WBNM2017 NOV 2017

RELEASE NOTES FOR EXPERIENCED WBNM USERS

Introduction

These readme notes are intended as a summary description of the functionality and use of WBNM2017 and in particular the differences with WBNM2012 It assumes readers are reasonably familiar with the operation of WBNM2012. This document is not a replacement for the WBNM User or Reference Manuals.

In summary WBNM2017.exe is an upgraded extension of WBNM2012, recoded to meet the Fortran 2003/2008 standard with added functionality to support simulation of design storms in accordance with the provisions of Australian Rainfall and Runoff 2016 (AR&R 2016). This extended code supports ensemble storm analysis in accord with the requirements of AR&R 2016 for design flood estimation. It also supports the use of downloaded BOM and AR&R hub data for IFD, temporal patterns, areal reduction factors and losses, recognising the impact of pre-burst rainfall on initial losses. The functionality required to support design storms to AR&R 1987 has been retained to facilitate comparisons in design discharges. By removing the proprietary graphic display library calls (Realwin) in the 2012 model, the remaining fortran 2003/8 code is now compatible with and can be compiled for windows in both a 64 bit and 32 bit format and Linux(Ubuntu) in either format. Together with some optimisation, the code now executes faster than the 2012 code. The introduction of design storm spectrums has however substantially increased the quantum of computational effort, increasing run times and output file sizes relative to the single storm/event runs in WBNM2012.

Differences from WBNM2012

As noted above, the primary change is associated with the introduction of functionality to support design (DES16) storm simulation to AR&R 2016. Because WBNM2017 needs additional ini parameters to support this functionality, the opportunity has been taken to remove old depreciated parameters from the ini parameter list while adding new ones. WBNM2017 must therefore be run with the new GLOBAL and PROJECT.INI's included in the distribution.

Deleted INI parameters include;

- *usr_txt_editor*
- *usr_doc_viewer*
- *inp_IFDfilename*
- *dbg_edit, dbg_ifd*
- *sum_mutistorms*

Modified INI parameters include;

- *sum_catchments to sum_catchment* (singular)

New INI Parameters include;

- *Snyder_multiplier* (default of 3.0) to allow users to alter the hydrograph array sizes. Hydrograph array sizes are dynamically allocated at the outset of the run by adding the max rainfall duration to a factored estimate of natural catchment lag as estimated by Snyder. When large storage basins are present this may be insufficient to fully capture the tail causing calculated runoff volumes to be less than they should be. If this occurs users can increase the hydrograph duration by increasing the Snyder_muliplier in the project.ini file. A warning is presented in the on screen summary if runoff volume is less than 95% of the rainfall excess.
- *sum_storms;* to trigger output of a summary for each storm reflecting the critical duration – pattern -discharge at the outlet. Written optionally to the screen and QA file.
- *out_critdes*; to trigger the creation of a separate output file (project_critdes.out) where the spectrum of duration (and pattern for DES16) results can be recorded, together with a critical event summary for each subarea indicating which duration (and pattern DES16) combination produced the 'critical' design discharge.

As previously noted, <u>all</u> of the functionality of WBNM2012 is retained in WBNM2017.

Modified Runfile Version (Status block)

While WBNM2017 will run a runfile with an older version number in the status block it will provide a warning in the QA file to the effect that it is not a version 2017 runfile. Best to update the version to 2017_000 if an older runfile.

Modified Runfile Format (Surfaces block)

WBNM2017 optionally adds the ability to specify C and the ImpLagFactor globally in the Surfaces Block eg;

#####START_SURFACES_BLOCK##########|##########|##########|##########|

    0.77   1.3   0.10

   -99.90

Sub01   185.94   0.00 < no subareal C or ILF required >

Sub02   57.69   0.00

Sub03   188.88   0.00 < etc >

The old format is still accepted but may be depreciated at some point in the future.

A warning message is posted in the QA file if the old format is used, reminding users that C is the lag factor for the catchment in a natural condition. There is no data supporting spatial changes in subareal Cs other than the factors incorporated into

wbnm (urbanisation and water course improvements) so it should not be altered on a subarea by subarea basis.

