W2 VERSION 4.1 RELEASE NOTES

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

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

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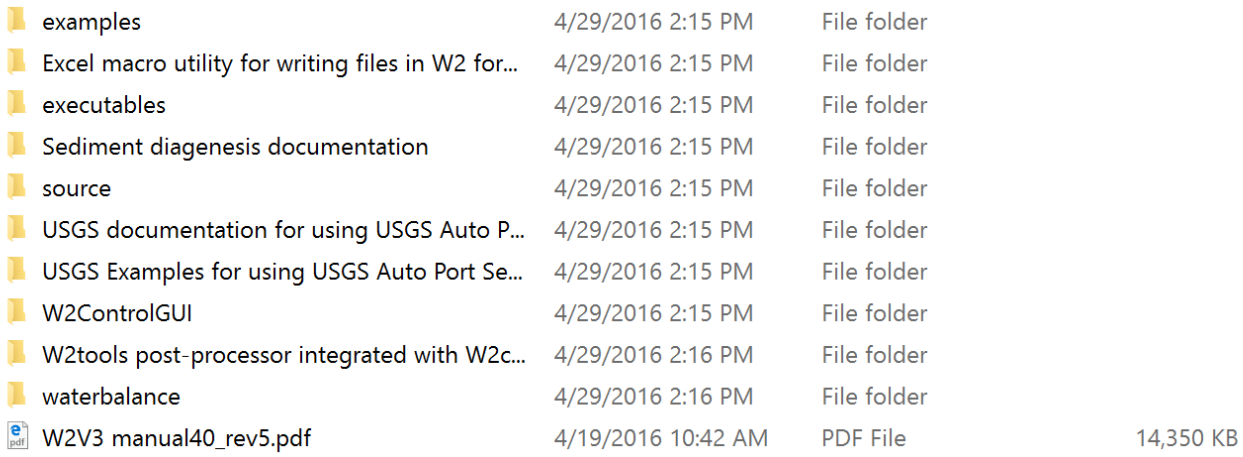
THE MODEL PACKAGE

Download model package from http://www.cee.pdx.edu/w2

After downloading the model package, you will end up with a directory structure as shown below:



These are descriptions of the subdirectories and files:

1. **Examples** – Model application examples include DeGray Reservoir, Spokane River, Spokane River (input files in csv format), Columbia Slough estuary, a sediment diagenesis example, and a particle tracking example.
2. **Executables** – The executables for the preprocessor and the model in this directory were compiled using Intel Fortran XE 14 compiler and have both 32- and 64-bit versions. These executables must be placed into the directories of the model input files or be used with the command-line for setting the default directory where the model files reside.
3. **W2ControlGUI** - The W2Control GUI was compiled using Visual Basic 6. The GUI directory also has an installation routine for W2Control. There is a "setup.exe" routine that installs the Visual Basic W2 V3.7 Model Preprocessor called W2CONTROL which is also compatible with the V4 model. 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. A user manual in pdf format is included in this directory. Also, a separate executable, W2Control, is provided in case an earlier version has already been installed. Note that this GUI is a part of the install routine for W2Tools now.
4. **W2Tools** – This is the new W2 post-processor by Dynamic Solutions-International, LLC (www.ds-international.biz). They have provided an installation routine that includes both the post-processor and the W2ControlGUI. When the user selects W2L output (the old VPL output), the resulting post-processing file is used by W2Tool for all post-processing tasks that include contour plots, animations, profile plots and time series plots. A brief user manual is included showing many of the features of this post-processor as well as a directory that shows how to take field data and plot field data and model results in the post-processor. There is a zip file with an example from DeGray reservoir on how to include model predictions versus field data for reservoir profiles.
5. **Source** – This directory contains the source code for the preprocessor and model written in Fortran. The compiler settings and files necessary to compile using the Intel compiler are also included using the Intel Fortran

compiler. Generally, we use the following compiler settings: /O2 [maximum speed in Intel] and default real is double precision. Also, for the following subroutines we had to use /O1 optimization: init-cond.f90 and init-u-elws.f90. For the preprocessor, the windows source code is compiled using a QuickWin application rather than a console application. We use the debug version for the released executable. The generic preprocessor code should work compiled as a console application.

