTIVE HEIGHT(H)= 65.1 FEET, PRODUCT= 139198. (H \* STORAGE AT CREST AUX.).

INPUT DESIGN CLASS = C

NRCS-SDH D= 24.00 HR P= 13.20 IN Q= 10.61 IN DA= 2.76 SM  
 TC= 1.23 HR CN= 80.00 VOL= 1568.6 ACFT

PEAK = 3787.8 CFS, AT 10.0 HRS.

NRCS-FBH D= 24.00 HR P= 37.00 IN Q= 34.16 IN DA= 2.76 SM  
 TC= 1.23 HR CN= 80.00 VOL= 5035.3 ACFT

PEAK = 11700.7 CFS, AT 10.0 HRS.

\*\*\*\*\*  
 RATING TABLE DEVELOPED, SITE = 15 :  
 BY PROGRAM FOR PS AND AUX. SPILLWAYS  
 AUX. RATING USED WSPVRT METHOD.

RATING TABLE NUMBER 2

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	2488.10	0.00	0.00	0.00	1583.15	0.00
2	2488.51	9.73	9.73	0.00	1612.11	0.00
3	2488.92	27.52	27.52	0.00	1641.07	0.00
4	2489.33	50.55	50.55	0.00	1670.03	0.00
FULL CONDUIT FLOW, ELEV = 2489.74 FT						
5	2489.74	77.82	77.82	0.00	1698.99	0.00
6	2490.41	78.27	78.27	0.00	1751.11	0.00
7	2491.08	78.71	78.71	0.00	1806.26	0.00
8	2491.75	79.14	79.14	0.00	1861.42	0.00
9	2492.42	79.57	79.57	0.00	1916.57	0.00
10	2493.09	80.00	80.00	0.00	1971.73	0.00
11	2493.76	80.43	80.43	0.00	2026.88	0.00
12	2494.43	80.85	80.85	0.00	2082.04	0.00
13	2495.10	81.27	81.27	0.00	2138.28	0.00
14	2496.85	836.32	82.36	753.96	2300.62	0.00
15	2498.59	2359.86	83.43	2276.43	2462.99	0.00
16	2501.73	6659.54	85.33	6574.21	2775.47	0.00
17	2505.57	14039.40	87.60	13951.80	3184.18	0.00
18	2512.55	34320.46	91.57	34228.89	4029.67	0.00
19	2521.27	68951.96	96.31	68855.65	5205.48	0.00
20	2530.00	115326.40	100.83	115225.57	6400.00	0.00

\*\*\*\*\*

SUMMARY OF AUXILIARY SPILLWAY SURFACE CONDITIONS USED IN COMPUTATIONS BY REACH

REACH	FROM STA (ft)	TO STA (ft)	SLOPE (%)	RETARDANCE CURVE INDEX@	VEGETAL COVER FACTOR	MAINT. CODE +	ROOTING DEPTH (ft)	REACH LOCATION *
1	0.	20.	-30.0	0.020	**	**	**	INLET
2	20.	150.	-3.2	0.035	**	**	**	INLET
3	150.	170.	0.0	0.035	**	**	**	CREST
4	170.	356.	2.7	0.035	0.50	1	1.0	EXIT !
5	356.	438.	6.0	0.035	0.50	1	1.0	EXIT
6	438.	489.	39.4	0.035	0.50	1	1.0	exit
7	489.	539.	40.0	0.035	0.50	1	1.0	exit
8	539.	577.	13.3	0.035	0.50	1	1.0	exit
9	577.	740.	3.1	0.035	0.50	1	1.0	exit
10	740.	845.	2.9	0.035	0.50	1	1.0	exit

@ The program interprets retardance curve index entries of less than 1 as

## Brush Creek Site 15 – ASW Integrity (24-hr)

Manning's n values.  
 + The minimum maintenance code value of 2 is used in INTEGRITY computations  
 (the program changes values of 1 to 2 during computation).  
 \* Upper case indicates a reach of constructed spillway channel.  
 \*\* The program does not use vegetal cover factor, maintenance code, and  
 rooting depth for inlet and crest reaches in computations.  
 ! Reach 4 used in computing exit channel velocities.  
 \*\*\*\*\*

ROUTED	BTM WIDTH	MAX ELEV	VOL-MAX	AREA-MAX	AUX.-HP	VOL-AUX.
RESULTS	FT	FT	ACFT	AC	FT	ACFT
NRCS-SDH	125.0	2497.40	2352.4	0.0	2.30	214.2

PEAK - CFS	Q-PS	Q-AUX.	Q-TOT.
DISCHARGE =	83.	1240.	1323.

