USER'S GUIDE FOR SDB GUI (SDB-J)
Modifications by Janice Sylvestre

Based on NWS Document
THE NWS SIMPLIFIED DAM-BREAK FLOOD FORECASTING MODEL[1]
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This document contains portions of the NWS SMPDBK document[1] which includes a description of the input and output variables. It contains corrections to the original documentation in addition to a description of the enhancements to the model (renamed SDB to distinguish it from the NWS model).

Application Description

The National Weather Service (NWS) developed a simplified procedure for predicting downstream flooding information produced by a dam failure. This procedure, known as the Simplified Dam Break (SMPDBK) Flood Forecasting Model, produces information needed for delineating areas endangered by dam-break floodwaters while substantially reducing the amount of time, data, and technical expertise required in employing more highly sophisticated unsteady flow routing models such as the NWS FLDWAV model. With a minimal amount of data, The NWS SMPDBK model can be used to predict the dam-break flood-wave peak flows, peak flood elevations, and peak travel times at selected downstream points. This capacity for providing results quickly and efficiently makes the NWS SMPDBK model a useful forecasting tool in a dam failure emergency when warning response time is short and data are sparse. The NWS SMPDBK model is also useful for pre-event dam failure analysis by emergency management personnel engaged in preparing disaster contingency plans when the use of other flood routing models is precluded by limited resources.

The NWS SMPDBK model retains the critical deterministic components of the numerical NWS DAMBRK model by approximating the downstream channel as a prism, including the effects of the off-channel (dead) storage where appropriate; concerning itself with only the peak flows, maximum water surface elevations and travel times; neglecting the effects of backwater from downstream bridges and dams; and utilizing dimensionless peak-flow routing graphs developed using the NWS DAMBRK model (which has been replaced by the NWS FLDWAV model). The applicability of the NWS SMPDBK model is further enhanced by its minimal data requirements.

Three steps make up the procedure used in the NWS SMPDBK model, These are: (1) calculation of the peak outflow at the dam using the temporal and geometrical description of the breach and the reservoir volume; (2) approximation of the channel downstream of the dam as a prismatic channel; and (3) calculation of dimensionless peak-flow routing parameters used with families of dimensionless routing curves to determine the peak flow at specified cross sections downstream of the dam. A detailed description of these steps is in the original NWS SMPDBK paper[1].

The RiverMechanics.net Group (RM) has enhanced the NWS SMPDBK GUI by adding the ability to export an NWS FLDWAV input data file. This feature allows the FLDWAV model to be used as easily as NWS SMPDBK while removing NWS SMPDBK's limitations including backwater effects caused by natural or man-made channel constrictions, the presence of which can substantially reduce NWS SMPDBK's accuracy.

Development History

NWS SMPDBK vs. SDB-J

The original NWS SMPDBK model was developed in 1983 and the last major NWS revision was in 1993. In 2003, NWS replaced the awkward Fortran-based interactive component of NWS SMPDBK with a JAVA Tool (NWS SMPDBK GUI) which improved data input and the graphical output display. The hydraulic component in the FORTRAN application was unchanged. The NWS SMPDBK GUI was never officially released. The last beta release was in 2005.

In 2009, the RiverMechanics.net group enhanced NWS SMPDBK GUI and renamed the application since it is no not affiliated with NWS. The FORTRAN component (hydraulic algorithms) is SDB, and the JAVA GUI component is SDB-J (Version 1.00). Since the source code in SDB is identical the code in NWS SMPDBK, the hydraulic results in the two models produced the same results. The changes in the SDB-J output display better reflected the content of the output table.

In 2018, SDB-J Version 1.0.0 underwent extensive testing using over 100 datasets. The changes made to this version (2.0.0) may result in slight changes in the output when compared to the previous version. This is due to corrections made as stated in the SDB-J Release Notes. SDB-J Version 2-0-0 (2019) is more robust than any version of the SMPDBK model since its development.