Modified Runfile Format (DES87 and EMB87 Storm Block)

In order to differentiate AR&R 1987 design storm simulations from AR&R 2016 design storm simulations it was necessary to alter the design storm header line for DES87 and EMB87 design storms by adding _ARR1987 to the start and end lines eg.

#####START_DESIGN_RAIN_ARR1987

…………. Data……….

#####END_DESIGN_RAIN_ARR1987

Older design (ARR 1987) runfiles will run under WBNM2017 with this change.

Earlier storm runfiles do not normally require change. An exception arises however when the REC/DES87/EMB87 model directs flow in the topology block to SINK from more than just the bottom subarea. WBNM2017 requires the topology be structured with only one downstream SINK at the very bottom of the topology block. Having more than on SINK created a problem even in WBNM2012, in that the running area calculation at the last subarea did not sum to the whole model area. This was not of particular consequence in WBNM2012 but WBNM2017 uses the running area calculations to exclude subareas from the '*project_critdes.out*' summary tables if they have a running area greater than that of the target 'partial area check' (PAC) site. If external diversions are important in a new model or you are running a 2012 model that includes multiple SINKs, the solution is to rename all SINKS to say DUMMY or EXTERNAL and create an additional subarea with that name at the bottom of the topology block that discharges to SINK. In this way the volumes remain correct and the PAC algorithm runs as intended. If multiple SINKs are present in your runfile, an error message will be displayed on screen, indicating the running area at the last sub is not that of the total catchment and the program will terminate.

Extended Runfile Format (DES87 and DES16)

- **DES87:** Some limited extensions were made to the AR&R 1987 design storm code.
  - DES87 storms now allow -1 as the storm duration which triggers analysis of the full AR&R 1987 duration spectrum – optionally recording results for each event in the project_crit_des.out file together with a summary for all events, if activated, in the QA file). Eg
    - o #####START_DESIGN_RAIN_ARR1987
    - o 100   -1   -1.0
  - DES87 storms now allow 'GLOBAL' in the loss block to assign the following IL/CL values to all subareas. Eg

- o #####START_LOSS_RATES
- o GLOBAL   36.00   4.00   1.00
- o #####END_LOSS_RATES

- **DES16:** Most extensions were made to accommodate this new design storm
  - o DES16 storms now include a temporal pattern number to be specified in the base storm data line The following example is for a storm with 1% AEP, 720min duration, pattern 7 and ARF of 0.95.
    - ▪ #####START_DESIGN_RAIN_ARR2016
    - ▪ 1.0   720   7   0.95
  - o Both the duration and patterns can be set as spectrums by using the -1 flag eg
    - ▪ #####START_DESIGN_RAIN_ARR2016
    - ▪ 1.0   -1   -1   0.95
  - o ARF can be calculated in accordance with the AR&R 2016 procedure by also setting it to -1.0 eg (ARF is real so needs the decimal pt)
    - ▪ #####START_DESIGN_RAIN_ARR2016
    - ▪ 1.0   -1   -1   -1.0
  - o DES16 Storms are designed to draw data from a csv database of BOM IFD data for each gauge, the downloaded hub txt file for catchment and loss data generally and the downloaded point and areal temporal pattern data files. The format for including reference to these in a DES16 storm block is as follows. All referenced files should be in the runfile directory. The IFD database - patt data and cat data filenames in the runfile must exactly match those in the runfile directory (including extension)
    - ▪ #####START_DESIGN_RAIN_ARR2016
    - ▪ 1.0   -1   -1   -1.0
    - ▪ IFD_DATA_IN_DATABASE_FILE
    - ▪ Tasmanian_Rainfall_IFDdatabase.csv
    - ▪ 3
    - ▪ SorellCkBot
    - ▪ SorellCkMid
    - ▪ SorellCkTop
    - ▪ PAT_DATA_IN_REGION_FILE
    - ▪ Southern_Slopes_Tasmania_Increments.csv
    - ▪ CAT_DATA_IN_CATCHMENT_FILE
    - ▪ SorellCk_Catchment.txt
    - ▪ #####END_DESIGN_RAIN_ARR2016
  - o DES16 storms can run with specific subareal losses (as in WBNM2012) or with the 'GLOBAL' flag as described above for DES87 storm runs. DES16 storms add the ability to run with AR&R calculated losses using data from the hub by using 'ARR2016Losses' as the loss entry. eg
    - ▪ #####START_LOSS_RATES
    - ▪ ARR16LOSSES
    - ▪ #####END_LOSS_RATES