	CRITICAL	CRITICAL	CRITICAL	25% OF Q
	DEPTH	VELOCITY	SLOPE-Sc	Sc
AUXILIARY	FT	FT/SEC	FT/FT	FT/FT
SPILLWAY ---	1.44	6.71	0.016	0.022

AUXILIARY SPILLWAY DURATION FLOW = 19.3 HOURS

EXIT CHANNEL FLOW SUPERCRITICAL: MAX VELOCITY= 7.9 FT/SEC  
 EXIT SLOPE = 0.027 FT/FT  
 FLOW DEPTH = 1.2 FT

\*\*\*\*\*

EROSIONALLY EFFECTIVE STRESS FOR STABILITY ANALYSIS OF AUX. EXIT CHANNEL  
 (Refer to Ag. Handbook 667, Chapt. 3, for allowable stresses.)

Aux. Spillway Discharge = 1240. cfs; Bottom Width = 125. ft

REACH	FROM	TO	SLOPE	MANNING`S	VELOCITY	TOTAL	EFFECTIVE
NO.	STA	STA	%	n	ft/s	lb/ft^2	lb/ft^2
4	170.	356.	2.75	0.035	7.91	2.10	0.261
5	356.	438.	6.05	0.035	10.06	3.65	0.454 max.

\*\*\*\*\*

ROUTED	BTM WIDTH	MAX ELEV	VOL-MAX	AREA-MAX	AUX.-HP	VOL-AUX.
RESULTS	FT	FT	ACFT	AC	FT	ACFT
NRCS-FBH	125.0	2503.52	2962.6	0.0	8.42	824.3

PEAK - CFS	Q-PS	Q-AUX.	Q-TOT.
DISCHARGE =	86.	9952.	10038.

	CRITICAL	CRITICAL	CRITICAL	25% OF Q
	DEPTH	VELOCITY	SLOPE-Sc	Sc
AUXILIARY	FT	FT/SEC	FT/FT	FT/FT
SPILLWAY ---	5.60	12.80	0.011	0.014

INTEGRITY ANALYSIS - REACH SURFACE PERFORMANCE SUMMARY  
 (The auxiliary spillway began flow at time = 7.7 hours  
 and peaked at time = 10.6 hours.)

REACH 4: FROM STATION 170. TO 356. ON 2.7% SLOPE.  
 Vegetal cover failed and concentrated flow developed  
 at time = 10.8 hours.

REACH 5: FROM STATION 356. TO 438. ON 6.0% SLOPE.  
 Vegetal cover failed and concentrated flow developed  
 at time = 10.0 hours.

REACH 6: FROM STATION 438. TO 489. ON 39.4% SLOPE.  
 Vegetal cover failed and concentrated flow developed  
 at time = 8.6 hours.

## Brush Creek Site 15 – ASW Integrity (24-hr)

REACH 7: FROM STATION 489. TO 539. ON 40.0% SLOPE.  
 Vegetal cover failed and concentrated flow developed  
 at time = 8.6 hours.

REACH 8: FROM STATION 539. TO 577. ON 13.3% SLOPE.  
 Vegetal cover failed and concentrated flow developed  
 at time = 8.6 hours.

REACH 9: FROM STATION 577. TO 740. ON 3.1% SLOPE.  
 Vegetal cover failed and concentrated flow developed  
 at time = 9.2 hours.

REACH 10: FROM STATION 740. TO 845. ON 2.9% SLOPE.  
 Vegetal cover failed and concentrated flow developed  
 at time = 10.7 hours.

### INTEGRITY ANALYSIS - HEADCUT EROSION DAMAGE SUMMARY

The headcut BREACHED the spillway crest at  
 time equal approximately 12.7 hours.  
 Computations terminated at that point!