Features in SDB-J

The following enhancements have been made to SDB-J:

- ***Input GUI –*** The SMPDBK GUI allows the user to enter the data in a simpler, easier way. A debug option (JNK) has been added to SDB-J to allow the user to see hydraulic information printed at each iteration.
- ***Error Checking*** – Error checking is done to the input parameters in SDB-J to reduce computational problems.
- ***Metric Option –*** The input and output may now be displayed in metric units. The input parameters (in metric units) are converted to English units for computations. Although the computations are done in English units, all output information, including debug information, is displayed in metric units.
- ***Graphical Output Display –*** A graphical representation of the water surface profile is displayed in SDB-J along with an average symmetrical cross sectional view which includes the peak water surface and flood depth of each cross section.
- ***Export FLDWAVE File*** – SDB-J will export a FLDWAVE text file with a ".fwd" extension which can be run by the FLDWAVE model.

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\SDB-J for Windows or ~/RiverMechanics/SDB-J for Linux

Windows Installation Instructions

The installation package for SDB-J Version 2-0-0 (sdbjInstall-020419.exe) can be downloaded from the RiverMechanics.net website. When executed, the Install Shield will copy the files in Tables 1 & 2 into the RiverMechanics\SDB-J folder. The user has the option to change the path. If the path is changed, the sdb-j.bat file must be manually modified to reflect the new path location. A shortcut (SDB GUI 2019) is placed on the desktop. The user must have JAVA installed on their computer in order to run the SDB GUI.

Linux Installation Instructions

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

1. Download the sdbjLinuxInstallation020419.zip file from the RiverMechanics.net website.
2. Unzip the sdbjLinuxInstallation020419.zip file which contains the .sh installation shell script file.
3. Open a terminal session, and change to the directory containing the .sh file.
4. Type ". sdbjLinuxInstall020419.sh" (*Note: there is a space after the dot).*
5. SDB-J will be installed in the root folder ~/RiverMechanics/. All the files in Tables 1 and 2 will be copied to the SDB-J folder. If the root folder is changed, it must be created prior to running the shell script.
6. A SDB-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 **SDB GUI** image will appear on the desktop. The SDB GUI will also open.

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

- *sdbGUI*.jar – Java archive file for SDB-J application
- *sdbGUI.ico* – SDB-J icon
- *SDB GUI User's Guide.pdf* – this file
- *SDB GUI Release Notes 020419.pdf* – release notes for SDB and SDB-J
- *SDB Input Summary.pdf* – updated Input/Output summary which was extracted from the NWS SMPDBK paper (smpdbk.pdf)
- *smpdbk.pdf* – the last NWS SMPDBK documentation
- *teton.dat* – sample input data set
- *lib* – folder containing jars for graphics (collections.jar & jcchart450j.jar)

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

- *sdbjInstall020419.exe* – Installation program
- *sdb-x32.exe* – Fortran executable for SDB application (32-bit)
- *sdb-x64.exe* – Fortran executable for SDB application (64-bit)
- *sdbGUI.bat* – batch file to execute SDB-J

Table 3. Additional Files within the Linux Installation Package

- *sdbjLinuxInstall020419.zip* – Compressed file containing common files (.zip) and installation program (.sh)
- *SDB GUI Linux Installation Instructions.pdf* – instructions for Linux installation document
- *sdbjLinuxInstall020419.sh* –Shell script to install SDB-J
- *sdb-j-linux-installation.zip* – Contains files common to Windows & Linux and the SDB executable
- *sdb-lx* – Fortran executable for SDB application

