USER'S GUIDE FOR BRCH GUI (BRCH-J)
Version 2-0-0 05-14-2018

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Application Description

The National Weather Service (NWS)[1] developed a procedure for predicting the breach characteristics and the outflow hydrograph emanating from a breached earthen dam. The procedure known as the Breach Erosion Model (**BREACH**) computes the size and shape of the dam breach opening, the time of formation, the outflow hydrograph, and the tailwater elevation hydrograph of an earthen dam. The model is physically based on the principles of hydraulics, sediment transport, soil mechanics, the geometric and material properties of the dam, and the reservoir properties (storage volume, spillway characteristics, and the time-dependent reservoir inflow rate). The dam may be either man-made or naturally formed as a consequence of a landslide. The critical material properties of the dam are the internal friction angle, cohesive strength, and average grain size diameter (D_{50}). These parameters may be used in the River Mechanics hydraulic models (e.g., **FLDWAVE**, **SDB-J**) to model the breach outflow and route it through the river.

NWS developed a JAVA GUI (**BREACH GUI**) which may be used to create or read in an input data file, run it through the BREACH application, display an animation of the dam breach formation, and display the hydrographs and rating curve graphically.

The RiverMechanics.net Group (RM) has modified the animation views in the output component of the BREACH GUI to better reflect the BREACH application's representation of a breach failure. The water surface is allowed to attenuate throughout the breach process. Backwater affects are also represented. The previous version assumed a horizontal water surface throughout the breach progression.

Development History

NWS BREACH vs. BRCH

The original FORTRAN code for the NWS BREACH model was developed in 1984 and the last NWS revision was in 1999. Although the source code is that of the 1999 version, the executable in the NWS package is actually the 1997 version of the NWS BREACH model. The results for some data sets may vary slightly between the two models.

In 2010, the Breach Erosion Model name was changed from NWS BREACH to BRCH (Version 1-0-0) because it is not affiliated with NWS. The code in BRCH (2010) is identical to the code in NWS BREACH (1999) with the exception of changes noted in the BRCH Release Notes.

In 2018, BRCH (2010) underwent extensive testing using over 50 datasets. The changes made to BRCH Version 2-0-0 (2018) may result in noticeable changes in the output when compared to the previous version. This is due to modifications and bug fixes as stated in the BRCH Release Notes. BRCH Version 2-0-0 is more robust and stable than any version of the BREACH model since its development.

BREACHJ vs. BRCH-J

Although NWS developed the BREACH GUI in 2004, it was never officially released. The last beta release was in 2005. In 2010, RM released the BREACH GUI (BREACHJ) as developed at NWS. Since it is not affiliated with NWS, the name of the GUI in BRCH Version 2-0-0 (2018) has been changed to BRCH-J to be consistent with the name of the BRCH application. Major changes were made to the GUI; however, the results were not impacted except for the changes in the animation views as noted previously. BRCH-J has been extensively tested using the BRCH datasets and is more robust than the version developed at NWS.

All release versions of BRCH and BRCH-J have been tested and compared to the results of NWS BREACH (1999). Any major changes in the results are documented in the BRCH GUI Release Notes.

Features in BRCH-J

The following enhancements have been added to BRCH-J.

- Input GUI – The BRCH GUI allows the user to enter the data in a simple, easier way. There is also a graphical display of some of the input data (i.e., inflow hydrograph, area-elevation curve; cross section, and spillway rating curve).
- Output GUI – After reading in or creating the input file, BRCH-J will run the BRCH application and generate an output text file with a ".out" extension. It will then generate an animation of the dam breach showing the breach opening as well as display the outflow hydrograph, tailwater elevation hydrograph, and rating curve. The user may pause the animation and replay any portion of the breach.

A detailed description of the input parameters and output variables is in the BRCH Input Summary documentation. The information has been extracted from the NWS BREACH document[1] and enhanced by adding additional parameters and variables.

System Information

Operating Systems – Windows 2000, XP, Vista, Windows 7-10. Windows processor can be 32-bit or 64-bit.
Linux Fedora 27 with 64 bit processor.