The most upstream headcut began at station 170.  
 and progressed upstream to station 150.  
 The final height of the headcut was 19.3 ft.

The headcut having the maximum final overfall height began  
 at station 356. and progressed upstream to station 272.  
 The final height of the headcut was 60.3 ft.

THE HYDROGRAPH WAS NOT ADJUSTED FOR THE EFFECTS OF EROSION.

	DURATION	ATTACK	DIST. FROM MOST U/S
	FLOW	OE/B	HEADCUT TO U/S EDGE
AUXILIARY	HRS	ACFT/FT	AUX. CREST, FT
SPILLWAY----	23.9	34.4	>>>BREACH<<<
			Depth = 19.3 ft

EXIT CHANNEL FLOW SUPERCRITICAL: MAX VELOCITY= 17.4 FT/SEC  
 EXIT SLOPE = 0.027 FT/FT  
 FLOW DEPTH = 4.2 FT

Inflow Hyd 1 SDH-Peak = 1322.53 CFS at 11.99 hrs., Location Point  
 Inflow Hyd 1 FBH-Peak = 10038.17 CFS at 10.55 hrs., Location Point  
 HYDOUT 1 15

1SITES....JOB NO. 1 COMPLETE.

-----  
 BC15 Brush Creek Site 15

0 SUBWATERSHED(S) ANALYZED.

1 STRUCTURE(S) ANALYZED.

2 HYDROGRAPHS ROUTED AT LOWEST SITE.

0 TRIALS TO OBTAIN BOTTOM WIDTH FOR SPECIFIED STRESS OR VELOCITY.

\*\*\*\*\*

# Brush Creek Site 15 – ASW Integrity (24-hr)

SITES.....COMPUTATIONS COMPLETE

1 SUMMARY TABLE 1 SITES VERSION 2005.1.04  
 ----- DATED 01/01/2005

WATERSHED ID		RUN DATE					RUN TIME		
-----		-----					-----		
BC15		02/11/2011					09:03:39		
>>>	SITE ID	SUBWS ID	SUBWS DA (SQ MI)	CURVE NO.	TC (HRS)	TOTAL DA (SQ MI)	TYPE DESIGN	STRUC CLASS	<<<
	-----	-----	-----	-----	-----	-----	-----	-----	
	15	15	2.76	80.	1.23	2.76	TR60	C	
PASS NO.	DIA./ WIDTH (IN/FT)	AUX.CREST ELEV (FT)	BTM. WIDTH (FT)	MAX. HP (FT)	MAX. ELEV (FT)	EMB. VOL. (CY)	INTEGR.* DIST. (FT)	EXIT* VEL. (FT/SEC)	TYPE HYD
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
1	24.0	2495.1	125.0	8.4	2503.5	0.<BREACH>		17.4	NRCS-FBH

\* INTEGRITY DIST. AND EXIT VEL. VALUES ARE BASED ON THE ROUTED HYDROGRAPH SHOWN UNDER TYPE HYD.

SITES.....SUMMARY TABLE 1 COMPLETED.

NRCS SITES VERSION 2005.1.04 ,01/01/2005  
 BC15 FILES

INPUT = W:\426\Active Jobs\52299 - WV NRCS 2010 Contract\05 Working\41 Dam Assessments\Brush Creek Site 15\BC15 SITES Model\BrC15\BC\_Site15\_ASW\_24Hr\_Integrity.D2C  
 OUTPUT = W:\426\Active Jobs\52299 - WV NRCS 2010 Contract\05 Working\41 Dam Assessments\Brush Creek Site 15\BC15 SITES Model\BrC15\BC\_Site15\_ASW\_24Hr\_Integrity.OUT  
 DATED 02/11/2011 09:03:39

GRAPHICS FILES GENERATED

OPTION "L" = W:\426\Active Jobs\52299 - WV NRCS 2010 Contract\05 Working\41 Dam Assessments\Brush Creek Site 15\BC15 SITES Model\BrC15\BC\_Site15\_ASW\_24Hr\_Integrity.DRG  
 DATED 02/11/2011 09:03:39

