W2 Version 3.6 Release Notes

February 3, 2012

The code, updates and further information on the W2 model are available from the following web page (subject to change):

http://www.ce.pdx.edu/w2

Please address questions about the code to

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W2 V3.6 Release Package

The current release of the model includes the following:

1. The w2 model and preprocessor executables, source codes, and an example application

The model source code is found in 2 files: **w2_IVF_source.zip** and **w2_generic_source.zip**. The w2 executable is in **w2_ivf.zip**. The preprocessor source code and executable is in **v36_ preprocessor.zip**. The executables (prew2_ivf.exe and w2_ivf.exe) were compiled using Intel Fortran 11 and are for 32-bit and 64-bit Windows computers. These executables need to be run in the same directory as the input files (*.npt), unless the control file specifies file locations in other directories. Also, generic FORTRAN source codes are included that the user can compile with his/her FORTRAN 90/95 compiler on another platform.

Compiler settings for the Intel Visual Fortran compiler that were used for the w2_ivf.exe 'release' executables are:

/nologo /O3 /Og /Qparallel /real_size:64 /module:"Release\\" /object:"Release\\" /libs:static /threads /winapp /c /Qopenmp-link:static

For WATER-QUALITY.F90, WQCONSTITUENTS.F90, and TRANSPORT.F90 the options were:

/nologo /Og /Qparallel /Qopenmp /real_size:64 /module:"Release\\" /object:"Release\\" /libs:static /threads /winapp /c /Qopenmp-link:static

Included in this package is another set of files in the zip file: **w2v36matfor.zip**. This is an executable and DLL files that include a PC animator that runs graphs up to 4 at a time based on input from the file graph.npt and is only for Win32 bit environments at this time. This package allows users to view during the model run a specified model state variable or derived variable and to record that movie as an AVI file for later use. See the notes included below on how to use this interface.

2. The GUI preprocessor

The GUI preprocessor is found in the file "gui.zip". There is a "setup.exe" routine that installs the Visual Basic W2 V3.6 Model Preprocessor called W2CONTROL. Once installed, the GUI preprocessor is able to aid the model user in setting up the Control File and in evaluating and changing the bathymetry of the system. This preprocessor does not automatically set-up the bathymetry of the system, nor does it provide post-processing support. A lot of effort is required to properly set-up the model bathymetry prior to using the Bathymetry editor within W2Control. Also, note that on the W2 web page there may be updates to the file “w2control.exe”. If there are, copy this new file over the one installed during the setup program. There is no need to run the setup program again. Note that there is now a separate pdf user manual for the GUI interface. The exe file, w2control, may work without going through the setup routine if you have Windows XP.

3. User’s Manual

On the web page the User’s Manual is provided in a zipped PDF file.

4. Waterbalance Utility

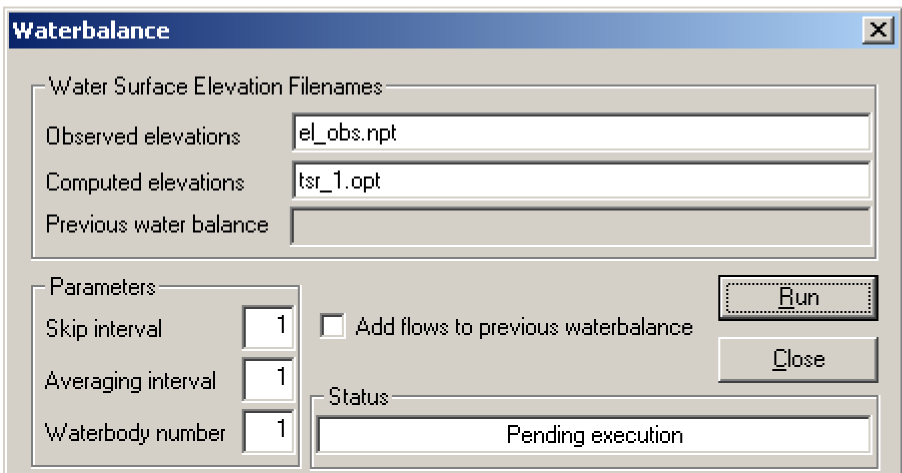
The code and executable for this are in the file “waterbalance.zip”. The purpose of this code is to approximate the waterbalance for a reservoir by computing flows (positive and negative) that will allow the model predicted water level to agree to water level data for a reservoir. See the notes included below on how to use this interface. The code has been developed for a PC.

Registration information will be required for model download in order to alert users to bug fixes and enhancements.

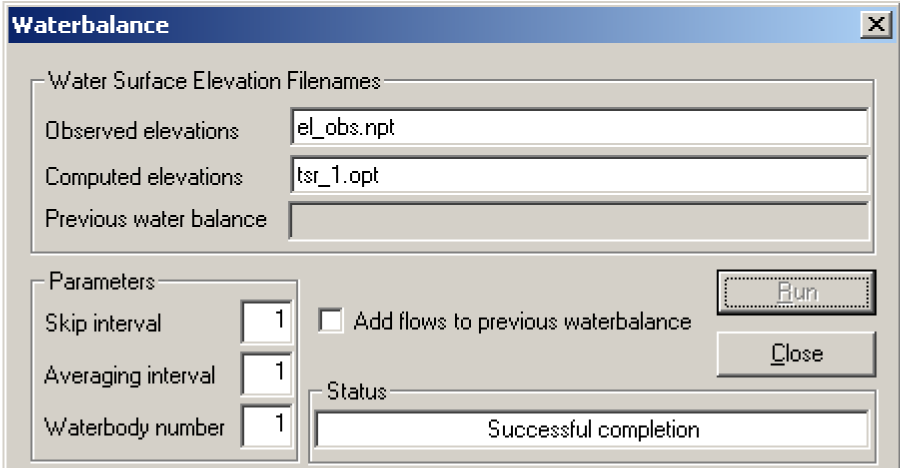
How to use the Water balance Utility

Running the water balance program

When the executable is run, a window appears that allows the following inputs (note that the executable runs under the Windows operating system only):



When the dialog box first appears, default values populate the edit boxes. The user can then edit each one if the default values are not correct. Selecting Run will run the waterbalance utility to completion as show in the following dialog box.



Observed elevations filename. This file consists of a Julian day and observed elevation as in the following example:

```
2000-2001 Oologah Reservoir observed water surface elevations

    JDAY      ELO
  90.792 195.453
  90.833 195.456
  90.875 195.459
  90.917 195.441
  90.958 195.444
  91.000 195.450
  91.042 195.441
  91.083 195.441
  91.125 195.447
  91.167 195.441
  91.208 195.444
  91.250 195.438
  91.292 195.432
```

This example is prepared similar to all other CE-QUAL-W2 time-varying inputs with a fixed format with eight columns each for the JDAY and ELO values. However, the utility will read in values using variable field lengths so long as the JDAY and ELO values are separated by a space. Data need not be at regular intervals that might cause a repeat of the same values. Better results will be obtained if the same values that repeat over a time interval are not included. Doing this compresses the time interval that the utility uses to compute the flows thus generating much larger flows over a shorter time interval, which is generally not desirable.

For example, the water surface elevation at day 91.083 should be deleted in the above example. Also note that the degree of accuracy in the observed elevations can have an impact on the computed flows. The above example will yield different water balance flows if the elevations are rounded off to two decimal places. If flows are computed at three and two decimal places for each date, the resulting files will have the following positive/negative flows at the given time intervals if repeating elevations are eliminated, assuming that the observed water surface elevation is constant at 195.453 m and 195.45, respectively, over the time period. It is up to the user to decide the necessary precision used in the observed water surface elevations.

```
   JDAY     QWB              JDAY     QWB
  90.792      +             90.792      -
  90.833      +             90.958      +
  90.875      +             91.000      -
  90.917      -             91.083      +
  90.958      +             91.125      -
  91.000      +             91.292
  91.042      -
  91.125      +
  91.167      -
  91.208      +
  91.250      -
  91.292
```

Computed elevations filename. The following shows an example output file (the ……. leader indicates that additional information is included in the time series output file, but is not included here):

```
Density placed inflow, point sink outflow
Default hydraulic coefficients
Default light absorption/extinction coefficients
Temperature simulation - run 29 turned WQ on
Tom Cole and Dottie Tillman - WES




Model run at 13:11:22 on 08/22/03
      JDAY       DLT      ELWS..............................
    92.000    456.39    195.37..............................
    93.000    952.28    195.28..............................
    94.000    494.28    195.27..............................
    95.000     34.43    195.17..............................
    96.000    170.88    195.08..............................
    97.000    211.93    194.99..............................
    98.000    255.11    194.92..............................
    99.000   1459.08    194.78..............................
```

The water balance utility reads in the [JDAY] and [ELWS] values and uses these in the water balance computations. The user must turn on time series output in the model control file and specify the segment at which the water surface elevation values are output (typically the segment next to the dam for reservoirs). Information on how to accomplish this is given in the User’s Manual under the Time Series output file discussion.

Add to previous water balance. For various reasons, the water balance utility may not perfectly close the water balance the first time through the computations. Depending upon the discrepancies between computed and observed elevations, the utility may need to be used iteratively by rerunning the model using output from the first run of the water balance utility and then rerunning the water balance utility on the water surface elevations output in the new time series file. For a system with multiple branches, each iteration of the utility and the resulting output file can be saved as a separate file that is then incorporated as a distributed tributary for branch 2, then branch 3, etc. In the case of a system with only one branch, this approach cannot be used. Rather, the new flows generated at the second iteration need to be added to the previously computed flows and incorporated as an "improved" distributed tributary inflow file. This option allows the user to continue adding flows to the same inflow file.

The computed flows are contained in the "qwb.opt" file. For most simulations, these flows will generate water surface elevations sufficiently close to the observed elevations such that further refinement is unnecessary. However, as mentioned above, the solution may need to be iterated. Rarely, manual adjustment of the generated flows may be required. This is usually only needed when observed water surface elevations change significantly over a short time period.

Previous water balance filename. If the "Add to previous water balance" option is used, you must specify the existing water balance output file for the computed flows to be added to

Skip interval. Some reservoirs have a lot of noise in the observed water surface elevation data, such as in peaking hydropower operations, and this option allows the user to specify how many observed elevations are ignored when computing the flows between observed elevations. For example, if water surface elevations are available on an hourly interval, the resulting flows generated by the water balance utility can have large + and – flows that are completely unrealistic as opposed to using observed elevations on a daily basis taken during periods of no hydropower generation. In order to smooth out the computed flows, a skip factor of 24 would result in computed flows being output on a daily basis with all of the "noise" generated by hydropower operations ignored over the 24 hour period.

Averaging interval. This option computes a running average of the water surface elevation based on the input value. This is an additional aid to smooth out water surface elevation "noise". For example, consider the case in which there is no inflow/outflow to the system, but there is considerable wind seiching. The water balance utility would compute alternating inflows and outflows from the system that, depending on the amount of seiching, could be very large when in reality there should not be any flows added to or subtracted from the system. Using a running average alone or in combination with skipping over a number of observed elevations specified in (4) can help alleviate many of the problems caused by an automated water balance computation.

Waterbody number. In the case of multiple waterbodies each of which has a separate bathymetry input file, the user must specify which waterbody (and thus which bathymetry file) the water balance is being computed for. This capability is necessary for modeling systems with multiple reservoirs.

INCORPORATING THE COMPUTED FLOWS INTO THE SIMULATION

The water balance utility can be used for lakes and reservoirs in which water surface elevations are a function of inflows and controlled outflows from the system. The utility computes the flows necessary to match observed water surface elevations (typically taken at the dam) and outputs them to the "qwb.opt" file. This file is composed of a Julian date and an inflow (m^3 sec^{-1}). The flows can be either positive or negative. Temperatures and/or constituent concentrations must also be provided in the corresponding temperature and constituent concentration input files if the computed flows are incorporated as inflows to the system. ***The water balance utility does not provide this information***, but this information needs to be provided by the user depending upon how the computed flows are incorporated into the simulation. Considerable thought should go into how best to incorporate temperature and constituent concentrations and is discussed in more detail below.

Note that negative flows use temperatures/concentrations in the waterbody when calculating the impact on the system of these flows rather than the temperatures/concentrations in the corresponding inflow temperature and constituent concentration files. This ensures that negative flows generate no change in temperature or constituent concentrations. However, positive flows can impact simulation results and care must be taken as to how the flows are incorporated into the simulation.