Language – Java 1.8+

Default Directory – C:\RiverMechanics\BRCH-J for Windows or ~/RiverMechanics/BRCH-J for Linux

Windows Installation Instructions

The installation package for BRCH-J Version 2-0-0 (brchjInstall-050118.exe) can be downloaded from the RiverMechanics.net website. When executed, the Install Shield will copy the files in Tables 1 & 2 into the c:\RiverMechanics\BRCH-J folder. The user has the option to change the path. If the path is changed, the brchGUI.bat file must be manually modified to reflect the new path location and . A shortcut (BRCH GUI) is placed on the desktop. The user must have JAVA installed on their computer in order to run the BRCH GUI.

Linux Installation Instructions

To install BRCH-J Version 2-0-0, do the following:

1. Download brchj-installation-Linux-051418.zip file from the RiverMechanics.net website.
2. Unzip the linux-installation-051418.zip file which contains the .sh installation shell script file.
3. Open a terminal window, and change to the directory containing the .sh file.
4. Type ". brchjLinuxInstall051418.sh" (*Note: there is a space after the dot).*
5. BRCH-J will be installed in the root folder ~/RiverMechanics/. All the files in Tables 1 and 3 will be copied to the BRCH-J folder. If the root folder is changed, it must be created prior to running the shell script.
6. A BRCH-J icon will be placed on the desktop.
7. To run the program, double-click on the icon. A "Untrusted Application Launcher" message will pop up. Select the "Trust and Launch" option, and the **BRCH GUI** image will appear on the desktop. The BRCH GUI will also open.

Table 1. Files within the Installation Package (Common to Both Windows & Linux)

• *brchGUI*.jar – Java archive file for BRCH-J application • *brchGUI.ico* – BRCH-J icon • *BRCH GUI User's Guide.pdf* – this file • *BRCH GUI Release Notes 050118.pdf* – release notes for BRCH and BRCH-J • *BRCH Input Summary.pdf* – updated Input/Output summary which was extracted from the NWS BREACH paper (breach.pdf) • *breach.pdf* – the last NWS BREACH documentation • *BRREAD.ME* – text file containing history of changes to NWS BREACH	• *Example Input Files* ▪ *Bsmbot2.dat* ▪ *Clay.dat* ▪ *Lawn.dat* ▪ *Peru.dat* ▪ *Redrock.dat* ▪ *Teton.dat*

Table 2. Additional Files within the *Windows* Installation Package

- *brch-jInstall-51218.exe* – Installation program
- *brch-x32.exe* – Fortran executable for BRCH application (32-bit)
- *brch-x64.exe* – Fortran executable for BRCH application (64-bit)
- *brchGUI.bat* – batch file to execute BRCH-J

Table 3. Additional Files within the Linux Installation Package

- *brchj-installation-Linux-051418.zip* – Compressed file containing common files (.zip) and installation program (.sh)
- *brchjLinuxInstall051218.sh* –Shell script to install BRCH-J
- *brch-j-linix-installation.zip* – Contains files common to Windows & Linux and the BRCH executable
- *brch-lx* – Fortran executable for BRCH application

Input GUI

The user may populate the Input GUI by entering the input data manually into the GUI (File|New) or by loading an existing BRCH text file (File|Open) created using the ***BRCH Input Structure*** document. The GUI also allows the user to view a graphical display of the following input parameters:

- Inflow Hydrograph (Inflow Tab)
- Area-Elevation Curve (Surface Area Tab)
- Symmetrical Cross Section (Cross Section Tab)
- Spillway Rating Curve (Spillway Tab)

The input file should be saved with a ".dat" extension. After the user specifies the file name, the output file root name is automatically set to the input file name with a ".out" extension.

The BRCH model uses two parameters to control output: *DBG* and *TPR* on the Misc Tab. The *DBG* parameter can be set to 0.0 to suppress the hydraulic information, 0.001 to show the hydraulic details at each time step, or 0.002 to show the hydraulic details at each iteration and time step. To utilize all of the output features in the GUI, set DBG=0.001. The *TPR* parameter allows the user to suppress hydraulic information until the TPR time is reached. To show the hydraulic information at all time steps, set TPR=0.