OPTION "P" = W:\426\Active Jobs\52299 - WV NRCS 2010 Contract\05 Working\41 Dam Assessments\Brush Creek Site 15\BC15 SITES Model\BrC15\BC\_Site15\_ASW\_24Hr\_Integrity.DHY  
 DATED 02/11/2011 09:03:39

OPTION "E" = W:\426\Active Jobs\52299 - WV NRCS 2010 Contract\05 Working\41 Dam Assessments\Brush Creek Site 15\BC15 SITES Model\BrC15\BC\_Site15\_ASW\_24Hr\_Integrity.DEM  
 DATED 02/11/2011 09:03:39

AUX.GRAPHICS = W:\426\Active Jobs\52299 - WV NRCS 2010 Contract\05 Working\41 Dam Assessments\Brush Creek Site 15\BC15 SITES Model\BrC15\BC\_Site15\_ASW\_24Hr\_Integrity.DG\*  
 DATED 02/11/2011 09:03:39



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Appendix D  
Evaluation of Potential Rehabilitation  
Projects-Priority Ranking Spreadsheet

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**EVALUATION OF POTENTIAL REHABILITATION PROJECTS**

<b>STATE</b>	WV	<b>DAM</b>	Brush Creek Site 15	<b>BY</b>	TAR	<b>DATE</b>	01/20/11
<b>YEAR BUILT</b>	1967	<b>DESIGN HAZARD CLASS</b>	C	<b>DRAINAGE AREA</b>	2.76	mi <sup>2</sup>	
<b>WORK PLAN DATE</b>	1959	<b>CURRENT HAZARD CLASS</b>	C	<b>DAM HEIGHT</b>	75.04	ft	

sht 1 of 5 **CONSEQUENCES OF DAM FAILURE** ver 100101

**POTENTIAL DAM FAILURE:**

Total Failure Index 170 A

**POTENTIAL LOSS OF LIFE:**

Maximum Population-at-Risk [PAR] (number) 1833 B

Total Risk Index 12464 C

**POTENTIAL LOSS OF PROPERTY:**

Identify major community affected by breach and rate impact as High (H), Medium (M), Low (L) or None(blank)

Community Glenwood (H,M,L,-) H D

Number of homes, businesses, major buildings (number) 733 E

**POTENTIAL LIFELINE DISRUPTION:**

Water supply, identify community disrupted by dam failure, and estimate number/amount

Municipal sole source \_\_\_\_\_ Users (number)  F

Supplemental source \_\_\_\_\_ Users (number)  G

Irrigation water \_\_\_\_\_ Storage (Ac-Ft)  H

**POTENTIAL INFRASTRUCTURE DISRUPTION:**

Transportation system crossings, identify major crossing rendered unusable by dam failure, and estimate number

Major/Interstate U.S. Routes 19 and 460 Roads (number) 2 I

Secondary/County WV Rtes 20,104,Co Rtes 17/1,71/13,71/7,20/13,20/12Roads (number) 19 J

**POTENTIAL ADVERSE IMPACTS ON THE ENVIRONMENT:**

Describe impacts and rate each as High (H), Medium (M), Low (L), or None (blank)

Threatened & endangered species \_\_\_\_\_ (H,M,L,-) L K

Sensitive riparian areas \_\_\_\_\_ (H,M,L,-) L L

Contaminated reservoir sediment \_\_\_\_\_ (H,M,L,-) L M

Wetland and wildlife habitat \_\_\_\_\_ (H,M,L,-) L N

Other \_\_\_\_\_ (H,M,L,-)  O

**POTENTIAL ADVERSE SOCIAL IMPACTS:**

Describe impacts and rate each as High (H), Medium (M), Low (L) or None(blank)

Known cultural resources \_\_\_\_\_ (H,M,L,-) L P

Historic preservation issues \_\_\_\_\_ (H,M,L,-)  Q

Socially disadvantaged community \_\_\_\_\_ (H,M,L,-) M R

**POTENTIAL ADVERSE ECONOMIC IMPACTS:**

Average annual benefits attributed to this dam, updated workplan value ( \$ ) 61,473 S

Changes in benefits since workplan; Increase(I), No change(NC), Decrease(D) (I,NC,D) I T