Input GUI

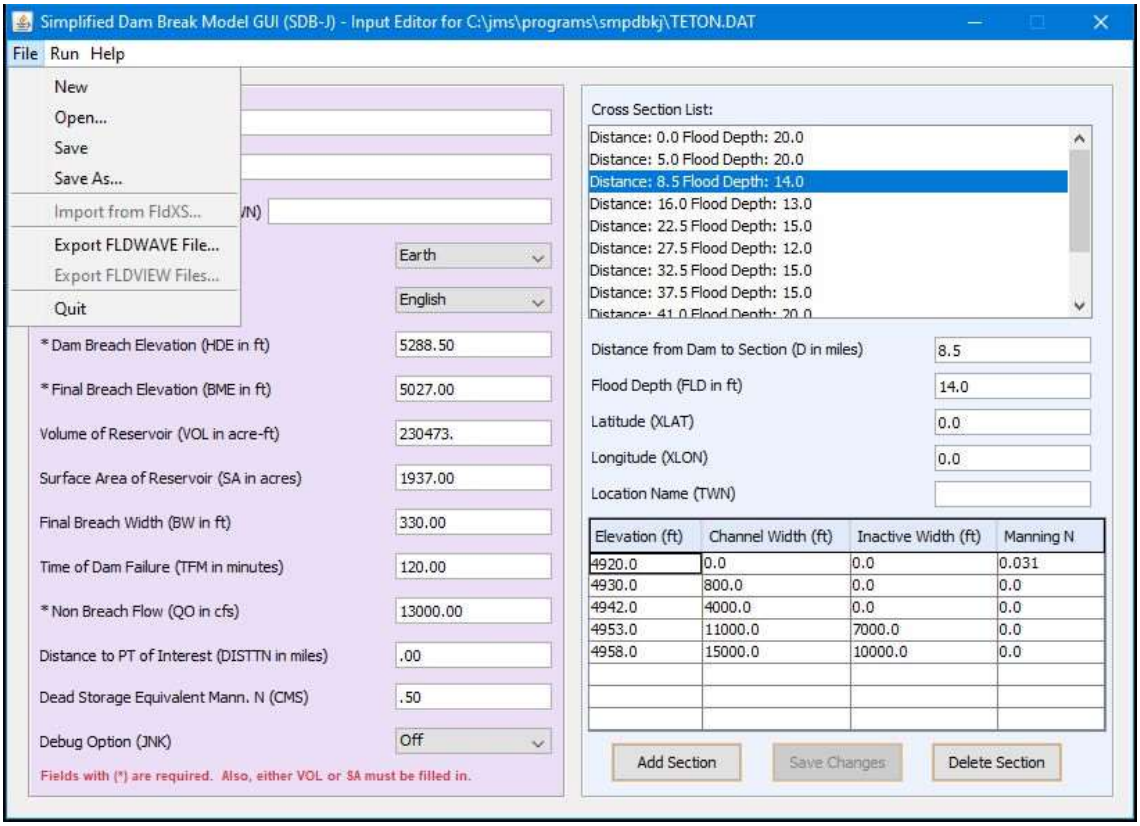
A description of the SDB input parameters is in the SDB Input Summary document. The user may populate the Input component of SDB-J (Figure 1) by entering the input data manually into the GUI (File|New) or by loading an existing SDB text file (File|Open) created using the SDB Input Summary document or created and saved previously using SDB-J. All parameters with an asterisk (*) in addition to at least two cross sections must be entered before the file can be saved. Error checking exists to ensure that real numbers are entered when appropriate. The TAB key may be used to navigate between parameters.

When entering new cross sections, the user must hit the "Add Section" button first. Each cross section must have at least two levels. All cross sections must have the same number of levels. Cross sections can be read-in in any order; they will be sorted automatically. The arrow, TAB, and ENTER keys may be used to navigate between the cross section values. The TAB key is used to navigate between the parameters.

When viewing of editing an existing cross section, select the cross section in the Cross Section List section.

Although the input can be saved to a file with or without an extension, it is recommended that a ".dat" extension be used. Error checking is done prior to saving the file to ensure that SDB can be run without input errors.