The flows required to complete the water balance are computed as a step function. If they are incorporated into the model as an additional inflow or outflow whose current values are being linearly interpolated, such as a branch inflow, then the resulting water balance will not be correct. Typically, the flows in the qwb.opt file are first included as a distributed tributary inflow assigned to the mainstem branch and interpolation [DTRIC] is turned "OFF". The corresponding distributed tributary inflow temperatures are usually set to air temperatures in the qdt_br1.npt file. When running water quality, care must be taken as to what constituents should be included in the corresponding inflow constituent concentration file. Typically, only DO values are included if the distributed tributary option of incorporation is used, and they are set to saturated values corresponding to the observed air temperatures. Keep in mind that if the water balance flows are incorporated as branch inflows, then the mass loading of organic matter and nutrients will be increased as well.

The branch corresponding to the distributed tributary inflow is usually assigned to the mainstem branch of a reservoir. Using a distributed tributary minimizes the impact of the flow, temperature, and/or water quality associated with the distributed tributary by distributing the flow throughout all segments in a branch weighted by surface area. Be aware that large flows as a result of large errors in inflow/outflow measurements can and have had a significant impact on temperature and water quality calibration in the surface layers. Usually, this is not a problem, but sensitivity analyses should be conducted to see if the flow and associated temperature/constituent concentrations have an impact on the simulation results. If so, then the following discussion is of particular relevance.

As emphasized previously, a great deal of thought should go into how the flows generated from the water balance utility are incorporated into the simulation. As discussed previously, these are typically incorporated as distributed tributary inflows so as to minimize the impact of the flows on the simulation. However, this may not always be the best, most accurate, or most realistic method. For example, suppose that the water balance flows are consistently negative. This would indicate that either inflows are consistently overestimated or outflows are consistently underestimated. Obviously, incorporating the flows as a positive increase in the outflows as opposed to subtracting them from the inflows can potentially have a very significant impact on simulation results. In this case, sensitivity analyses should be conducted to determine which method improves the simulation results. If, say, hypolimnetic temperatures are consistently being underestimated, then incorporating the flows into a hypolimnetic outflow could improve the simulation results. Conversely, if hypolimnetic temperatures were being overpredicted, then the inflows should probably be reduced. The key point to keep in mind is that there are a number of different ways to incorporate the computed flows, and they generally should all be tested to determine the best way to incorporate the computed flows into the simulation.

As another example, consider the case in which the generated flows are consistently positive and a branch in which sometimes significant inflows are ungauged. In this case, a sensitivity analyses should be performed to determine if incorporating the flows or a portion of the flows into the ungauged branch inflow improves model results. Oftentimes, the model can be used as a guide as to how best to incorporate the computed flows into the simulation.

REAL WORLD EXAMPLE

Walter F. George is a U.S. Army Corps of Engineer reservoir located on the Chattahoochee River in Alabama. The reservoir is operated as a peaking hydropower facility. During calibration, the model consistently underpredicted hypolimnetic temperatures by 0.5-1ºC. Wind sheltering could be adjusted to increase hypolimnetic temperatures, but this adjustment always adversely impacted thermocline depth. After considerable thought, it was concluded that including possible seepage at the dam might improve hypolimnetic temperature predictions. A portion of the distributed tributary flows were incorporated as an additional outflow at the bottom of the dam. The final value used was 5 m^3 sec^{-1}, which was less than 1% of the average outflows, and brought hypolimnetic temperatures into almost exact agreement with observed temperatures. Further investigation of the outflows revealed that during times of no power generation, an additional flow of 5.1 m^3 sec^{-1} was specified in a file that was not originally sent as part of the outflow data. Thus, the model pointed the way as to how best to incorporate the computed flows and was a surprisingly accurate indicator of what was actually occurring in the prototype.

HOW TO USE THE MATFOR GRAPHICAL INTERFACE ON A WINDOWS PC

When the executable "w2_ivf_MATFOR.exe" is used, another dialog box is presented showing dynamic animation of the model results. The dialog box below is one example of an animation for a reservoir system showing water age and temperature.

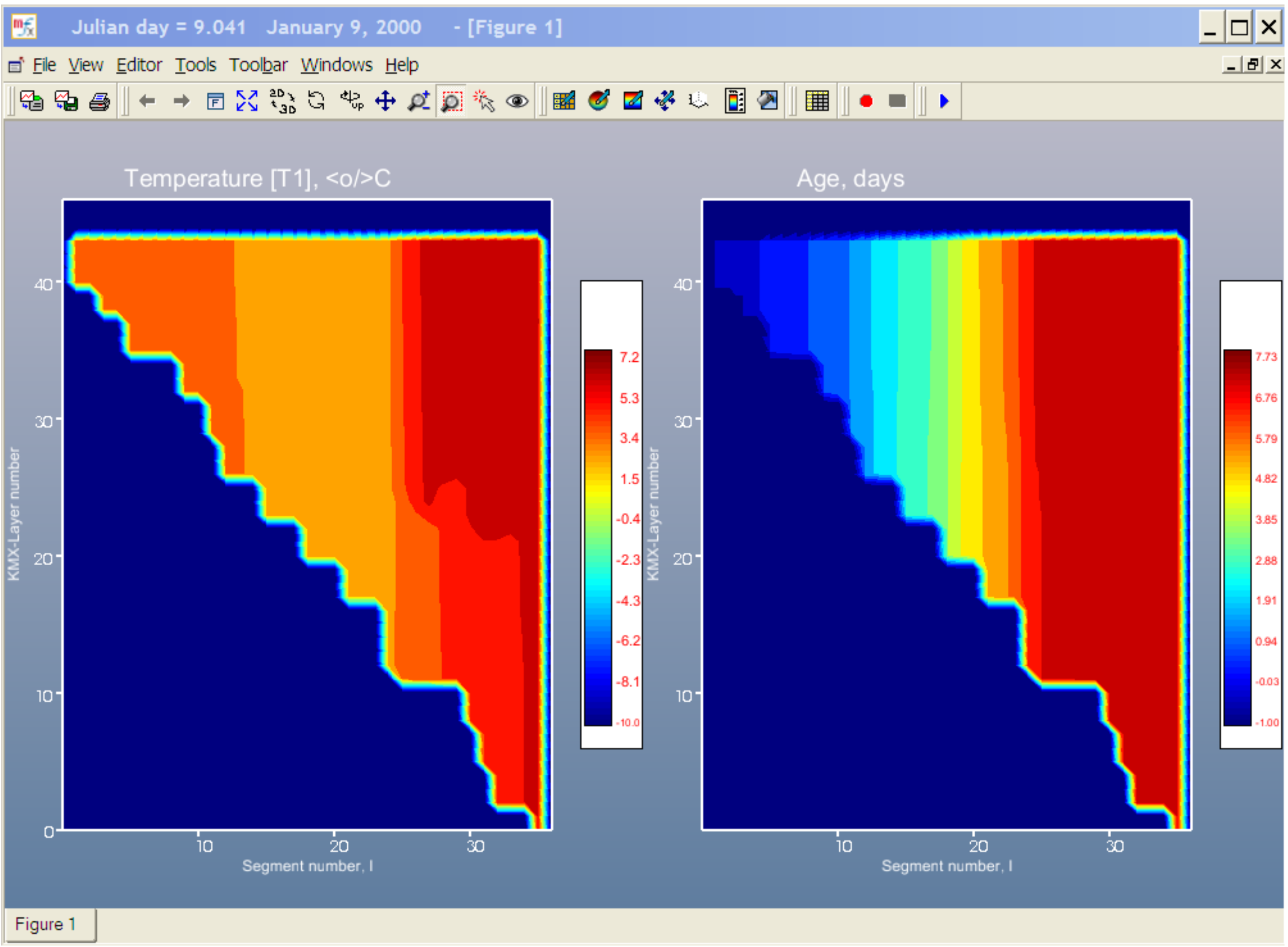


FIGURE 1. MATFOR ANIMATION OF MODEL RESULTS.

The model DLL files must be in the same directory as the executable for this animation to work. The details of the animation are set out in the graph.npt file which is described in the User Manual. For this animation though, only the first 4 graphs will be animated. If the user presses the red button for recording, the following dialog box asks the user to record the animation as an AVI file as shown in the following figure. The model user must enter a filename with the AVI file suffix to produce an AVI file for later viewing. Be careful when setting the SCR update frequency to a high frequency since the file size of the AVI file can grow significantly such that your AVI file is too big for later viewing. This can be adjusted in the control file (w2_con.npt SCR FREQ).

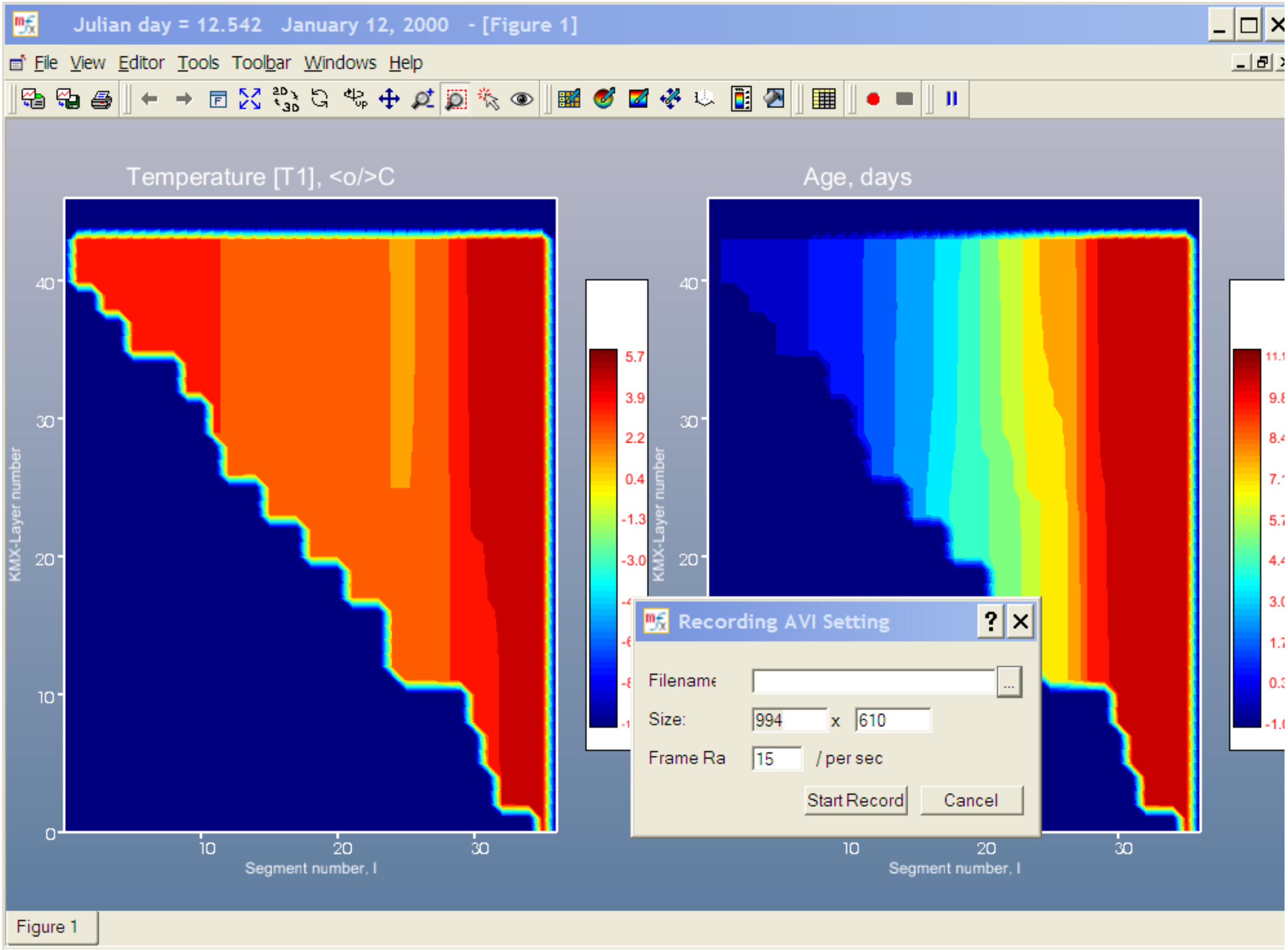


FIGURE 2 DIALOG BOX FOR RECORDING THE ANIMATION.