- DES16 storms can now (optionally) check ARR2016 design flow estimates at points internal to the model by referencing a Partial Area Check (PAC) subarea as an additional parameter on the first design rain parameter line. For example, to set WBNM2017 to calculate ARF and use temporal patterns for a location at SUBJ, an internal subarea in the model, the first design rain parameter line would be extended as follows;

  - #####START_DESIGN_RAIN_ARR2016
  - 1.0   -1   -1   -1.0   SubJ
  - IFD_DATA_IN_DATABASE_FILE
  - Tasmanian_Rainfall_IFDdatabase.csv
  - 3
  - SorellCkBot
  - SorellCkMid
  - SorellCkTop
  - PAT_DATA_IN_REGION_FILE
  - Southern_Slopes_Tasmania_Increments.csv
  - CAT_DATA_IN_CATCHMENT_FILE
  - SorellCk_Catchment.txt
  - #####END_DESIGN_RAIN_ARR2016

  This will produce a true ARR2016 DFE for the target SubJ (and any other sub areas with similar contributory areas). For partial area simulations WBNM only produces output in the '*project_critdes.out*' file for those subareas with contributory areas <= those of the target subarea. By progressively running storm blocks with target subareas further up the system (lesser contributory area) and progressively replacing discharges from earlier (more downstream targeted) PAC runs in the peak flow and critical combination tables with the more upstream flows, a full set of ARR2016 internal DFEs can be created. The user must be careful that the correct (Point <= 75km12, or Areal > 75Km2) temporal pattern is referenced in the associated storm block. WBNM will warn if the wrong one is referenced. As partial area effects are only important if the total catchment area is > 75km2 (triggering a change in patterns for internal areas) or the whole of catchment ARF is less than about 0.95, these limits can be used to decide when partial area effects might be significant. It is noted that the ARR 2016 reference to 1000Km2 as a guide to when these effects become significant seems too high.

- DES16 storms read various input data from files downloaded from the BOM and ARR datahub. The datahub files can be used as downloaded but the BOM IFD data needs to be converted from its (csv) table format into a one line per gauge csv database specific to wbnm. A utility will be made available in due course to download and convert the IFD data into the wbnm specific format but for now it needs to be created by adding gauge data to the provided (or copied) rainfall_IFD.csv database file. DO NOT USE

EXCELL TO DO THIS!! Excel strips the headers of the quotes that are used to define a multi character string with embedded spaces. The quotes are required to let normal (not Excel) software know these headers are a unit and not split at each space. Add gauges using Notepad or Notepad++ to avoid being Microsft(ed).

Running WBNM2017 on WINDOWS :

Make sure you have the new global.ini in the WBNM2017 directory (appropriately configured for your purposes).

Make sure you have the new project.ini in the directory of your runfile (appropriately configured).

All Fatal Errors now display on screen.

All warnings now are recorded in the QA file (so important to enable it in INI settings)

Only minor changes to the metafile.

Considerable additional output to the debug log – can be a very very large file!

Running from the command line - in a command window type :

 cd fullpath_to_my_runfiles

(eg c:\WBNM2017\SampleRunfiles) then type

 full path to_WBNM2017_var.exe <space> mymodel.wbn

(eg   c:\WBNM2017\WBNM2017_w64.exe Natural16.wbn)

Running from a batch file - (Note - relative addressing does not seem to work!)