Figure 1. SDB-J Input GUI



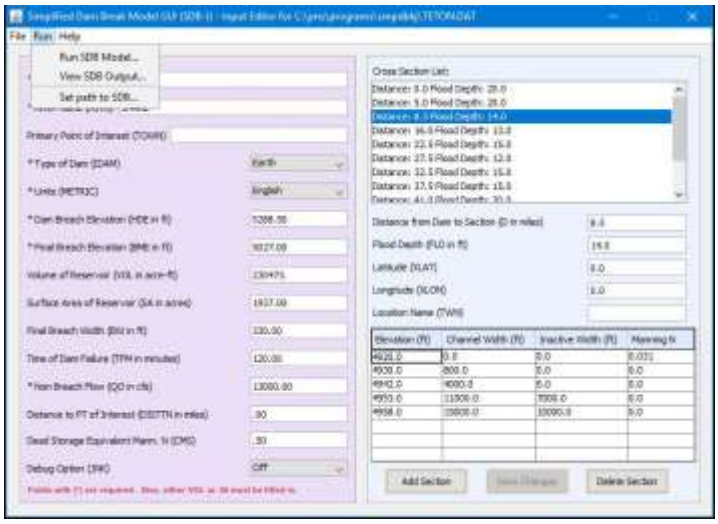
Running SDB

If an input file exists, the user can run SDB manually or by using the SDB-J Run Option. To run SDB manually, double-click on the executable file (sdb-x64.exe or sdb-x32.exe for Windows-based computers or sdb-lx for linux-based computers) located in the RiverMechanics/SDB-J folder. The user will be prompted for the input

and output file names. Although the output file name does not require a specific extension, it is recommended that a ".out" extension be used. The output file can be viewed with a text editor or using SDB-J.

If no input file has been loaded into the input GUI, the Run Option of SDB-J (Run|Run SDB Model) will prompt the user for input and output file names (Figure 2). If an input file is loaded into the Input GUI, the loaded file will be used for input, and the users will be prompted for the output filename. Error checking is done prior to running SDB. Errors and warnings will guide the user to correct the data so that a successful run is made. If SDB runs successfully, the output display manager will be shown.

Figure 2. SDB-J Input GUI Run Menu



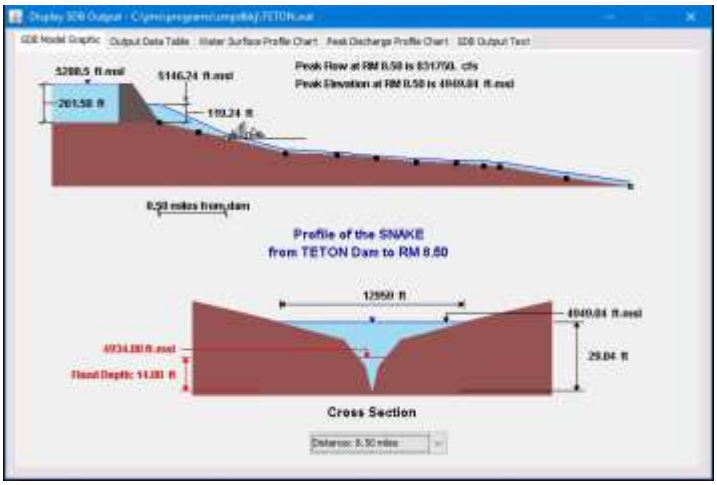
The user may view an output file that was run previously by clicking Run|View SDB Ouptut.

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

Output GUI

The SDB Output Display Manager will show the contents of the hydraulic summary table in the output text file visually as follows:

Figure 3. SDB Model Graphic



<u>SDB Model Graphic **Tab**</u> – This tab (Figure 3) shows a graphical representation of the dam and the down-stream routing reach are shown:

- Pool level before failure
- Channel invert and peak water surface profiles.
- A symmetrical cross section at each river location showing the maximum depth and the flood stage. To see additional cross sections, select the appropriate river location in the Cross Section pull-down window.

<u>Output Data Table Tab</u> – This tab (Figure 4) shows the summary table from the output text file which contains the maximum discharge and water surface profiles in addition to the times of flooding and de-flooding.