Low income families impacted (number) 267 U

**INPUT BY STATE DAM SAFETY AGENCY:**

State dam safety order issued for repair, modification, removal issued, Yes(Y), No(N) ( Y,N )  V

State Dam Safety Agency Priority, High(H), Medium(M), Low(L), None(blank) (H,M,L,-)  W

**OTHER CONSIDERATIONS:**

Identify any other considerations and rate as High(H), Medium(M), Low(L) or None(blank)

\_\_\_\_\_ (H,M,L,-)  X

\_\_\_\_\_ (H,M,L,-)  Y

**EVALUATION OF POTENTIAL REHABILITATION PROJECTS**

<b>STATE</b>	WV	<b>DAM</b>	Brush Creek Site 15	<b>BY</b>	TAR	<b>DATE</b>	01/20/11
sht 2 of 5	<b>FAILURE &amp; RISK INDEXES</b>						ver 102201

Adopted from Bureau of Reclamation "Risk Based Profile System"

see: <http://www.usbr.gov/dsis/risk/rbpsdocumentation.pdf>

**LIFE LOSS:**

Population-at-Risk [PAR], see NRCS dams inventory definition (number of people)

Estimate PAR for static loading failure, typically assume water at top of dam	1833	A
Estimate PAR for hydrologic loading failure, typically assume water at top of dam	1833	B
Estimate PAR for seismic loading failure, typically assume water at ES crest (sunny day failure)	1833	C

Fatality Rates [FR] from dam breach

Adopted from BuRec "A Procedure for Estimating Loss of Life Caused by Dam Failure" DSO-99-06

see: [http://www.usbr.gov/research/dam\\_safety/documents/dso-99-06.pdf](http://www.usbr.gov/research/dam_safety/documents/dso-99-06.pdf)

Flood Severity/Lethality [DV] is the average depth [D] times velocity [V] across flood plain (ft2/sec)

$$DV = (\text{breach discharge} - \text{bank full discharge}) / \text{breach floodplain width}$$

Warning Time [T] between failure warning and flood wave at population (minutes)

Flood Severity Understanding [U] of the warning issuer of the likely flooding magnitude

scenario	breach discharge	bankfull discharge	breach width	DV	warning time	under-standing
	(cfs)	(cfs)	(ft)	(ft2/sec)	(minutes)	(N/A or Vague)
Static	144129	84	683	211	5	Vague
Hydrologic	189291	84	715	265	4	Vague
Seismic	144129	84	683	211	5	Vague

For DV>50	T=0	U=N/A (no warning)	FR=0.15
For DV>50	T<60	U=vague	FR=0.04
For DV>50	T>60	U=vague	FR=0.03
For DV<50	T=0	U=N/A (no warning)	FR=0.01
For DV<50	T<60	U=vague	FR=0.007
For DV<50	T>60	U=vague	FR=0.0003

Estimate FR for static loading failure scenario	0.04	D
Estimate FR for hydrologic loading failure scenario	0.04	E
Estimate FR for seismic loading failure scenario	0.04	F

Scenario	Load Factor	Response Factor	Failure Index	Fatality Rate	PAR	Risk Index
Static	1	66	66	0.04	1833	4839
Hydrologic	*	*	96	0.04	1833	7039
Seismic	0.15	53	8	0.04	1833	587
<b>TOTAL=</b>			170	<b>TOTAL=</b>		12464