The “pause” button allows the user to pause the animation so that a graph can be printed. By pausing the animation, the model stops running until the play button is pushed.

W2 Model Assistance for GUI Interface

The following list provides information to assist the model user to set up the program and files.

#	Item	Description
2	GUI Interface	Install this using the setup.exe file. Also, if there is a newer w2control.exe file in the zip file on the FTP site than installed during setup, use this latest w2control.exe file by overwriting the one installed during setup. The latest file includes the latest bug fixes.

W2 Known Issues

The following list shows known bugs and issues with the current release of the code - these are being addressed in the next release:

#	Item	Description
1	Water levels in a "bowl"	If water levels decrease in a waterbody shaped like a "bowl", the removal of model layers as the water level decreases will cause the model to bomb if an upstream segment dries up.
2	Pipes under high head	The pipes algorithm does not handle high-head, dynamic flow conditions in a pipe.
3	Time step limitation in a complex system model	The time step for stability in a system model is governed by the lowest time step for numerical stability. If you have a very dynamic river with several reservoirs, the time step for the river will control. This can result in very long run times. One can still break apart the model and run the pieces separately using the WDOUT files to provide boundary conditions for downstream waterbodies.
4	Partitioning	The partitioning coefficient is currently constant for all organic and inorganic compartments
5	Internal weir at a Dam segment	Putting an internal weir at a Dam segment does not affect the outflow from the selective withdrawal structure. One must limit selective withdrawal rather than use an internal weir at the dam segment. Remember the internal weir works for the right-hand-face of a model layer.
6	W2 multiple file error check	If the model user accidentally enters duplicate file names for an input file, the w2 executable will "bomb" because it will try to read the file in more than once. The first use of the file will lock its availability for the second instance. The W2 error message that comes on the screen (traceback error) should mention the file name that has problems. The W2 preprocessor should catch this potential error.
7	Raising level of spillway/weir above grid	The preprocessor will say there is an error if the user raises the weir, spillway, gate, water level control or any other hydraulic element above the current top-of-the-grid. The w2 code will still run properly though. But more correctly, the model user should increase the DZ of the upper-most layer to a value that would eliminate this problem. But keep in mind that the segment widths from the top layer then extend upward at that same width.

#	Item	Description
8	INTERNAL WEIRS	The internal weir algorithm does not work when all vertical layers of a segment are blocked by the weir.
9	MULTIPLE DAMS INTO ONE DOWNSTREAM REACH	Currently, the code will allow one dam inflow to a downstream branch by a user-specified outflow file. The code though does allow multiple dams inflowing to a common downstream branch if the outflow is specified as a hydraulic structure.
10	PROBLEMS READING FILE IN GUI	Sometimes the control file or bathymetry file cannot be read properly by the GUI interface. This can be a result of the text editor used to produce the file. [You will find that the problem file(s) look all messed up in NOTEPAD but look OK in the PFE Editor or in WORD; and W2 usually can read them OK.] Sometimes the following will "fix" the formatting: (1) Copy the file to a UNIX workstation and copy it back. (2) Load the file in WORD as a Text file, add a space somewhere in the file (but don't mess up the file formatting), then save it as a Text file. (3) Convert all tabs to 'spaces'
11	RESTART FROM RUN WINDOW	When using the MATFOR visualization, stopping a simulation and then pressing the RESTART button results in the code exiting with an error message. This is being worked on. The RESTART capability within the control file works fine.

W2 V3.6 Bug Fixes, Enhancements, and User Manual Changes

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added
1	W2	TKE1 model	The variable STRICK was incorrectly allocated as an INTEGER rather than REAL.	10/11/2008
2	W2	PIPE	Code was streamlined in the subroutine ZBRENT where calls were made directly to CDFUNC rather than through the dummy function FUNC	10/11/2008
3	W2 Manual	Z0	The User Manual had Z0 in an incorrect line in the control file (w2_con.npt). The write up and example control file in the User Manual were corrected.	10/28/2008
4	W2	Longitudinal profile input	The W2 program did not read initial constituent concentrations in the longitudinal profile file when CCC was 'OFF'. This has been fixed.	12/4/2008
5	W2	TECPLOT output	When using TECPLOT output for multiple waterbodies, the output format did not allow loading the information into TECPLOT. Fixed.	1/26/2009

6	W2	Epiphyton input	For entering vertical profile data for periphyton, there was an index error:
			OLD CODE:
			IF (VERT_EPIPHYTON(JW,JE)) EPD(:,I,JE) = EPIVP(K,JW,JE)
			NEW CODE:
			IF (VERT_EPIPHYTON(JW,JE)) EPD(:,I,JE) = EPIVP(:,JW,JE)
				5/21/2009

7	PreW2	Constituent loads	An enhancement was added to the Preprocessor to compute loads in kg/day for all inflow, tributary and distributed tributaries. Also, these are summed up for the model application. These are shown in the file “pre.opt”. These are approximate loads since the concentration data are used to set the frequency of loading update. Flow rates at the time of the concentration input data are used to compute load.	5/21/2009

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added

8	W2	Gas transfer at spillways	A couple code fixes in the hydroinout.f90 subroutine:
			(1) CGAS needed to be initialized in some cases to CGAS=C2(K,ID,CN(JC)) prior to calling the subroutine TOTAL_DISSOLVED_GAS for use in the Butts and Evans (1983) equation:
			NEW CODE:
			`CGAS=C2(K,ID,CN(JC))  ! MM 5/21/2009`
			
			(2) Change logic in several lines from
			IF(CAC(NDO) == ' ON' to
			IF(CAC(NDO) == ' ON' .and. CN(JC)==NDO
			NEW CODE:
			`IF (CN(JC)==NDO .AND. CAC(NDO) == '      ON' .AND. GASSPC(JS) == '      ON' .AND. QSP(JS) > 0.0) THEN`
			! MM 5/21/2009
				5/21/2009

9	W2	Reaeration from dams	An error was found in the formulae from Butts and Evans (1983).
			OLD CODE:
			`DB = SAT-C`
			`DA = DB*(1.0+0.38*AGASGT(N)*BGASGT(N)*CGASGT(N)*(1.0-0.11*CGASGT(N))*(1.0+0.046*T))`
			`C  = SAT-DA`
			NEW CODE:
			`DA = SAT-C`
			`! MM 5/21/2009 DA: Deficit upstream`
			`DB = DA/(1.0+0.38*AGASSP(N)*BGASSP(N)*CGASSP(N)*(1.0-0.11*CGASSP(N))*(1.0+0.046*T))`
			`! DB: deficit downstream`
			`C  = SAT-DB`
				5/21/2009

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added
10	W2	Order of flux parameters	The order of flux parameters in the User Manual and output were incorrect. The control file has them in this order: RPOMSET CBODDK **DOAP** **DOAR** **DOEP** **DOER** DOPOM DODOM DOOM whereas the code assumed they were in this order: RPOMSET CBODDK **DOAP** **DOEP** **DOAR** **DOER** DOPOM DODOM DOOM This has been corrected. The User Manual and control file order is now reflected in the W2 code.	6/2/2009

11	Pre	False errors for inflow location	The preprocessor sometimes gave false errors in the pre.err for tributary, internal weirs, pipes, and other hydraulic features saying that the pipe or tributary was below the elevation of the bottom of the segment. The W2 model ran fine even with this error message given in the preprocessor. This has been fixed.
			
			Example of OLD CODE:
			`IF (EBTR(JT) < EL(KB(ITR(JT)+1),ITR(JT))) THEN`
			`CALL ERRORS`
			`WRITE (ERR,FMTFI) 'Inflow placement bottom elevation [EBTR=',EBTR(JT),'] < bottom active cell elevation for tributary ',JT`
			
			New CODE:
			`IF (EBTR(JT) < EL(KB(ITR(JT))+1,ITR(JT))) THEN`
			`CALL ERRORS`
			`WRITE (ERR,FMTFI) 'Inflow placement bottom elevation [EBTR=',EBTR(JT),'] < bottom active cell elevation for tributary ',JT`
				6/18/09

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added
12	Pre	Additional error checking	Additional error checking was added to help debug an error in the bathymetry file when the problem was in the branch connectivity specifically BS and BE. Also, a false error was given when the temperature had an isothermal initial condition, constituents were OFF, and an initial concentration was set to "-2". This was fixed.	6/22/09
13	Pre	Command line processing and working directory displayed for windows	In the windows version of the preprocessor, the user can now supply a command line argument that sets the working directory of the code. Hence, one does not need to copy the preprocessor into every directory. In a batch file, for example, one can execute the following command: `preW2_ivf.exe "C:\scott\w2workshop\2009 workshop\waterqual\problem3"` The preprocessor now uses the supplied directory (in double quotes) as the working directory for all the files. The command line argument has one blank space between the end of the executable and the first quote. Also, the working directory is now displayed at the top of the window. Additional checks were also added for checking the grid linkage.	9/12/09

14	W2	# of processors	The model user can now control the # of physical processors the model uses. At this point, dual-processor model runs have shown an improvement of about 20% over a single processor. But, QUAD processors usually are slower. It is recommended that NPROC be set to 2 in the control file. The user can experiment on his/her own system. If this is not set by the user or is left blank, the model still runs but sets it to 2 processors.
			
			`GRID NWB NBR IMX KMX NPROC CLOSEC`
			`1 1 23 22 2 ON`
				9/12/09

<table>
<tr><th>#</th><th>Code: W2 or PREW2 or GUI</th><th>Fix or Enhancement Type</th><th>Description of Bug/Enhancement</th><th>Date Bug Fixed or Enhancement added</th></tr>
<tr><td>15</td><td>W2</td><td>Command line processing for windows</td><td>In the windows version of the w2 model, the user can now supply a command line argument that sets the working directory of the code. Hence, one does not need to copy the model executable into every directory. In a batch file, for example, one can execute the following command:

<code>W2_ivf.exe "C:\scott\w2workshop\2009 workshop\waterqual\problem3"</code>

The w2 model now uses the supplied directory (in double quotes) as the working directory for all the files. The command line argument has one blank space between the end of the executable and the first quote. The working directory is displayed in a text box in the window.</td><td>9/12/09</td></tr>
<tr><td>16</td><td>W2</td><td>W2 window closed at end of successful execution</td><td>At the end of a windows run, the windows dialog box waits for the user to press ‘close’ to exit the window. This allows the user to examine the final run parameters. In the w2_con.npt file there is now an option to close this window when the run has completed. If this option is not set, then the dialog box will stay until the user clicks ‘close’.

This allows for efficient batch processing of the model, especially if user in conjunction with command line processing mentioned in #15.