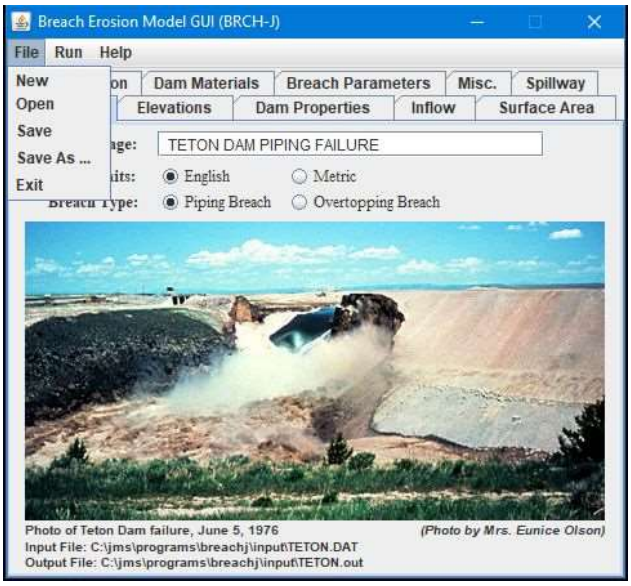

Figure 1 - BRCH GUI, File Menu

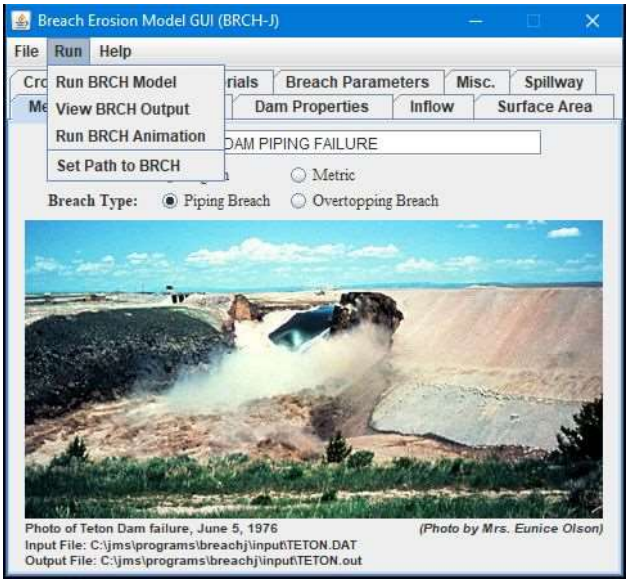

Figure 2 - BRCH GUI, Run Menu

Output GUI

After the input file has been opened and the output file name has been set, the user can run BRCH (Run|Run BRCH Model) and view the output. If the *DBG* parameter is set to 0.001, the GUI will automatically launch the BRCH Animation panel after running BRCH; otherwise, the Output Display panel will be launched.

The Output Manager associated with Breach Animation displays the following:

<u>Output Text Tab</u> - the content of the output file is displayed in text format. Clicking on the "Expand Window" bar will open the Output Text tab in a separate window sized to the full width of the output file.

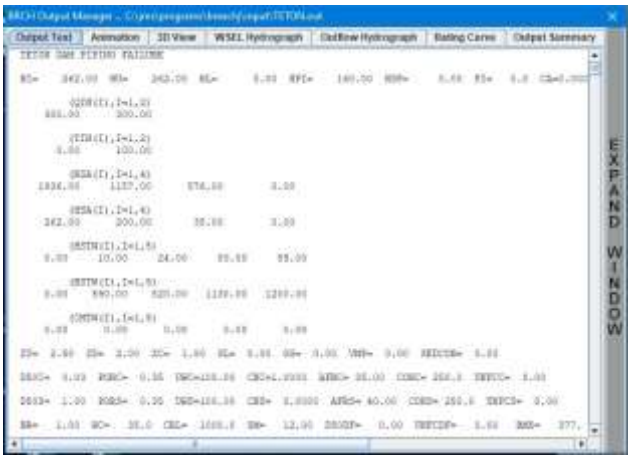

Figure 3 - BRCH GUI, Output Text Tab

Animation Tab – this tab shows the breach formation in four views:

- ***Elevation View*** – shows the breach formation looking upstream as well as the pool and tailwater elevation locations relative to the breach opening.
- ***Plan View*** – shows the path of the breach flow through the dam and the breach width as viewed from above.
- ***Cross Section View*** – shows the breach flow relative to the pool and tailwater elevations. It also shows the erosion of the dam.
- ***3-D View*** – shows an isometric view of the dam breach.

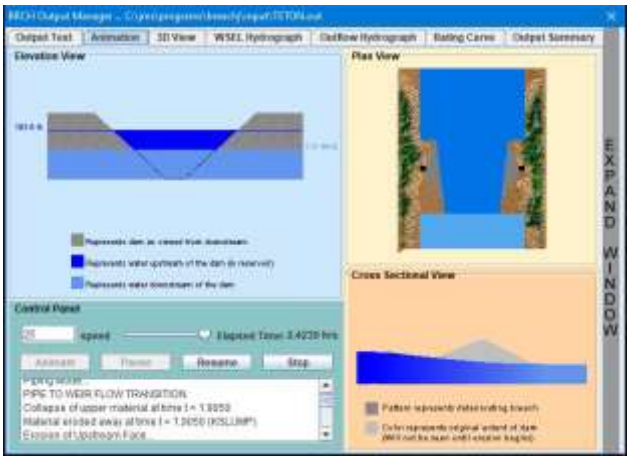

Figure 4 - Output Manager, Animation Tab

The ***Control Panel*** is used to progress the breach at each time step. The *speed* parameter determines the rate at which the animation is played. The range of the *speed* parameter is from 5 to 500; the higher the value, the faster the progression. Values greater than 15 may distort the graphs on slow computers. The buttons in the Control Panel have the following functionality:

- ***Animate*** – the animation begins, starting at the first time step in the output file.
- ***Pause*** – the animation is temporarily stopped. The user can use the slider or arrow keys to go back or forward in time to rerun the animation. All of the images will be updated to the desired time.
- ***Resume*** – the animation continues from the time on the slider to the end of the run period.
- ***Stop*** – the animation is stopped. If the *Animate* button is hit after the animation has been stopped, the animation will restart at the first time step.

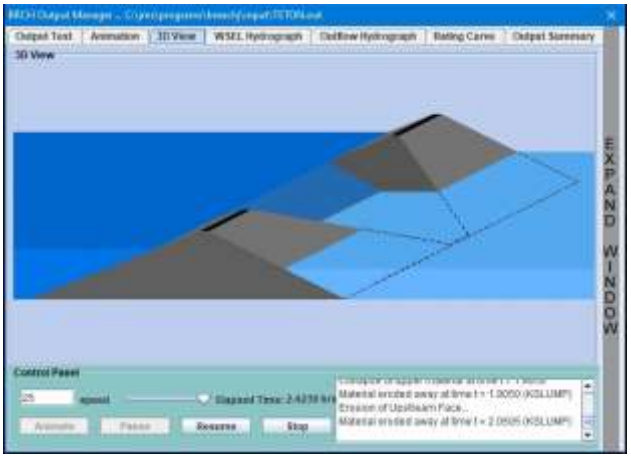

Figure 5 - Output Manager, 3-D View Tab

The status window shows the status of the breach failure throughout the breach formation process, reporting all of the failure regions.

Clicking on the ***Expand Window*** bar will animate the 3-View as well as the following graphs:

- ***Outflow Hydrograph Display*** – the spillway flow, breach outflow, and total outflow.
- ***Elevation Hydrograph Display*** – the reservoir and tailwater hydrographs.
- ***Rating Curve Display*** – the total outflow vs. tailwater elevation rating curve.