EVALUATION OF POTENTIAL REHABILITATION PROJECTS								
STATE	WV	DAM	Brush Creek Site 15	BY	TAR	DATE	01/20/11	
sht 3 of 5		<b>STATIC FAILURE INDEX</b>					ver 100101	
<b>PRINCIPAL SPILLWAY SYSTEM</b> (60 points max):						(total points)	20	A
Downstream filter or filter zone around conduit (yes=0 or no=10)							0	B
Conduit trench deep (>2d) and narrow (<3d) and steep sideslope (<2:1) (no=0 or yes=10)							0	C
Principal spillway system (inlet, pipe, or outlet) in deteriorated condition (no=0 or yes=10)							0	D
Conduit has seepage cutoff collars or other compaction adverse features (no=0 or yes=10)							10	E
Conduit contains open joints, open cracks, steady seepage (no=0 or yes=10)							10	F
Conduit founded on competent bedrock (yes=0 or no=10)							0	G
Reservoir control gate located at outlet of conduit (no=0 or yes=10)							0	H
<b>RESERVOIR FILLING HISTORY</b> (75 points max):						(total points)	10	I
Reservoir has filled to x% of effective height (earth spillway crest minus original streambed)							91	J
(<50%=75 or 51-75%=50 or 76-90%=25 or 91-95%=10 or 96-100%=5 or >100%=0)							10	K
<b>SEEPAGE AND DEFORMATION</b> (85 points max):						(total points)		L
Seepage carrying fines, or seepage increases with reservoir elevation increases, or sinkholes/jugholes exist in embankment (no=0 or yes=80)							0	M
Large amounts of seepage (no=0 or yes=6)							0	N
Visible and significant slope movement or sloughing (no=0 or yes=6)							0	O
Longitudinal or transverse embankment cracking greater than one foot in depth (no=0 or yes=6)							0	P
Sinkholes/depressions within two times effective height of the dam, either face (no=0 or yes=6)							0	Q
Poor top of dam condition, eroded, trees, rodent holes, settlement (no=0 or yes=6)							0	R
Abnormally wet areas at downstream toe/groin of embankment (no=0 or yes=6)							0	S
Inadequate slope protection against erosion by rainfall or waves (no=0 or yes=6)							0	T
<b>FOUNDATION GEOLOGY</b> (41 points max):						(total points)	30	U
Highly fractures rock under core (no=0 or treated=3 or untreated=30)							0	V
Karst terrain and soluble rock (gypsum or limestone) (no=0 or treated=3 or untreated=30)							0	W
Collapsible soils (no=0 or treated=3 or untreated=30)							0	X
Significant stress relief fractures in abutments (no=0 or treated=3 or untreated=30)							30	Y
History of underground mining under embankment area (no=0 or treated=3 or untreated=30)							0	Z
Coarse grained and highly permeable soils (no=0 or yes=3)							0	AA
Presence of weak layers/conditions diminishing embankment stability (no=0 or yes=3)							0	AB
Erodible soils (sandy/silty materials) or weakly cemented rock (no=0 or yes=3)							0	AC
Reservoir area prone to landslides that could cause overtopping (no=0 or yes=3)							0	AD
<b>EMBANKMENT DESIGN AND CONSTRUCTION</b> (24 points max):						(total points)		AE
Filters for core or foundation or incompatibility between zones (no=3 or yes=0)							0	AF
Embankment or foundation drainage system (yes=0 or no=4)							0	AG
Erodible core material (sands, silts, dispersive clays) (no=0 or yes=4)							0	AH
Incomplete or no foundation cutoff of shallow permeable layers (no=0 or yes=4)							0	AI
Poorly placed earthfill, inadequate density (no=0 or yes=4)							0	AJ
Gate features to drain reservoir (yes=0 or no=4)							0	AK
<b>EMBANKMENT MONITORING</b> (15 points max):						(total points)	6	AL
Instruments (except surficial survey points) installed at dam (yes=0 or no=3)							3	AM
Installed instruments routinely read and evaluated (yes=0 or no=3)							3	AN
Visual inspection of dam by engineer less often than yearly (no=0 or yes=3)							0	AO
Good physical/visual access to downstream groin/toe for inspection (yes=0 or no=3)							0	AP
<b>STATIC FAILURE INDEX:</b> A+I+L+U+AE+AL							66	AQ