<code>GRID NWB NBR IMX KMX</code>
<code>NPROC CLOSEC</code>
<code>1 1 23 22</code>
<code>0 ON</code>

When CLOSEC is set to ON, then the dialog box will disappear once the run finishes. If it is set to OFF, then the dialog box will remain until the user clicks ‘close’.</td><td>9/12/09</td></tr>
<tr><td>17</td><td>User Manual</td><td>Updates</td><td>Updates and changes to the control file (#13-#16) were reflected in an updated User Manual.</td><td>9/12/09</td></tr>
</table>

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added
18	GUI	Updates	The GUI was updated with the following: (1) new control file parameters NPROC and CLOSEC were added (see #14 and 16). There is also a SELECTC that will be used in V3.7 that has been included – ignore it for now. (2) The GUI also can be controlled by command line passing of the working directory and file. In a batch program or from the command line in a DOS box you can execute the GUI as follows: `"C:\scott\research\corps of engineers\tomcole\w2code\GUI36\w2control\w2control36.exe" C:\scott\w2workshop\2009 workshop\waterqual\problem1\w2_con.npt` The first string in quotes executes the GUI. The command line argument is NOT in quotes. This program was developed in VB6 and does not take quotes around the command line. Note that this is different than the FORTRAN command line argument. So the above command will open the GUI and load the control file automatically. (3) A text box now shows the file path and name of the file that you are working on (4) In file open, earlier all *.npt files were shown. Since only "w2_con.npt" files are loaded into the GUI, only the "w2_con.npt" file was shown for opening.	9/12/09

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added

19	W2	Gates, spillways, pipes	Whenever DOWN was specified for a gate, spillway or pump, the model estimated the water level at the end of the segment, rather than using the branch center water level. This is important in sloping river systems where a long segment may have a water surface elevation drop between the segment center and the edge. In the past this was computed assuming the slope of the channel. This was updated to estimate the water surface elevation using linear interpolation rather than the grid slope. Below is an example of the code fix – in this case for GATES:
			
			OLD CODE:
			`ELIU=ELWS(IUGT(JG))-SINA(JBUGT(JG))*DLX(IUGT(JG))*0.5`
			
			NEW CODE:
			`ELIU= ELWS(IUGT(JG)) + (ELWS(IUGT(JG))-ELWS(IUGT(JG)-1))/(0.5*(DLX(IUGT(JG))+DLX(IUGT(JG)-1)))*DLX(IUGT(JG))*0.5`
				9/25/09

20	W2	New executable	A new executable was made using a new release of Intel Version 11 compiler that corrected problems with Windows 7 applications.	9/25/09

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added

21	W2	ICE cover algorithm	There were a couple logic errors in the ice cover algorithm. These were corrected below:
			
			`!************** Ice thickness`
			`ICETH(I) = ICETH(I)+ICETHU+ICETH1+ICETH2`
			`IF (ICETH(I) < ICE_TOL) ICETH(I) = 0.0`
			`IF (WINTER .AND. (.NOT. ICE_IN(JB))) THEN`
			`IF (.NOT. ALLOW_ICE(I)) ICETH(I) = 0.0`
			`END IF`
			`ICE(I)   = ICETH(I) > 0.0`
			`IF (ICE(I))THEN    ! 3/27/08 SW`
			`ICESW(I) = 0.0`
			`ELSE`
			`ICESW(I) = 1.0`
			`ENDIF`
			`ICETHU   = 0.0`
			`ICETH1   = 0.0`
			`ICETH2   = 0.0`
			`IF (ICETH(I) < ICE_TOL .AND. ICETH(I) > 0.0) ICETH(I) = ICE_TOL`
			`ELSE`
			`IF(TERM_BY_TERM(JW))CALL EQUILIBRIUM_TEMPERATURE          ! SW 10/20/09 Must call this first otherwise ET and CSHE are 0`
			`HIA      = 0.2367*CSHE(I)/5.65E-8`
			`! JM 11/08 convert SI units of m/s to English (btu/ft2/d/F) and then back to SI W/m2/C`
			`!    ICETH(I) = MAX(0.0,ICETH(I)+DLT*((RIMT-ET(I))/(ICETH(I)/RK1+1.0/HIA)-(T2(KT,I)-RIMT))/RHOIRL1)     ! OLD CODE`
			`ICETH(I) = MAX(0.0,ICETH(I)+DLT*((RIMT-ET(I))/(ICETH(I)/RK1+1.0/HIA)-HWI(JW)*(T2(KT,I)-RIMT))/RHOIRL1)   ! SW 10/20/09 Revised missing HWI(JW)`
			`ICE(I)   = ICETH(I) > 0.0`
			`ICESW(I) = 1.0`
			`IF (ICE(I)) THEN`
			`!     TFLUX      = 2.392E-7*(RIMT-T2(KT,I))*BI(KT,I)*DLX(I)  ! OLD CODE`
			`TFLUX      = 2.392E-7*HWI(JW)*(RIMT-T2(KT,I))*BI(KT,I)*DLX(I) ! SW 10/20/09 Revised missing HWI(JW)`
			`TSS(KT,I)  = TSS(KT,I) +TFLUX`
			`TSSICE(JB) = TSSICE(JB)+TFLUX*DLT`
			`ICESW(I) = 0.0`
			`END IF`
			`END IF`
			`END DO`
			`END IF`
			`END IF`
				10/20/09

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added

22	W2	Gates output in QWD file	The following bug was found in defining which branch a gate was located. This affected the output for the withdrawals at a location where there were gates that were not tied to other branches.
			
			Old code:
			`JWUGT(JG) = JW`
			`      IF (IDGT(JG) > 0) THEN`
			`        DO JB=1,NBR`
			`          IF (IDGT(JG) >= US(JB) .AND. IDGT(JG) <= DS(JB)) EXIT`
			`        END DO`
			`        JBDGT(JG) = JB`
			`        DO JW=1,NWB`
			`          IF (JB >= BS(JW) .AND. JB <= BE(JW)) EXIT`
			`        END DO`
			`        JWDGT(JG) = JW`
			`      else  ! BUG FIX 9/27/07`
			`        jbdgt(jp)=1`
			`        jwdgt(jp)=1`
			`      END IF`
			
			New code:
			`JWUGT(JG) = JW`
			`      IF (IDGT(JG) > 0) THEN`
			`        DO JB=1,NBR`
			`          IF (IDGT(JG) >= US(JB) .AND. IDGT(JG) <= DS(JB)) EXIT`
			`        END DO`
			`        JBDGT(JG) = JB`
			`        DO JW=1,NWB`
			`          IF (JB >= BS(JW) .AND. JB <= BE(JW)) EXIT`
			`        END DO`
			`        JWDGT(JG) = JW`
			`      else  ! BUG FIX 9/27/07`
			`        jbdgt(jg)=1   ! SW 3/24/10`
			`        jwdgt(jg)=1   ! SW 3/24/10`
			`      END IF`
				3/24/10

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added

23	PreW2	Reading of WSC	Reading in of the WSC file was limited to only 100 dates in the preprocessor. This limitation was fixed by the code shown below:
			`!  DO J=1,100`
			`28995 continue  ! cb 3/26/10`
			`READ (NPT,'(10F8.0:/(8X,9F8.0))',END=29000) SDAY,(WSC(I),I=1,IMX)`
			`IF (SDAY <= SDAYO) THEN`
			`CALL ERRORS`
			`WRITE (ERR,'(3(A,F0.3))') 'Julian date ',SDAY,' <= previous date of ',SDAYO,' in '//WSCFN`
			`END IF`
			`DO I=1,IMX`
			`IF(WSC(I) <= 0.0)THEN`
			`CALL ERRORS`
			`WRITE (ERR,'(A,F0.3,A,I4,A)') 'Julian date ',SDAY,': WSC AT SEG(I)=',I,' <= 0.0 in '//WSCFN`
			`ENDIF`
			`IF (WSC(I) > 2.0) THEN`
			`CALL WARNINGS`
			`WRITE (WRN,'(A,F0.3,A,I4,A)') 'Julian day ',SDAY,': WSC(I) AT SEG(I)=',I,' > 2.0 in '//WSCFN`
			`END IF`
			`IF (WSC(I) > 0.0 .and. wsc(i) < 0.5) THEN`
			`CALL WARNINGS`
			`WRITE (WRN,'(A,F0.3,A,I4,A)') 'Julian day ',SDAY,': WSC(I) AT SEG(I)=',I,' < 0.5 in '//WSCFN`
			`END IF`
			`ENDDO`
			`SDAYO=SDAY`
			`! ENDDO`
			
			`go to 28995   ! cb 3/26/10`
				3/26/10

24	PreW2	Check on LAT or DOWN	Added an enhancement to do a check in case a spillway, pipe, pump, or gate was specified as 'DOWN'. In all cases where 'DOWN' is specified, the segment that the hydraulic structure originates must be at the end of a branch. Additional logic was added to check for this in all the hydraulic structures.	3/26/10
25	W2 Manual	Light extinction, ice	Added more text to the section on computation of light extinction and inserted a missing reference. Revised an equation for clarity in ICE algorithm and added more explanation on how to estimate HICE.	4/13/2010
26	W2 Manual	Precipitation input file	The units of precipitation are in m/s. The example precipitation input file was changed to more realistic values.	4/14/2010

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added

27	W2	ICE	Added code to account for the need to compute long wave radiation in case user chose the equilibrium temperature approach. Fixed subscript error in ice melt computation. Also, made the variable TICE double precision since it is assumed double precision in the call to Surface_terms.
			
			New code:
			`IF (ICE(I)) THEN`
			`TICE = TAIR(JW)`
			`DEL  = 2.0`
			`J    = 1`
			
			`if(tair(jw).ge.5.0)then  ! SW 4/19/10`
			`RANLW(JW) = 5.31E-13*(273.15+TAIR(JW))**6*(1.0+0.0017*CLOUD(JW)**2)*0.97`
			`else`
			`RANLW(JW) = 5.62E-8*(273.15+TAIR(JW))**4*(1.-0.261*exp(-7.77E-4*TAIR(JW)**2))*(1.0+0.0017*CLOUD(JW)**2)*0.97`
			`endif`
			
			`RN1=SRON(JW)/(REFL*RHOWCP)*SHADE(I)*(1.0-ALBEDO(JW))*BETAI(JW)+RANLW(JW)`
			`! SW 4/19/10`
			`DO WHILE (DEL > 1.0 .AND. J < 500)`
			`CALL SURFACE_TERMS (TICE)`
			`RN(I) = RN1-RB(I)-RE(I)-RC(I)     ! 4/19/10`
			`!  RN(I) = SRON(JW)/(REFL*RHOWCP)*SHADE(I)*(1.0-ALBEDO(JW))*BETAI(JW)+RANLW(JW)-RB(I)-RE(JW)-RC(I) ! OLD CODE`
			`DEL    = RN(I)+RK1*(RIMT-TICE)/ICETH(I)`
			`IF (ABS(DEL) > 1.0) TICE = TICE+DEL/500.0`
			`J = J+1`
			`END DO`
				4/19/10

28	W2	Evaporation	Units for EV in the SNP file were given in m/s but were actually m^3/s	4/21/10

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added

29	W2	Ice	In the ice melt algorithm, SRON should not have been divided by RHOCP in computing RN1 and DEL in the DO WHILE loop should have been ABS(DEL) rather than DEL:
			
			`RN1=SRON(JW)/REFL*SHADE(I)*(1.0-`
			`ALBEDO(JW))*BETAI(JW)+RANLW(JW)`
			`! SW 4/19/10 eliminate spurious divsion`
			`of SRO by RHOCP`
			`      DO WHILE (ABS(DEL) > 1.0 .AND. J <`
			`500)`
			`! SW 4/21/10 Should have been ABS of DEL`
			`      CALL SURFACE_TERMS (TICE)`
				4/21/2010

30	PRE	Constituent loading	The output from the preprocessor in the pre.opt file for constituent loading was in kg rather than the output header of kg/day. The output was updated to kg/day by adding the following lines of code:
			
			`cdtload(incdt(1:NACdt(Jb),Jb),jb)=cdtload`
			`(incdt(1:NACdt(Jb),Jb),jb)/(jday-tstart)`
			`! CB 5/10/10 Change units to kg/day`
			
			`ctrload(trcn(1:NACtr(Jt),Jt),jt)=ctrload(`
			`trcn(1:NACtr(Jt),Jt),jt)/(JDAY-TSTART)`
			`!CB 5/11/10 convert to units of kg/day`
				5/10/10

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added

31	W2	Gate, spillways, pipes	In the case where the user has specified that the flow is DOWN, in the case of reverse flow, the model did not assign the flow correctly if the user had no other tributaries or withdrawals specified in the control file. For this rare event, additional code was written to account for this fact. Also, a logic error was discovered in reverse flow for spillways and gates. This was corrected.
			