<u>Peak Water Surface Profile Chart Tab</u> – This tab (Figure 5) shows a graphical representation of the maximum water surface and the channel invert profiles.

<u>Peak Discharge Profile Chart Tab</u> - This tab (Figure 6) shows a graphical representation of the peak discharge profile.

SDB Output Text Tab – This tab (Figure 7) shows the contents of the output text file generated by SDB.

Figure 4. Output Data Table

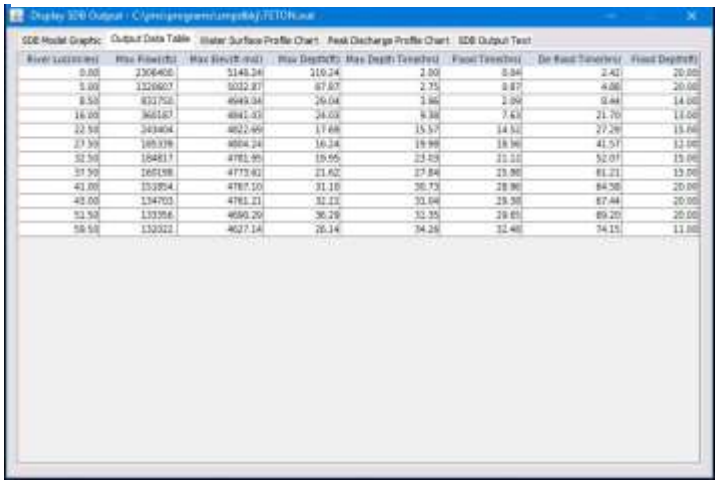


Figure 5. Peak Water Surface Table

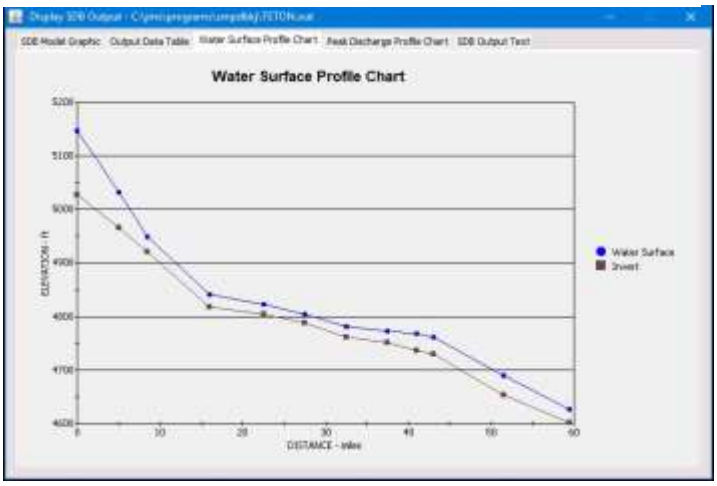


Figure 6. Peak Discharge Table

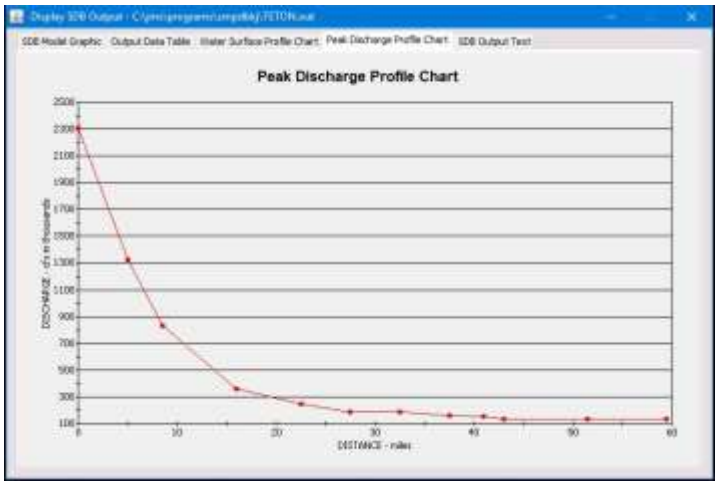
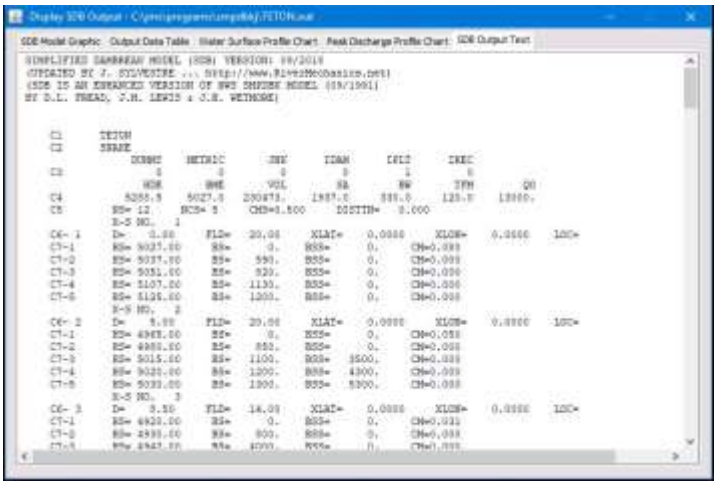


Figure 7. SDB Output Text



Exporting FLDWAVE File

SDB-J will export a FLDWAVE text file (File|Export FLDWAVE File) with a ".fwd" extension which can be run by the FLDWAVE model (Figure 1). The following assumptions have been made regarding FLDWAVE parameters. After a successful run of the FLDWAVE model with the file exported from SDB-J, these parameters should be modified.

- **TEH (DG 7)** – The run period is 1.5 times the time to peak of the downstream water level. This parameter may need to be increased to allow the falling limb of the downstream hydrograph to be reached.
- **DXM (DG 19)** – The distance interval is computed using the equation $\boldsymbol{DXM = c\,\Delta t}$ where $\boldsymbol{c}$ is the distance interval divided by the difference between the times to the peak water level at adjacent cross

sections, and Δt is the time of failure in hours (TFH)/20. The DXM values are usually much smaller than they need to be. The values should be adjusted according to the recommendations in the FLDWAVE output.