EVALUATION OF POTENTIAL REHABILITATION PROJECTS								
STATE	WV	DAM	Brush Creek Site 15	BY	TAR	DATE	01/20/11	
sht 4 of 5		HYDROLOGIC FAILURE INDEX					ver 100101	
<b>HYDROLOGIC LOADING:</b>								
Total Spillway Capacity (PS&ES) for 6hr storm [Pfb], Work Plan Tbl 3 (rainfall inches)						10.1	A	
Obtained from Work Plan Tbl 3, or dams inventory data, or computer routings								
100 year, 6hr rainfall [P100] (inches)						3.63	B	
Probable Maximum Precipitation [PMP] (inches)						28.5	C	
if Pfb <: P100 = 3.63 enter 40								
if Pfb = P100+0.2(PMP-P100) = 8.604 enter 25								
if Pfb = P100+0.4(PMP-P100) = 13.58 enter 15								
if Pfb = P100+0.6(PMP-P100) = 18.55 enter 7								
if Pfb = P100+0.8(PMP-P100) = 23.53 enter 3								
if Pfb =: PMP = 28.5 enter 1								
Enter interpolated value						22	D	
<b>HYDROLOGIC UNCERTAINTY:</b>								
Drainage Area [DA] (square miles)						2.76	E	
DA<10 enter 1.5 ; 10<DA<20 enter 1.4 ; 20<DA<50 enter 1.3 ; DA=>50 enter 1.2						1.5	F	
<b>PIPE SPILLWAY PLUGGING:</b>								
Pipe Diameter [D] (inches)						24	G	
D<12 enter 1.1; 12<=D<24 enter 1.0; 24<=D enter 0.9						0.9	H	
Riser & trash rack type:								
Non-standardized inlet enter 1.1, Open Top riser enter 1.0; Covered or Baffle Top enter 0.9						0.9	I	
<b>EARTH SPILLWAY FLOW:</b>								
Earth spillway flow depth [Des] from top of dam to spillway crest (feet)(10' max)						9.3	J	
<b>DAM EROSION RESISTANCE:</b>								
Non-plastic (PI<10) fill enter 2.0 ; Plastic core enter 1.7 ; Overtopping armoring enter 0.8						2	K	
Vegetal Cover Factor [Cf], see SITES or AH667						0.7	L	
<a href="http://www.pswcrl.ars.usda.gov/ah667/ah667.htm">http://www.pswcrl.ars.usda.gov/ah667/ah667.htm</a>								
Cf <0.4 enter 1.1; Cf < 0.7 enter 1.0; Cf<1.0 enter 0.9; larger Cf enter 0.8						0.9	M	
<b>EARTH SPILLWAY EROSION RESISTANCE:</b>								
Low, can be excavated with hand tools, enter 2.0								
PI>10 and SPT blows<8, PI<10 and SPT blows>8, Kh<0.10, seismic velocity<2000fps								
Moderate, can be excavated with construction equipment, easy ripping, enter 1.2								
PI>10 and SPT blows>8, PI<10 and SPT blows>30, Kh<10, seismic velocity<7000fps								
High, very hard ripping, requires drilling and blasting, enter 0.2								
moderately hard rock, Kh>10, seismic velocity>7000fps						1.2	N	
Vegetal Cover Factor [Cf], see SITES or AH667						0.7	O	
Cf <0.4 enter 1.1; Cf < 0.7 enter 1.0; Cf<1.0 enter 0.9; larger Cf enter 0.8						0.9	P	
<b>HYDROLOGIC FAILURE INDEX:</b>								
dam overtopping breach: (2)(D)(F)(H)(I)(K)(M)						96	Q	
earth spillway breach: (D+5J)(F)(H)(I)(N)(P)						90	R	
larger of (2)(D)(F)(H)(I)(K)(M) or (D+5J)(F)(H)(I)(N)(P) but less than 300						96	S	

**EVALUATION OF POTENTIAL REHABILITATION PROJECTS**

<b>STATE</b>	WV	<b>DAM</b>	Brush Creek Site 15	<b>BY</b>	TAR	<b>DATE</b>	01/20/11
sht 5 of 5	<b>SEISMIC FAILURE INDEX</b>						ver 102201

**SEISMIC LOADING:**

Latitude (degrees.decimal) 37.325 A

Longitude (degrees.decimal) -81.18 B

See "http://eqint.cr.usgs.gov/eq/html/lookup.shtml"

PGA [peak ground acceleration] for 2% chance in 50 years, see NEHRP maps (%g) 14.914 C

if PGA is less than 10% g, enter 0

if PGA is between 10% g and 19% g, enter 0.15

if PGA is between 20% g and 39% g, enter 0.30

if PGA is between 40% g and 59% g, enter 0.65

if PGA is greater than 60% g, enter 1.0 0.15 D

**FOUNDATION LIQUEFACTION:**

Select only one of the following foundation conditions which best represents the site