For maximum reliability suggest formatting the batch file as follows;

REM move to the runfile drive

 Z:

REM cd to the runfiles directory on that drive

cd Z:\projects\WBNM2017\SampleRunfiles

REM run WBNM2017 with the runfile

REM runfile and PROJECT.INI are now in the current directory

Z:\projects\WBNM2017\WBNM2017_w64.exe   Natural16.wbn

The above command line can be repeated as many times as necessary.

Pause

Running Using Association

In windows the wbn runfile can be 'associated' with a program of your choice so that clicking the runfile executes that runfile with the associated program. If say WBNM2017_w64.exe is associated with files with a wbn extension, clicking on a runfile with that extension will run it with the associated engine. This is probably the most efficient approach for those windows users that are normally running only a single wbn runfile at a time.

Running WBNM2017 on LINUX/UBUNTU :

!!!! NOTE LINUX IS CASE SENSITIVE !!!!!

Make sure you have the new global.ini in the WBNM2017 directory (appropriately configured for your purposes).

Make sure you have the new project.ini in the directory of your runfile (appropriately configured).

All Fatal Errors now display on screen.

All warnings now are recorded in the QA file (so important to enable it in INI settings)

Only minor changes to the metafile.

Considerable additional output to the debug log – can be a very very large file!

Running from the command line - in a terminal window type :

 cd fullpath_to_my_runfiles

(eg cd /home/ted/projects/WBNM2017/SampleRunfiles) then type

 full path to_WBNM2017 <space> mymodel.wbn

(eg   /home/ted/projects/WBNM2017/WBNM2017_u64 Natural16.wbn)

Running from a script file - (Note - relative addressing does not work!)

For maximum reliability suggest formatting the bash script as follows;

cd to the runfiles directory

cd /home/ted/projects/WBNM2017/SampleRunfiles

run the engine with the runfile

runfile and PROJECT.INI are now in the current directory

/home/ted/projects/WBNM2017/WBNM2017_u64 Natural16.wbn

The above command line can be repeated as many times as necessary.

LIMITATIONS (WBNM2017 @ July 2017)

- No monte carlo capability exists at this time. (Future option)
- DES16 storms do not at this time accommodate AEPs rarer than 1:100 (no 200 500 2000 PMP) (ARR2016 limitation)
- Concern exists in regard to the lower duration limit of 720min for Areal Patterns in catchments approaching the lower area limit of 75km2. (ARR2016 limitation)
- The limits of the various parameters required in an ARR2016 are not well correlated. When spectrums are run the range may be significantly curtailed by these different limits from what one would expect (eg 720min lower limit for areal temporal patterns cf 1min for point). (ARR2016 limitation)
- WBNM does not currently respond when a CR is typed in response to a 'hit any key to terminate' request. To terminate type any key (but CR) and follow with a CR. (A current Portable Fortran Limitation.)

GENERAL COMMENT

There are several variants of the compiled code available

There is no major difference in speed apparent between the Windows and Linux executables but the 32 bit versions do run slightly slower and have much smaller allocatable array limits. These memory based limits may be important in running large complex models.

WBNM2017_w64.exe   (Intel fortran Windows 64 bit)

WBNM2017_w32.exe   (Intel fortran Windows 32 bit)

WBNM2017_U   (gfortran Linux/ubuntu 64/32 bit)

It is strongly suggested that the full WBNM2017_var name be used in command strings to identify what compilation variant is in use. The running code version (as distinct from compilation variant) is displayed in the on screen header text and in the QAfile.

It is recommended that you always turn on output to the QA file in your INI together with the sum_catchment (event based summary) and sum_storms (storm based summary) . The QA file is particular important as it includes any warnings encountered during the run. It is also helpful to include the echo and debug logs for a run or two when first running a new model. In WBNM2017 all file output can be optionally turned off to minimise run times for the output you need! Writing out files (particularly the debug file and to a lesser extent the meta file} does significantly extend run times.

Yours

Ted Rigby

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