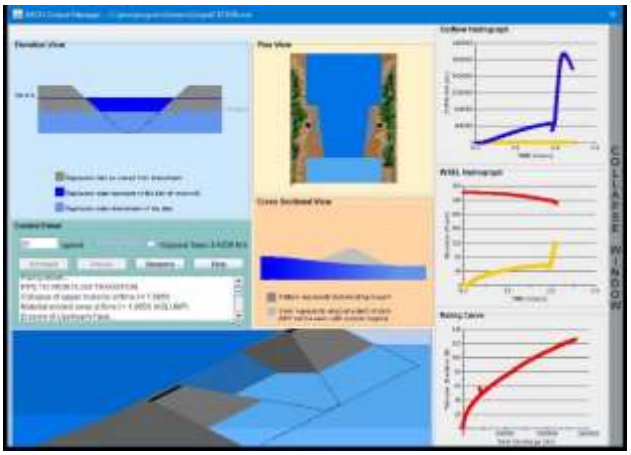

Figure 6 – Output Manager, Expanded Animation Tab

Output Summary Tab – this tab shows the summary table from the ".out" file which contains the peak outflow and the breach parameters required to run the dam break programs (e.g., SDB, FLDWAVE).

Remaining Tabs – these four tabs (i.e., 3-D View, WSEL Hydrograph, Outflow Hydrograph, and Rating Curve) display enlarged versions of the graphs and views in the Expanded Animation View.

Although a Breach Animation can take several minutes to play, the Output Display (Run|View BRCH Output) is immediate. The **Output Display Panel** shows the final graphs and tables described previously. The following tabs are shown:

- Output Text
- WSEL Hydrograph
- Outflow Hydrograph
- Rating Curve
- Output Table – this table contains all of the data used to generate the graphs.
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The Output Display Panel may also be viewed while the breach animation is running.

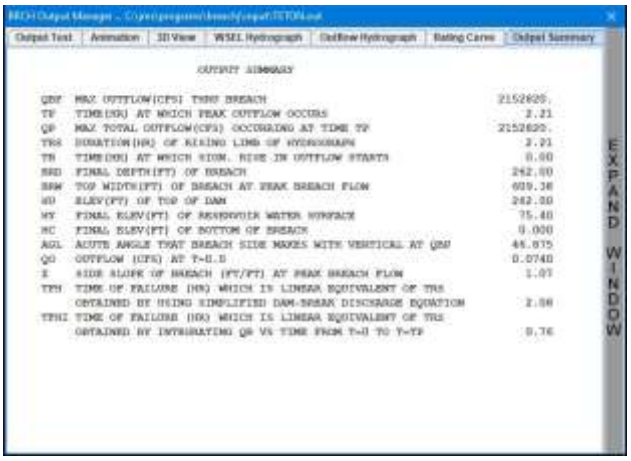

Figure 7 - Output Manager, Output Summary

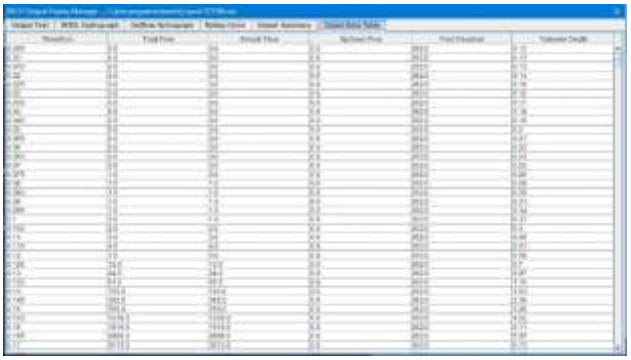

Figure 8 Output Display Manager, Output Table

Note: If BRCH-J was not installed in the default directory, the BRCH path may need to be set (Run|Set Path to BRCH) prior to running the BRCH model.

REFERENCE

[1]Fread, D.L. 1991, "BREACH, An Erosion Model for Earthen Dam Failures", Hydrology Laboratory, National Weather Service, Silver Spring, MD.