Loose alluvium, lacustrine, loess materials (no=0 or yes=10) 0 E

Bedrock, glacial till, highly clayey materials (no=0 or yes=5) 5 F

**EMBANKMENT FREEBOARD FOR FOUNDATION LIQUEFACTION:**

Dam height for seismic event is the height from top of dam to downstream channel bottom (ft) 75.04 G

Freeboard for seismic event is the depth from top of dam to assumed pool surface (ft) 9.3 H

Freeboard percent of dam height (%) 12 I

if Freeboard is less than 25% of dam height, enter 10

if Freeboard is 25% to 50% of dam height, enter 5

if Freeboard is more than 50% of dam height, enter 1 10 J

**EMBANKMENT FREEBOARD FOR EMBANKMENT CRACKING:**

Freeboard is less than or equal to 15 feet (no=0 or yes=1) 1 K

**EMBANKMENT CRACKING:**

Embankment contains self-healing filter zones (no=4 or yes=0) 4 L

**SEISMIC FAILURE INDEX:**

(D) ( (E)(J) + (F)(K+1)(L+1) ) but less than 100 8 M



Digitally signed by Angela D. Greene, PE  
Date: 2011.03.21 09:58:39 -04'00'

\_\_\_\_\_  
**State Conservation Engineer's Signature**

concurring with technical content of sheets 2 thru 5

**Brush Creek 15**  
**Review Comments Related to Geotechnical Factors in the**  
***“Evaluation of Potential Rehabilitation Projects-Priority Ranking Spreadsheet”***

<b>Failure Index</b>	<b>Line</b>	<b>Comment</b>
Static	B	As-built drawings show single aggregate filter materials placed around conduit. Current filter diaphragm criteria met in both horizontal and vertical directions.
Static	C	As-built drawings show PSW excavation slopes of 1H:1V, a 10 ft bottom width and an approximate depth of 5 feet for a 24-inch conduit.
Static	E	As-built drawings show that 10 anti-seep collars were constructed along the PSW.
Static	G	As-built drawings show conduit on rock.
Static	M, N	No excessive seepage observed. Both drain pipes flowing, combined flow less than ½ gpm during 10/19/10 GF inspection. Wet area observed near right gutter and toe.
Static	O,P,Q	No sloughs, cracks or sinkholes/depressions observed.
Static	R	Tree stumps (leveled to ground surface) on embankment slope, minor tire ruts on dam crest.
Static	S	Wet area observed near right gutter and toe.
Static	T	Wave erosion on upstream slope and at entrance of auxiliary spillway.
Static	V	As-built drawings show cutoff trench excavated to rock. No foundation grouting completed during construction.
Static	W	No karst geology or soluble rock mapped on West Virginia Geologic Survey publications.
Static	X	No collapsible soils identified in the design reports.
Static	Y	No stress relief fractures identified in the design reports.
Static	Z	No underground mining under embankment described in the design reports.
Static	AA	Soil thickness is approximately 10 to 15 feet. Testing in the Soils Report shows an average PI of 8, however one specimen was classified as non-plastic.
Static	AB	No weak layers/conditions identified in the design reports.
Static	AC	Geology Report indicates rock near auxiliary spillway to be removed with common excavation indicating poor cemented rock is present on site.
Static	AD	Susceptibility of reservoir area to landslides that could overtop dam was not accessed in the design files.
Static	AF	As-built drawings indicate three embankment zones. No transition zones are identified, however the seepage drain does extended between the majority of the interface between embankment fill and the downstream shell/rock toe. Calculations for the compatibility of filters/embankment zones were not included in the design files.
Static	AG	As-built drawings show a seepage drain system.
Static	AH	No erodible core materials identified in the design reports.
Static	AI	As-built drawings show cutoff trench excavated to rock.
Static	AJ	As-built drawings indicate class B-1 compaction for Zones I & II, class C compaction for shell (Zone III), however no construction quality control testing results are available.
Static	AM	Dam does not have any instrumentation.
Hydrologic	N	Minimum shale, average shale and average siltstone SITES parameters were used.
Seismic	E, F	Liquefaction was not evaluated in the design documents reviewed.
Seismic	L	As-built drawings do not indicate transitions between embankment zones and the central core.