- **SAR (DG 26) vs HSAR (DG 27**) – The Surface Area – Elevation table consist of two points. This table may not adequately represent the volume of the reservoir. Preferably, the actual table should be used. If the table does not exist, it can be created by generating a table of values that result in the outflow volume matching the reservoir volume. The outflow volume is computed in FLDWAVE and shown in the output file when JNK ≥ 4. The base flow volume should be subtracted from the outflow volume before comparing it to the reservoir volume.
- **HDD (DG 28)** – The height of the dam is set equal to the pool level. If piping failure is the failure mode or if the pool level is above the dam crest, HDD should be set back to the actual top of dam elevation.
- **CLL (DG 28)** – The crest length is set equal to 3 times the height of the dam. It should be reset to the actual crest length. If piping failure is modeled as overtopping failure, the crest length should be set to the length of the dam at the pool level.
- **QTD (DG 28)** – The turbine flow is equal to the initial inflow hydrograph value.
- **ST1 (DG 58)** – The inflow hydrograph is a steady-state value equal to 1% of the peak flow. This value may be decreased if a minimum base flow is desired. Also, if the routing reach is complex and the time of failure is short, the base flow may need to be increased for stability reasons.
- **T1 (DG 59)** – The time period for the inflow hydrograph goes from 0 to TEH.

Running FLDWAVE provides instantaneous results (hydrographs, profiles, and rating curves) along the routing reach that are not available in SDB-J.

REFERENCE

[1]Fread, Danny L., Lewis, Janice M., and Wiele, Stephen M. 1991, "The NWS Simplified Dam-Break Flood Forecasting Model", Hydrology Laboratory, National Weather Service, Silver Spring, MD.