			New code added to hydroinout.f90:
			
			`JWW  = NWD`
			`withdrawals = jww > 0     ! 6/4/10 SW`
			`JTT  = NTR`
			`tributaries = jtt > 0          ! 6/4/10 SW`
			`JSS  = NSTR`
			`IF (SPILLWAY) THEN`
			…
			`END IF`
			`tributaries = jtt > 0     ! 6/4/10 SW`
			`withdrawals = jww > 0  ! 6/4/10 SW`
			
			`DO JW=1,NWB`
			`KT = KTWB(JW)`
			`DO JB=BS(JW),BE(JW)`
			
			New code in gate-spill-pipe.f90:
			
			For spillway:
			`IF (ISUB == 0) THEN`
			`DLEL = ELIU-ESP(JS)`
			`IF (ELID > ESP(JS)) DLEL = ELIU-ELID`
			`! SW 6/7/10`
			`IF (DLEL < 0.0) THEN`
			`DLEL    = -DLEL`
			For gates:
			`IF (A2GT(JG) == 0.0 .AND. G2GT(JG) /= 0.0)`
			`DLEL = ELIU-G2GT(JG)`
			`IF (ELID > EGT(JG)) DLEL = ELIU-ELID`
			`! SW 6/7/10`
			`IF (DLEL < 0.0) THEN`
				6/4/10

<table>
<tr><th>#</th><th>Code: W2 or PREW2 or GUI</th><th>Fix or Enhancement Type</th><th>Description of Bug/Enhancement</th><th>Date Bug Fixed or Enhancement added</th></tr>
<tr><td>32</td><td>W2</td><td>Branch intersections with multiple waterbodies</td><td>In cases where there are branch intersections between waterbodies, it was possible that the variable KBI and KB were incorrectly set. Here is the fix: Move the statement defining KBI in the subroutine init-geom.f90 to the place shown below (delete the earlier reference):

<pre>
IF (B(K,ID+1) == 0.0) B(K,ID+1) = B(K-
1,ID+1)
              IF (IEXIT == 1) EXIT
            END IF
          END IF
        END IF
      END DO
    END DO   ! SW 1/23/06
   END DO   ! SW 1/23/06
   bnew=b   ! SW 1/23/06
   KBI = KB   ! SW 10/30/2010

!**** Upstream active segment and single
layer ! 1/23/06 entire section moved SW
  DO JW=1,NWB
    KT = KTWB(JW)
    DO JB=BS(JW),BE(JW)
</pre></td><td>10/30/2010</td></tr>
<tr><td>33</td><td>W2</td><td>SS resuspension</td><td>The code index was incorrect in the loop for computing resuspension. This led in some compilers to an infinite loop.
The corrected code is shown below:

<pre>
  SSSS(KT,I,J)   =   -
SSS(J)*SS(KT,I,J)*BI(KT,I)/BH2(KT,I)+SSR
   ! DO K=KT-1,KB(I)-1
    DO   K=KT,KB(I)-1
! JP 2/3/12
      IF (SEDIMENT_RESUSPENSION(J)) THEN
</pre>
Thanks to James Pasley for this bug report/fix.</td><td>2/3/2012</td></tr>
</table>

W2 Planned Enhancements

The following list shows planned enhancements:

#	Item	Description
1	Sediment Diagenesis	Complex sediment diagenesis model
2	Simultaneous water level solution	Currently, water surface is solved branch-by-branch. The new technique will involve solving all water surfaces for the system or waterbody simultaneously.
3	W3	3D version of W2
4	Hypoheric flow algorithm	Groundwater-surface water interaction
5	Sediment channel bottom heating algorithm	Dynamic heat transfer between channel bottom and stream

Differences between Version 3.6 and Version 3.5

Version 3.6 can be run without changing any of the input files, even though the preprocessor will identify errors in the control file because of missing variables. Below is a highlighted list of locations in the file w2_con.npt where additional variables have been added. There are no other changes in the input files for Version 3.6.

The TKE algorithm has been updated with new algorithms that match experimental tank data for kinetic energy and dissipation. This is based on a Master's degree project by Sam Gould at Portland State University. A new user option is the TKE1 algorithm, in add addition to the legacy algorithm TKE. This results in several new input variables on the following line of the w2_con.npt file that are only active if TKE1 is chosen for AZC:

```
EDDY VISC     AZC   AZSLC   AZMAX      FBC        E    ARODI  STRCKLR BOUNDFR  TKECAL
WB 1           W2     IMP 1.00000        3    9.535   0.430     24.0    10.00     IMP
```

The roughness height of the water for correction of the vertical velocity wind profile is now a user-defined input, z_0. Prior to this the model had hardwired the value of z_0=0.003 m for wind speed correction at 2m (for evaporation where wind height at 2 m is typical) and z_0=0.01 m for wind at 10 m (for shear stress calculations where wind height of 10 m is typical). For consistency, both conversions now use the same value of roughness height. If the user does not specify the value of z_0 (for example if he/she leaves the spaces blank for z_0 using a V3.5 control file), the code uses 0.001 m.

```
HYD COEF       AX       DX     CBHE     TSED       FI    TSEDF    FRICC       Z0
WB 1      1.00000 1.00000 0.30000 11.5000 0.01000 1.00000     MANN    0.001
```

A new option for output is in the format required for TECPLOT. For TECPLOT animation there is only a flag in the CPL output line. This allows for easy model animation of the variables U, W, T, RHO, and all active constituents at the frequency specified by the CPL file as a function of distance and elevation.

```
CPL PLOT     CPLC     NCPL TECPLOT
WB 1           ON        1      ON
```

A new variable for determining the fraction of NO3-N that is diffused into the sediments that becomes organic matter, or SED-N was introduced. According to one study, only about 37% of NO_3-N that diffuses into the sediments becomes incorporated into organic matter in the sediments. The rest is denitrified.

```
   NITRATE     NO3DK     NO3S FNO3SED
   Wb 1         0.05      0.0    0.37
   Wb 2         0.05      0.0    0.37
```

In V3.5 the model computed an average decay coefficient of the sediments based on what was deposited. The user now has the option to dynamically compute that decay rate or to have it fixed and controlled by the model user. A new variable was introduced called DYNSEDK which is either ON/OFF to allow or not allow dynamic computation of the sediment decay rate.

```
   SEDIMENT     SEDC    PRNSC    SEDCI     SEDK     SEDS     FSOD     FSED    SEDBR DYNSEDK
   Wb 1           ON       ON      0.0      0.1      0.0      1.0      1.0    0.001     OFF
   Wb 2           ON       ON      0.0      0.1      0.0      1.0      1.0    0.001     OFF
```

The User can now specify the # of processors to use on the host computer. Most users find that setting NPROC=2 gets the best results. Sometimes setting this greater than 2 results in slower model performance. Also, the CLOSEC control closes the windows dialog box after the model completes its simulation. This is useful in using the windows version of the release code in batch simulations. These are specified in the control file as follows:

```
GRID          NWB      NBR      IMX      KMX    NPROC  CLOSEC
                1        4       66      117        2      ON
```

DIFFERENCES BETWEEN VERSION 3.2 AND VERSION 3.5

The differences in V3.5 and V3.2 input files are found in the control file: **w2_con.npt** and in the **graph.npt** file. All other files are the same between the 2 versions.

w2_con.npt

Below is an example of parts of the control file from V3.5 where all new variables are highlighted. Most of these changes have to do with the new zooplankton, macrophyte, and new state variables added to the model. See the User Manual for a list of changes between V3.2 and V 3.5 in the version history. Also there were some deletions from the V3.2 w2_con.npt file. These are shown below.

New variables added to the control file are highlighted

```
.
.
IN/OUTFL      NTR     NST     NIW     NWD     NGT     NSP     NPI     NPU
                1       1       0       0       0       0       0       0

CONSTITU      NGC     NSS     NAL     NEP    NBOD     NMC     NZP
                5       1       1       1       5       0       1

MISCELL      NDAY
              100
.
.
CST COMP      CCC    LIMC     CUF
               ON      ON      10

CST ACTIVE    CAC
TDS           OFF
Gen1           ON
Gen2          OFF
Gen3          OFF
Gen4          OFF
Gen5          OFF
ISS1          OFF
PO4           OFF
NH4           OFF
NO3           OFF
DSI           OFF
PSI           OFF
FE            OFF
LDOM          OFF
RDOM          OFF
LPOM          OFF
RPOM          OFF
BOD1          OFF
BOD2          OFF
BOD3          OFF
BOD4          OFF
BOD5          OFF
ALG1          OFF
```

```
DO            OFF
TIC           OFF
ALK           OFF
ZOO1          OFF
LDOM_P        OFF
RDOM_P        OFF
LPOM_P        OFF
RPOM_P        OFF
LDOM_N        OFF
RDOM_N        OFF
LPOM_N        OFF
RPOM_N        OFF

CST DERI   CDWBC   CDWBC   CDWBC   CDWBC   CDWBC   CDWBC   CDWBC   CDWBC   CDWBC
DOC           OFF
POC           OFF
TOC           OFF
DON           OFF
PON           OFF
TON           OFF
TKN           OFF
TN            OFF
DOP           OFF
POP           OFF
TOP           OFF
TP            OFF
APR           OFF
CHLA          OFF
ATOT          OFF
%DO           OFF
TSS           OFF
TISS          OFF
CBOD          OFF
pH            OFF
CO2           OFF
HCO3          OFF
CO3           OFF

CST FLUX   CFWBC   CFWBC   CFWBC   CFWBC   CFWBC   CFWBC   CFWBC   CFWBC   CFWBC
TISSIN        OFF
TISSOUT       OFF
PO4AR         OFF
PO4AG         OFF
PO4AP         OFF
PO4ER         OFF
PO4EG         OFF
PO4EP         OFF
PO4POM        OFF
PO4DOM        OFF
PO4OM         OFF
PO4SED        OFF
PO4SOD        OFF
PO4SET        OFF
NH4NITR       OFF
NH4AR         OFF
NH4AG         OFF
NH4AP         OFF
NH4ER         OFF
NH4EG         OFF
NH4EP         OFF
NH4POM        OFF
NH4DOM        OFF
NH4OM         OFF
```

```
NH4SED       OFF
NH4SOD       OFF
NO3DEN       OFF
NO3AG        OFF
NO3EG        OFF
NO3SED       OFF
DSIAG        OFF
DSIEG        OFF
DSIPIS       OFF
DSISED       OFF
DSISOD       OFF
DSISET       OFF
PSIAM        OFF
PSINET       OFF
PSIDK        OFF
FESET        OFF
FESED        OFF
LDOMDK       OFF
LRDOM        OFF
RDOMDK       OFF
LDOMAP       OFF
LDOMEP       OFF
LPOMDK       OFF
LRPOM        OFF
RPOMDK       OFF
LPOMAP       OFF
LPOMEP       OFF
LPOMSET      OFF
RPOMSET      OFF
CBODDK       OFF
DOAP         OFF
DOAR         OFF
DOEP         OFF
DOER         OFF
DOPOM        OFF
DODOM        OFF
DOOM         OFF
DONITR       OFF
DOCBOD       OFF
DOREAR       OFF
DOSED        OFF
DOSOD        OFF
TICAG        OFF
TICEG        OFF
SEDDK        OFF
SEDAS        OFF
SEDLPOM      OFF
SEDSET       OFF
SODDK        OFF

CST ICON   C2IWB   C2IWB   C2IWB   C2IWB   C2IWB   C2IWB   C2IWB   C2IWB   C2IWB
TDS      0.00000
Gen1     0.00000
Gen2     0.00000
Gen3     0.00000
Gen4     0.00000
Gen5     0.00000
ISS1     0.00000
PO4      0.03000
NH4      0.01000
NO3      0.30000
DSI      0.00000
PSI      0.00000
```

```
FE       0.00000
LDOM     0.10000
RDOM     0.10000
LPOM     0.10000
RPOM     0.10000
BOD1     0.00000
BOD2     0.00000
BOD3     0.00000
BOD4     0.00000
BOD5     0.00000
ALG1     0.10000
DO       12.0000
TIC      5.00000
ALK      19.8000
ZOO1      0.1000
LDOM_P    0.0005
RDOM_P    0.0005
LPOM_P    0.0005
RPOM_P    0.0005
LDOM_N    0.0080
RDOM_N    0.0080
LPOM_N    0.0080
RPOM_N    0.0080

CST PRIN  CPRWBC  CPRWBC  CPRWBC  CPRWBC  CPRWBC  CPRWBC  CPRWBC  CPRWBC  CPRWBC
TDS          OFF
Gen1          ON
Gen2         OFF
Gen3         OFF
Gen4         OFF
Gen5         OFF
ISS1         OFF
PO4          OFF
NH4          OFF
NO3          OFF
DSI          OFF
PSI          OFF
FE           OFF
LDOM         OFF
RDOM         OFF
LPOM         OFF
RPOM         OFF
BOD1         OFF
BOD2         OFF
BOD3         OFF
BOD4         OFF
BOD5         OFF
ALG1         OFF
DO           OFF
TIC          OFF
ALK          OFF
ZOO1         OFF
LDOM_P       OFF
RDOM_P       OFF
LPOM_P       OFF
RPOM_P       OFF
LDOM_N       OFF
RDOM_N       OFF
LPOM_N       OFF
RPOM_N       OFF

CIN CON   CINBRC  CINBRC  CINBRC  CINBRC  CINBRC  CINBRC  CINBRC  CINBRC  CINBRC
TDS           ON
```

```
Gen1         OFF
Gen2          ON
Gen3          ON
Gen4          ON
Gen5          ON
ISS1          ON
PO4           ON
NH4           ON
NO3           ON
DSI          OFF
PSI          OFF
FE           OFF
LDOM          ON
RDOM          ON
LPOM          ON
RPOM          ON
BOD1          ON
BOD2          ON
BOD3          ON
BOD4          ON
BOD5          ON
ALG1          ON
DO            ON
TIC           ON
ALK           ON
ZOO1         OFF
LDOM_P       OFF
RDOM_P       OFF
LPOM_P       OFF
RPOM_P       OFF
LDOM_N       OFF
RDOM_N       OFF
LPOM_N       OFF
RPOM_N       OFF

CTR CON   CTRTRC  CTRTRC  CTRTRC  CTRTRC  CTRTRC  CTRTRC  CTRTRC  CTRTRC  CTRTRC
TDS           ON      ON
Gen1         OFF     OFF
Gen2          ON      ON
Gen3          ON      ON
Gen4          ON      ON
Gen5          ON      ON
ISS1          ON      ON
PO4           ON      ON
NH4           ON      ON
NO3           ON      ON
DSI          OFF     OFF
PSI          OFF     OFF
FE           OFF     OFF
LDOM          ON      ON
RDOM          ON      ON
LPOM          ON      ON
RPOM          ON      ON
BOD1          ON      ON
BOD2          ON      ON
BOD3          ON      ON
BOD4          ON      ON
BOD5          ON      ON
ALG1          ON      ON
DO            ON      ON
TIC           ON      ON
ALK           ON      ON
ZOO1         OFF     OFF
```

```
LDOM_P          OFF       OFF
RDOM_P          OFF       OFF
LPOM_P          OFF       OFF
RPOM_P          OFF       OFF
LDOM_N          OFF       OFF
RDOM_N          OFF       OFF
LPOM_N          OFF       OFF
RPOM_N          OFF       OFF

CDT CON    CDTBRC  CDTBRC  CDTBRC  CDTBRC  CDTBRC  CDTBRC  CDTBRC  CDTBRC  CDTBRC
TDS            ON
Gen1          OFF
Gen2           ON
Gen3           ON
Gen4           ON
Gen5           ON
ISS1           ON
PO4            ON
NH4            ON
NO3            ON
DSI           OFF
PSI           OFF
FE            OFF
LDOM           ON
RDOM           ON
LPOM           ON
RPOM           ON
BOD1           ON
BOD2           ON
BOD3           ON
BOD4           ON
BOD5           ON
ALG1           ON
DO             ON
TIC            ON
ALK            ON
ZOO1          OFF
LDOM_P        OFF
RDOM_P        OFF
LPOM_P        OFF
RPOM_P        OFF
LDOM_N        OFF
RDOM_N        OFF
LPOM_N        OFF
RPOM_N        OFF

CPR CON    CPRBRC  CPRBRC  CPRBRC  CPRBRC  CPRBRC  CPRBRC  CPRBRC  CPRBRC  CPRBRC
TDS            ON
Gen1          OFF
Gen2           ON
Gen3           ON
Gen4           ON
Gen5           ON
ISS1           ON
PO4            ON
NH4            ON
NO3            ON
DSI           OFF
PSI           OFF
FE            OFF
LDOM           ON
RDOM           ON
LPOM           ON
```

```
RPOM           ON
BOD1           ON
BOD2           ON
BOD3           ON
BOD4           ON
BOD5           ON
ALG1           ON
DO             ON
TIC            ON
ALK            ON
ZOO1          OFF
LDOM_P        OFF
RDOM_P        OFF
LPOM_P        OFF
RPOM_P        OFF
LDOM_N        OFF
RDOM_N        OFF
LPOM_N        OFF
RPOM_N        OFF

EX COEF    EXH2O    EXSS    EXOM    BETA     EXC     EXIC
WB 1     0.45000 0.01000 0.40000 0.45000     OFF     OFF

ALG EX       EXA     EXA     EXA     EXA     EXA     EXA
         0.10000

ZOO EX       EXZ     EXZ     EXZ     EXZ     EXZ     EXZ
             0.2     0.2     0.2

MACRO EX     EXM     EXM     EXM     EXM     EXM     EXM
          0.0100

GENERIC    CGQ10   CG0DK   CG1DK     CGS
CG 1     0.00000 -1.0000 0.00000 0.00000
CG 2     0.00000 0.00000 0.00000 0.00000
CG 3     1.04000 0.00000 0.50000 0.00000
CG 4     0.00000 0.00000 0.00000 0.00000
CG 5     0.00000 0.00000 0.00000 0.00000

S SOLIDS     SSS   SEDRC   TAUCR
SS1      1.50000     OFF    0.00

ALGAL RATE    AG      AR      AE      AM      AS    AHSP    AHSN   AHSSI    ASAT
ALG1     2.00000 0.12000 0.02000 0.05000 0.04000 0.00500 0.00500 0.00000 50.0000

ALGAL TEMP   AT1     AT2     AT3     AT4     AK1     AK2     AK3     AK4
ALG1     5.00000 12.0000 20.0000 30.0000 0.10000 0.99000 0.99000 0.10000

ALG STOI    ALGP    ALGN    ALGC   ALGSI   ACHLA   ALPOM   ANEQN    ANPR
ALG1     0.00500 0.08000 0.45000 0.00000 65.0000 0.80000       1 0.00100

EPIPHYTE    EPIC    EPIC    EPIC    EPIC    EPIC    EPIC    EPIC    EPIC    EPIC
EPI1         OFF

EPI PRIN    EPRC    EPRC    EPRC    EPRC    EPRC    EPRC    EPRC    EPRC    EPRC
EPI1         OFF

EPI INIT   EPICI   EPICI   EPICI   EPICI   EPICI   EPICI   EPICI   EPICI   EPICI
EPI1     10.0000

EPI RATE      EG      ER      EE      EM      EB    EHSP    EHSN   EHSSI
EPI1     2.00000 0.05000 0.02000 0.05000 0.01000 0.00200 0.00200 0.00000
```

```
EPI HALF    ESAT     EHS   ENEQN    ENPR
EPI1     50.0000 40.0000       2 0.00200

EPI TEMP     ET1     ET2     ET3     ET4     EK1     EK2     EK3     EK4
EPI1     2.00000 5.00000 20.0000 30.0000 0.10000 0.99000 0.99000 0.10000

EPI STOI      EP      EN      EC     ESI   ECHLA    EPOM
EPI1     0.00500 0.08000 0.45000 0.00000 65.0000 0.80000

ZOOP RATE     ZG      ZR      ZM    ZEFF   PREFP  ZOOMIN    ZS2P
Zoo1        1.50    0.10   0.010    0.50    0.50  0.0100    0.30

ZOOP ALGP  PREFA   PREFA   PREFA   PREFA   PREFA   PREFA   PREFA   PREFA   PREFA
Zoo1        1.00    0.50    0.50

ZOOP ZOOP  PREFZ   PREFZ   PREFZ   PREFZ   PREFZ   PREFZ   PREFZ   PREFZ   PREFZ
Zoo1        0.00    0.00    0.00

ZOOP TEMP    ZT1     ZT2     ZT3     ZT4     ZK1     ZK2     ZK3     ZK4
                0.0    15.0    20.0    36.0     0.1     0.9    0.98   0.100

ZOOP STOI     ZP      ZN      ZC
         0.01500 0.08000 0.45000

MACROPHYT MACWBC  MACWBC  MACWBC  MACWBC  MACWBC  MACWBC  MACWBC  MACWBC  MACWBC
Mac1             ON     OFF     OFF

MAC PRINT MPRWBC  MPRWBC  MPRWBC  MPRWBC  MPRWBC  MPRWBC  MPRWBC  MPRWBC  MPRWBC
Mac1             ON     OFF     OFF

MAC INI  MACWBCI MACWBCI MACWBCI MACWBCI MACWBCI MACWBCI MACWBCI MACWBCI MACWBCI
Mac1     0.00000       0.1     0.5

MAC RATE      MG      MR      MM    MSAT    MHSP    MHSN    MHSC    MPOM  LRPMAC
Mac 1       0.30    0.05    0.05    30.0     0.0     0.0     0.0     0.9     0.2

MAC SED     PSED    NSED
MAC 1        0.5     0.5

MAC DIST    MBMP    MMAX
Mac 1       40.0   500.0

MAC DRAG  CDSTEM     DWV    DMSA   ANORM
Mac 1        2.0     7e4    8.00    0.80

MAC TEMP     MT1     MT2     MT3     MT4     MK1     MK2     MK3     MK4
Mac 1        7.0    15.0    24.0    34.0     0.1    0.99    0.99    0.01

MAC STOICH    MP      MN      MC
Mac 1      0.005    0.08    0.45

DOM       LDOMDK  RDOMDK   LRDDK
WB 1     0.10000 0.00100 0.00100

POM       LPOMDK  RPOMDK   LRPDK    POMS
WB 1     0.08000 0.00100 0.00100 0.10000

OM STOIC    ORGP    ORGN    ORGC   ORGSI
WB 1     0.00500 0.08000 0.45000 0.18000

OM RATE     OMT1    OMT2    OMK1    OMK2
WB 1     4.00000 30.0000 0.10000 0.99000
```

```
CBOD        KBOD    TBOD    RBOD   CBODS
BOD 1    0.04180 1.01470 1.00000     0.0
BOD 2    0.13020 1.01470 1.00000     0.0
BOD 3    0.04690 1.01470 1.00000     0.0
BOD 4    0.08800 1.01470 1.00000     0.0
BOD 5    0.05000 1.01470 1.00000     0.0

CBOD STOIC  BODP    BODN    BODC
BOD 1    0.00500 0.08000 0.45000
BOD 2    0.00500 0.08000 0.45000
BOD 3    0.00500 0.08000 0.45000
BOD 4    0.00500 0.08000 0.45000
BOD 5    0.00500 0.08000 0.45000

PHOSPHOR    PO4R   PARTP
WB 1     0.00100 0.00000

AMMONIUM    NH4R   NH4DK
WB 1     0.00100 0.50000

NH4 RATE   NH4T1   NH4T2   NH4K1   NH4K2
WB 1     5.00000 25.0000 0.10000 0.99000

NITRATE    NO3DK    NO3S
WB 1     0.05000 0.00000

NO3 RATE   NO3T1   NO3T2   NO3K1   NO3K2
WB 1     5.00000 25.0000 0.10000 0.99000

SILICA      DSIR    PSIS   PSIDK  PARTSI
WB 1     0.10000 0.00000 0.30000 0.20000

IRON         FER     FES
WB 1     0.10000 0.00000

SED CO2     CO2R
WB 1     0.10000

STOICH 1   O2NH4    O2OM
WB 1     4.57000 1.40000

STOICH 2    O2AR    O2AG
ALG1     1.10000 1.40000

STOICH 3    O2ER    O2EG
EPI1     1.10000 1.40000

STOICH 4    O2ZR
ZOO1     1.10000

STOICH 5    O2MR    O2MG
MAC1         1.1     1.4

O2 LIMIT     KDO
         0.10000

SEDIMENT    SEDC  SEDPRC   SEDCI    SEDK    SEDS    FSOD    FSED   SEDBR
WB 1          ON      ON 0.00000 0.10000     0.1 1.00000 1.00000     0.2

SOD RATE   SODT1   SODT2   SODK1   SODK2
WB 1     4.00000 30.0000 0.10000 0.99000

S DEMAND     SOD     SOD     SOD     SOD     SOD     SOD     SOD     SOD     SOD
```

```
             0.6     0.6     0.6     0.6     0.6     0.6     0.6     0.6     0.6
             0.6     0.6     0.6     0.6     0.6     0.6     0.6     0.6     0.6
             0.6     0.6     0.6     0.6     0.6     0.6     0.6     0.6     0.6
             0.6     0.6     0.6     0.6     0.6     0.6     0.6     0.6     0.6
             0.6

REAERATION  TYPE    EQN#   COEF1   COEF2   COEF3   COEF4
WB1         LAKE       6
```

<u>Lines removed from the V3.2 control file:</u> These are a result of eliminating the pumpback and line printer settings.

Here is the part of the V3.2 control file that was deleted:

```
DST TRIB    DTRC
Br 1          ON
Br 2          ON
Br 3         OFF
Br 4         OFF
Br 5         OFF
```

~~PUMPBACK   JBG   KTG   KBG   JBP   KTP   KBP~~
~~0~~

~~PRINTER   LJC~~
~~IV~~

```
HYD PRINT HPRWBC  HPRWBC  HPRWBC  HPRWBC  HPRWBC  HPRWBC  HPRWBC  HPRWBC  HPRWBC
NVIOL        OFF     OFF
U             ON      ON
```

<u>Graph.npt file changes.</u> These changes are a result of the new state variables in W2 and are highlighted below.

```
Hydrodynamic, constituent, and derived constituent names, formats, multipliers, and array viewer
controls

....................HNAME..................     FMTH   HMULT    HMIN    HMAX   HPLTC       #
Timestep violations [NVIOL]                    (I10)     1.0    -1.0     1.0     OFF       1
Horizontal velocity [U], m/s               (1PE10.1)     1.0   -.1000    0.15    OFF       2
Vertical velocity [W], m/s                 (1PE10.1)     1.0   -.1E-6   -0.01    OFF       3
Temperature [T1], <o/>C                      (F10.2)     1.0   -10.0   -26.0      ON       4
Density [RHO], g/m^3                         (F10.3)     1.0   997.0  1005.0     OFF       5
Vertical eddy viscosity [AZ], m^2/s          (F10.3)     1.0  -1E-08    0.01     OFF       6
Velocity shear stress [SHEAR], 1/s^2         (F10.3)     1.0  -1E-08    0.01     OFF       7
Internal shear [ST], m^3/s                   (F10.3)     1.0  -1E-08    0.01     OFF       8
Bottom shear [SB], m^3/s                     (F10.3)     1.0  -1E-08    0.01     OFF       9
Longitudinal momentum [ADMX], m^3/s          (F10.3)     1.0  -1E-08    0.01     OFF      10
Longitudinal momentum [DM], m^3/s            (F10.3)     1.0  -1E-08    0.01     OFF      11
Horizontal density gradient [HDG], m^3/s     (F10.3)     1.0  -1E-08    0.01     OFF      12
Vertical momentum [ADMZ], m^3/s              (F10.3)     1.0  -1E-08    0.01     OFF      13
Horizontal pressure gradient [HPG], m^3/s    (F10.3)     1.0  -1E-08    10.0     OFF      14
Gravity term channel slope [GRAV], m^3/s     (F10.3)     1.0     0.0     0.0     OFF      15

....................CNAME...................     FMTC   CMULT    CMIN    CMAX   CPLTC       #
TDS, g/m^3                                   (F10.3)     1.0    -1.0   200.0     OFF       1
Age, days                                    (F10.3)     1.0    -1.0  -200.0      ON       2
Tracer, g/m^3                                (F10.3)     1.0 -20.000   100.0     OFF       3
Bacteria, col/100ml                          (F10.3)     1.0 -20.000   100.0     OFF       4
Conductivity, mhos                           (F10.3)     1.0 -20.000   100.0     OFF       5
```

```
Chloride, mg/l                              (F10.3)     1.0 -20.000   100.0     OFF        6
ISS, g/m^3                                  (F10.3)     1.0 -20.000   100.0     OFF        7
Phosphate, g/m^3                            (F10.3)  1000.0    -1.0   500.0     OFF        8
Ammonium, g/m^3                             (F10.3)  1000.0 -0.1000   300.0     OFF        9
Nitrate-Nitrite, g/m^3                      (F10.3)     1.0 -0.1000     5.0     OFF       10
Dissolved silica, g/m^3                     (F10.3)     1.0    -1.0    10.0     OFF       11
Particulate silica, g/m^3                   (F10.3)     1.0 -0.2000    15.0     OFF       12
Total iron, g/m^3                           (F10.3)     1.0 -0.1000     2.0     OFF       13
Labile DOM, g/m^3                           (F10.3)     1.0 -0.1000    -3.0     OFF       14
Refractory DOM, g/m^3                       (F10.3)     1.0 -0.1000    -4.0     OFF       15
Labile POM, g/m^3                           (F10.3)     1.0 -0.1000    -3.0     OFF       16
Refractory POM, g/m^3                       (F10.3)     1.0 -0.1000    -4.0     OFF       17
CBOD1, g/m^3                                (F10.3)     1.0 -0.0100     3.0     OFF       18
CBOD2, g/m^3                                (F10.3)     1.0 -0.0100     3.0     OFF       19
CBOD3, g/m^3                                (F10.3)     1.0 -0.0100     3.0     OFF       20
CBOD4, g/m^3                                (F10.3)     1.0 -0.0100     3.0     OFF       21
CBOD5, g/m^3                                (F10.3)     1.0 -0.0100     3.0     OFF       22
Algae, g/m^3                                (F10.3)     1.0 -0.0100     3.0     OFF       23
Dissolved oxygen, g/m^3                     (F10.3)     1.0 -0.0100    -1.0     OFF       24
Inorganic carbon, g/m^3                     (F10.3)     1.0 -0.0100     3.0     OFF       25
Alkalinity, g/m^3                           (F10.3)     1.0 -0.0100     3.0     OFF       26
zooplankton1, mg/m^3                        (g10.3)  1000.0 -0.0100     1.0     OFF       27
LDOM P, mg/m^3                              (g10.3)  1000.0     0.0     1.0     OFF       28
RDOM P, mg/m^3                              (g10.3)  1000.0     0.0     1.0     OFF       29
LPOM P, mg/m^3                              (g10.3)  1000.0     0.0     1.0     OFF       30
RPOM P, mg/m^3                              (g10.3)  1000.0     0.0     1.0     OFF       31
LDOM N, mg/m^3                              (g10.3)  1000.0     0.0     1.0     OFF       32
RDOM N, mg/m^3                              (g10.3)  1000.0     0.0     1.0     OFF       33
LPOM N, mg/m^3                              (g10.3)  1000.0     0.0     1.0     OFF       34
RPOM N, mg/m^3                              (g10.3)  1000.0     0.0     1.0     OFF       35

....................CDNAME..................   FMTCD  CDMULT   CDMIN   CDMAX  CDPLTC        #
Dissolved organic carbon, g/m^3             (F10.3)     1.0    -1.0    25.0     OFF        1
Particulate organic carbon, g/m^3           (F10.3)     1.0    -1.0    50.0     OFF        2
Total organic carbon, g/m^3                 (F10.3)     1.0    -1.0    25.0     OFF        3
Dissolved organic nitrogen, g/m^3           (F10.3)     1.0    -1.0    25.0     OFF        4
Particulate organic nitrogen, g/m^3         (F10.3)     1.0    -1.0    25.0     OFF        5
Total organic nitrogen, g/m^3               (F10.3)     1.0    -1.0    50.0     OFF        6
Total Kheldahl Nitrogen, g/m^3              (F10.3)     1.0    -1.0    15.0     OFF        7
Total nitrogen, g/m^3                       (F10.3)     1.0    -1.0    15.0     OFF        8
Dissolved organic phosphorus, mg/m^3        (F10.3)  1000.0    -1.0    25.0     OFF        9
Particulate organic phosphorus, mg/m^3      (F10.3)  1000.0    -1.0    -1.0     OFF       10
Total organic phosphorus, mg/m^3            (F10.3)  1000.0    -1.0     5.0     OFF       11
Total phosphorus, mg/m^3                    (F10.3)  1000.0    -1.0    20.0     OFF       12
Algal production, g/m^2/day                 (F10.3)     1.0    -1.0     5.0     OFF       13
Chlorophyll a, mg/m^3                       (F10.3)     1.0    -5.0   145.0     OFF       14
Total algae, g/m^3                          (F10.3)     1.0    -1.0    60.0     OFF       15
Oxygen % Gas Saturation                     (F10.3)     1.0    -1.0    50.0     OFF       16
Total suspended Solids, g/m^3               (F10.3)     1.0    -1.0     5.0     OFF       17
Total Inorganic Suspended Solids,g/m^3      (F10.3)     1.0    -1.0    20.0     OFF       18
Carbonaceous Ultimate BOD, g/m^3            (F10.3)     1.0     5.0     9.0     OFF       19
pH                                          (F10.3)     1.0    -1.0    10.0     OFF       20
CO2                                         (F10.3)     1.0    -1.0    10.0     OFF       21
HCO3                                        (F10.3)     1.0    -1.0    10.0     OFF       22
CO3                                         (F10.3)     0.0     0.0     0.0     OFF       23
```

DIFFERENCES BETWEEN VERSION 3.1 AND VERSION 3.2

There are minor differences in 2 input files between the 2 versions: **w2_con.npt** and the **graph.npt** file. All other files are the same between the 2 versions.

w2_con.npt

The only section where there is a slight difference in the control file is in the section where the inorganic suspended solids group settling velocities are entered. In Version 3.1, this section looks like this:

```
ALG EX       EXA     EXA     EXA     EXA     EXA     EXA
         0.10000

GENERIC    CGQ10   CG0DK   CG1DK     CGS
CG 1     0.00000 -1.0000 0.00000 0.00000
CG 2     0.00000 0.00000 0.00000 0.00000
CG 3     1.04000 0.00000 0.50000 0.00000
CG 4     0.00000 0.00000 0.00000 0.00000
CG 5     0.00000 0.00000 0.00000 0.00000

S SOLIDS     SSS     SSS     SSS     SSS     SSS     SSS     SSS     SSS     SSS
         1.50000

ALGAL RATE    AG      AR      AE      AM      AS    AHSP    AHSN   AHSSI    ASAT
ALG1     2.00000 0.12000 0.02000 0.05000 0.04000 0.00500 0.00500 0.00000 50.0000
```

In Version 3.2, there is now a sediment resuspension capability for wind driven resuspension along the shores of lakes and reservoirs. The Version 3.2 control file has the following lines in this same section of the control file:

```
ALG EX       EXA     EXA     EXA     EXA     EXA     EXA
         0.10000

GENERIC    CGQ10   CG0DK   CG1DK     CGS
CG 1     0.00000 -1.0000 0.00000 0.00000
CG 2     0.00000 0.00000 0.00000 0.00000
CG 3     1.04000 0.00000 0.50000 0.00000
CG 4     0.00000 0.00000 0.00000 0.00000
CG 5     0.00000 0.00000 0.00000 0.00000

S SOLIDS     SSS   SEDRC   TAUCR
SS1      1.50000     OFF    0.00

ALGAL RATE    AG      AR      AE      AM      AS    AHSP    AHSN   AHSSI    ASAT
ALG1     2.00000 0.12000 0.02000 0.05000 0.04000 0.00500 0.00500 0.00000 50.0000
```

For Version 3.2, SSS is the settling velocity for particle group 1, SEDRC is the control which turns ON or OFF sediment resuspension, and TAUCR is the critical shear stress at which resuspension occurs. For Version 3.2, each line represents 1 SS group, while in Version 3.1, each group settling velocity is in the next 8 columns moving across the page.

graph.npt

The graph file controls output formatting and the graphing parameters used in Array Viewer (only for the PC platform). The files have been rearranged significantly. A Version 3.1 graph file is shown below:

```
Constituent, hydrodynamic, and derived constituent names, formats, multipliers, and array viewer
controls

...................CNAME...................   CMULT    CMIN    CMAX   CPLTC       #
TDS g/m^3 or Salinity kg/m^3                 1.00000 -1.0000 200.000     OFF       1
Generic Constituent,g/m^3, #1                1.00000 -1.0000 -200.00      ON       2
Generic Constituent,g/m^3, #2                1.00000 -1.0000 1000.00     OFF       3
Generic Constituent,g/m^3, #3                1.00000 -1.0000 5.00000     OFF       4
Generic Constituent,g/m^3, #4                1.00000 -1.0000 -300.00     OFF       5
Generic Constituent,g/m^3, #5                1.00000 -1.0000 -3.0000     OFF       6
Suspended solids,g/m^3, #1                   1.00000 -1.0000 15.0000     OFF       7
Phosphate, g/m^3                             1000.00 -1.0000 -50.000     OFF       8
Ammonium,  g/m^3                             1000.00 -0.1000 -300.00     OFF       9
Nitrate-Nitrite, g/m^3                       1.00000 -0.1000 -5.0000     OFF      10
Dissolved silica, g/m^3                      1.00000 -1.0000 10.0000     OFF      11
Particulate silica, g/m^3                    1.00000 -0.2000 15.0000     OFF      12
Total iron, g/m^3                            1.00000 -0.1000 2.00000     OFF      13
Labile DOM, g/m^3                            1.00000 -0.1000 -3.0000     OFF      14
Refractory DOM, g/m^3                        1.00000 -0.1000 4.00000     OFF      15
Labile POM, g/m^3                            1.00000 -0.1000 3.00000     OFF      16
Refractory POM, g/m^3                        1.00000 -0.1000 4.00000     OFF      17
CBOD, g/m^3,     #1                          1.00000 -0.1000 10.0000     OFF      18
CBOD, g/m^3,     #2                          1.00000 -0.1000 10.0000     OFF      19
CBOD, g/m^3,     #3                          1.00000 -0.1000 10.0000     OFF      20
CBOD, g/m^3,     #4                          1.00000 -0.1000 10.0000     OFF      21
CBOD, g/m^3,     #5                          1.00000 -0.1000 10.0000     OFF      22
Algae,  g/m^3,      #1                       1.00000 -0.0100 -3.0000     OFF      23
Dissolved oxygen, g/m^3                      1.00000 -2.0000 15.0000     OFF      24
Inorganic carbon, g/m^3                      1.00000 -1.0000 10.0000     OFF      25
Alkalinity, g/m^3                            1.00000 -1.0000 200.000     OFF      26

...................HNAME..................     HFMT    HMIN    HMAX   HPLTC       #
Timestep violations [NVIOL]                  (F10.0) -1.0000  100000     OFF       1
Horizontal velocity [U], m/s               (1PE10.1) -0.0100 0.10000      ON       2
Vertical velocity [W], m/s                 (1PE10.1)-.10E-06 0.01000     OFF       3
Temperature [T1], <o/>C                      (F10.2) -2.0000 -30.000      ON       4
Density [RHO], g/m^3                         (F10.2) 997.000 1005.00     OFF       5
Vertical eddy viscosity [AZ], m^2/s        (1PE10.1)  -1E-08 0.00100     OFF       6
Velocity shear stress [SHEAR], 1/s^2       (1PE10.1)  -1E-08 0.01000     OFF       7
Internal shear [ST], m^3/s                 (1PE10.1)  -1E-08 0.01000     OFF       8
Bottom shear [SB], m^3/s                   (1PE10.1)  -1E-08 0.01000     OFF       9
Longitudinal momentum [ADMX], m^3/s        (1PE10.1)  -1E-08 0.01000     OFF      10
Longitudinal momentum [DM], m^3/s          (1PE10.1)  -1E-08 0.01000     OFF      11
Horizontal density gradient [HDG], m^3/s   (1PE10.1)  -1E-08 0.01000     OFF      12
Vertical momentum [ADMZ], m^3/s            (1PE10.1)  -1E-08 0.01000     OFF      13
Horizontal pressure gradient [HPG], m^3/s  (1PE10.1)  -1E-08 0.01000     OFF      14
Gravity term channel slope [GRAV], m^3/s   (1PE10.1)  -1E-08 10.0000     OFF      15

...................CDNAME..................  CDMULT   CDMIN   CDMAX  CDPLTC       #
Dissolved organic carbon, g/m^3              1.00000 -1.0000 3.00000     OFF       1
Particulate organic carbon, g/m^3            1.00000 -1.0000 25.0000     OFF       2
Total organic carbon, g/m^3                  1.00000 -1.0000 50.0000     OFF       3
Dissolved organic nitrogen, g/m^3            1.00000 -1.0000 25.0000     OFF       4
Particulate organic nitrogen, g/m^3          1.00000 -1.0000 25.0000     OFF       5
Total organic nitrogen, g/m^3                1.00000 -1.0000 25.0000     OFF       6
Total Kheldahl Nitrogen, g/m^3               1.00000 -1.0000 5.00000     OFF       7
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Total nitrogen, g/m^3	1.00000	-1.0000	50.0000	OFF	8
Dissolved organic phosphorus, mg/m^3	1000.00	-1.0000	15.0000	OFF	9
Particulate organic phosphorus, mg/m^3	1000.00	-1.0000	15.0000	OFF	10
Total organic phosphorus, mg/m^3	1000.00	-1.0000	25.0000	OFF	11
Total phosphorus, mg/m^3	1000.00	-1.0000	-1.0000	OFF	12
Algal production, g/m^2/day	1.00000	-1.0000	5.00000	OFF	13
Chlorophyll a, mg/m^3	1000.00	-1.0000	-70.000	OFF	14
Total algae, g/m^3	1.00000	-1.0000	5.00000	OFF	15
Oxygen % Gas Saturation	1.00000	-5.0000	145.000	OFF	16
Total suspended Solids, g/m^3	1.00000	-1.0000	60.0000	OFF	17
Total Inorganic Suspended Solids,g/m^3	1.00000	-1.0000	50.0000	OFF	18
Carbonaceous Ultimate BOD, g/m^3	1.00000	-1.0000	20.0000	OFF	19
pH	1.00000	6.00000	9.00000	OFF	20
CO2	1.00000	-1.0000	10.0000	OFF	21
HCO3	1.00000	-1.0000	10.0000	OFF	22
CO3	1.00000	-1.0000	10.0000	OFF	23

An example of the same graph file but for Version 3.2 is shown below:

Hydrodynamic, constituent, and derived constituent names, formats, multipliers, and array viewer controls

...................HNAME...................	FMTH	HMULT	HMIN	HMAX	HPLTC	#
Timestep violations [NVIOL]	(I10)	1.0	-1.0	1.0	OFF	1
Horizontal velocity [U], m/s	(Z10.8)	1.0	-.1000	0.15	ON	2
Vertical velocity [W], m/s	(Z10.8)	1.0	-.1E-6	-0.01	OFF	3
Temperature [T1], <o/>C	(Z10.8)	1.0	-10.0	-26.0	ON	4
Density [RHO], g/m^3	(Z10.8)	1.0	997.0	1005.0	OFF	5
Vertical eddy viscosity [AZ], m^2/s	(Z10.8)	1.0	-1E-08	0.01	OFF	6
Velocity shear stress [SHEAR], 1/s^2	(Z10.8)	1.0	-1E-08	0.01	OFF	7
Internal shear [ST], m^3/s	(Z10.8)	1.0	-1E-08	0.01	OFF	8
Bottom shear [SB], m^3/s	(Z10.8)	1.0	-1E-08	0.01	OFF	9
Longitudinal momentum [ADMX], m^3/s	(Z10.8)	1.0	-1E-08	0.01	OFF	10
Longitudinal momentum [DM], m^3/s	(Z10.8)	1.0	-1E-08	0.01	OFF	11
Horizontal density gradient [HDG], m^3/s	(Z10.8)	1.0	-1E-08	0.01	OFF	12
Vertical momentum [ADMZ], m^3/s	(Z10.8)	1.0	-1E-08	0.01	OFF	13
Horizontal pressure gradient [HPG], m^3/s	(Z10.8)	1.0	-1E-08	10.0	OFF	14
Gravity term channel slope [GRAV], m^3/s	(Z10.8)	1.0	0.0	0.0	OFF	15

...................CNAME...................	FMTC	CMULT	CMIN	CMAX	CPLTC	#
TDS, g/m^3	(Z10.8)	1.0	-1.0	200.0	OFF	1
Age, days	(Z10.8)	1.0	-1.0	-200.0	ON	2
Tracer, g/m^3	(Z10.8)	1.0	-20.000	100.0	OFF	3
Bacteria, col/100ml	(Z10.8)	1.0	-20.000	100.0	OFF	4
Conductivity, mhos	(Z10.8)	1.0	-20.000	100.0	OFF	5
Chloride, mg/l	(Z10.8)	1.0	-20.000	100.0	OFF	6
ISS, g/m^3	(Z10.8)	1.0	-20.000	100.0	OFF	7
Phosphate, g/m^3	(Z10.8)	1000.0	-1.0	500.0	OFF	8
Ammonium, g/m^3	(Z10.8)	1000.0	-0.1000	300.0	OFF	9
Nitrate-Nitrite, g/m^3	(Z10.8)	1.0	-0.1000	5.0	OFF	10
Dissolved silica, g/m^3	(Z10.8)	1.0	-1.0	10.0	OFF	11
Particulate silica, g/m^3	(Z10.8)	1.0	-0.2000	15.0	OFF	12
Total iron, g/m^3	(Z10.8)	1.0	-0.1000	2.0	OFF	13
Labile DOM, g/m^3	(Z10.8)	1.0	-0.1000	-3.0	OFF	14
Refractory DOM, g/m^3	(Z10.8)	1.0	-0.1000	-4.0	OFF	15
Labile POM, g/m^3	(Z10.8)	1.0	-0.1000	-3.0	OFF	16
Refractory POM, g/m^3	(Z10.8)	1.0	-0.1000	-4.0	OFF	17
CBOD1, g/m^3	(Z10.8)	1.0	-0.0100	3.0	OFF	18
CBOD2, g/m^3	(Z10.8)	1.0	-0.0100	3.0	OFF	19
CBOD3, g/m^3	(Z10.8)	1.0	-0.0100	3.0	OFF	20
CBOD4, g/m^3	(Z10.8)	1.0	-0.0100	3.0	OFF	21
CBOD5, g/m^3	(Z10.8)	1.0	-0.0100	3.0	OFF	22

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Algae, g/m^3                              (Z10.8)     1.0 -0.0100     3.0     OFF      23
Dissolved oxygen, g/m^3                   (Z10.8)     1.0 -0.0100    -1.0     OFF      24
Inorganic carbon, g/m^3                   (Z10.8)     1.0 -0.0100     3.0     OFF      25
Alkalinity, g/m^3                         (Z10.8)     1.0 -0.0100     3.0     OFF      26

....................CDNAME...................  FMTCD  CDMULT   CDMIN   CDMAX  CDPLTC       #
Dissolved organic carbon, g/m^3           (F10.3)     1.0    -1.0    25.0     OFF       1
Particulate organic carbon, g/m^3         (F10.3)     1.0    -1.0    50.0     OFF       2
Total organic carbon, g/m^3               (F10.3)     1.0    -1.0    25.0     OFF       3
Dissolved organic nitrogen, g/m^3         (F10.3)     1.0    -1.0    25.0     OFF       4
Particulate organic nitrogen, g/m^3       (F10.3)     1.0    -1.0    25.0     OFF       5
Total organic nitrogen, g/m^3             (F10.3)     1.0    -1.0    50.0     OFF       6
Total Kheldahl Nitrogen, g/m^3            (F10.3)     1.0    -1.0    15.0     OFF       7
Total nitrogen, g/m^3                     (F10.3)     1.0    -1.0    15.0     OFF       8
Dissolved organic phosphorus, mg/m^3      (F10.3)  1000.0    -1.0    25.0     OFF       9
Particulate organic phosphorus, mg/m^3    (F10.3)  1000.0    -1.0    -1.0     OFF      10
Total organic phosphorus, mg/m^3          (F10.3)  1000.0    -1.0     5.0     OFF      11
Total phosphorus, mg/m^3                  (F10.3)  1000.0    -1.0    20.0     OFF      12
Algal production, g/m^2/day               (F10.3)     1.0    -1.0     5.0     OFF      13
Chlorophyll a, mg/m^3                     (F10.3)     1.0    -5.0   145.0     OFF      14
Total algae, g/m^3                        (F10.3)     1.0    -1.0    60.0     OFF      15
Oxygen % Gas Saturation                   (F10.3)     1.0    -1.0    50.0     OFF      16
Total suspended Solids, g/m^3             (F10.3)     1.0    -1.0     5.0     OFF      17
Total Inorganic Suspended Solids,g/m^3    (F10.3)     1.0    -1.0    20.0     OFF      18
Carbonaceous Ultimate BOD, g/m^3          (F10.3)     1.0     5.0     9.0     OFF      19
pH                                        (F10.3)     1.0    -1.0    10.0     OFF      20
CO2                                       (F10.3)     1.0    -1.0    10.0     OFF      21
HCO3                                      (F10.3)     1.0    -1.0    10.0     OFF      22
CO3                                       (F10.3)     0.0     0.0     0.0     OFF      23
```

In Version 3.2, the user has format control of all output variables, as well as MULT control (see User Manual). In Version 3.1, some groups had one but not the other. Also, in Version 3.2, the groups (HNAME, CNAME, CDNAME) were reordered.