6. **Waterbalance** – This is the windows waterbalance utility that is described in the user manual. The purpose of this code is to approximate the waterbalance for a reservoir or lake by computing flows (positive and negative) that will allow the model predicted water level to agree to water level data for a reservoir.
7. **Excel macro utility for writing files in W2 format from Excel -** This directory contains an Excel macro that aids in writing our CE-QUAL-W2 compatible files from within Excel. There is a short user manual describing how to use the macro. This macro was developed by Jeffrey Gregory, Civil Engineer, USACE, Nashville District.
8. **W2V3 manual4_revX.pdf** - User Manual in searchable pdf format where X is the revision number.
9. **W2_Version_4_Release_Notes.pdf** – Release notes in pdf format.
10. **USGS Documentation for the Auto Port Selection Algorithm** – Technical report for the new USGS algorithm for auto port selection.
11. **USGS Model examples for the Auto Port Selection** – 4 example problems using the USGS algorithm for auto port selection
12. **Sediment diagenesis documentation** – reports and documents explaining the sediment diagenesis model in Version 4.
13. **Particle Tracking Documentation** – a pdf file documenting how to use particle tracking.

How to Run the Model for the First Time

In order to run the DeGray Reservoir example, copy the model executables for the **executables/w2 model** (for example **w2_v4_64.exe**) and **executables/w2 preprocessor** (for example **preW2-v4_64.exe**) from the executables directory to the **examples/DeGray Reservoir** directory. Double click the preprocessor executable to run the preprocessor. This produces several output files such as a warning file (pre.wrn) and an error file (pre.err) if there were any errors. If adjustments were made to input files, rerun the preprocessor until there are no more errors. Once this has completed, double click the w2 model executable. The model will run with a dialog box showing the progress of the simulation. Once it completes, you can then evaluate the model results by examining output files for evaluation and post-processing.

How to Set-Up and Run a Model Application

1. **Construct all boundary condition files**
   These files include flow rates, temperatures, and concentrations for all inflows, meteorological conditions for each waterbody, water levels for head BCs, shading for each segment, wind sheltering file for segments as a f(time), outflow rates, withdrawal rates, and precipitation files.

   Look in an example directory and notice all the files with the 'npt' extension. These are input files that the user must construct. Examine several of the files: the meteorological file (usually **met*.npt,** but the model user can name it anything) and a flow file (usually **q*.npt** where q implies flow rate) by opening a text editor to look at the file structure. There will also be other input files as described in the User Manual, such as temperature and water quality input files. We recommend using the program Notepad++ as a text editor. Notepad++ is a much more powerful than Notepad which is part of Windows.

How do you develop these files? One could use Excel (or equivalent) to set up all the input files. For example, open a new Excel worksheet. Let's develop a flow input file for the model. The 1st 2 lines are comment lines. Enter a descriptive comment on the 1st line like: 'Inflow #1 2003'. Skip a line or row. On row 3 add the column headers: 1st column type 'JDAY', 2nd column type 'Q(m3/s)'. On row 4 enter a Julian day, like 1.5 (this corresponds to January 1 at 12 noon) and a corresponding flow like 10.0 (enter decimal points). On row 5 enter 365. and 15. The model has the option of linearly interpolating or viewing these as step functions. How do we save this in the correct text format for W2? For many of the input files one can use a csv format or a fixed format. To save this in the fixed format, select all the worksheet and set the column widths all to 8 characters. Then File/SaveAs, choose a "prn" file, but in the file name enter the desired file name in quotes, such as **"qin_test.npt"** with the quotes. Then click OK. This will save a file with an acceptable format and appropriate file name extension for W2. To output this in csv format, there is an output option in Excel for writing it as a csv file. Remember that the first character in line 1 must be a '$' for a csv formatted file.

A simpler method of writing out files in either fixed format or in csv format is using the Excel macro utility provided on the PSU CE-QUAL-W2 website developed by Jeffrey Gregory in the Excel macro file w2_tools_L.xlam.

2. **Develop the Model Grid**

This involves developing a bathymetry file for each water body. Use a text editor to open the existing bathymetry file for DeGray Reservoir (**bth.npt**). Now open the GUI Interface (do this by using the file **W2Control37.exe**) and click on CON for the control file and BTH for the bathymetry editor. You can view the bathymetry graphically with views of the side, top and end of the segments by clicking on appropriate buttons.

Note that the model also now uses "csv" file format so that the grid can be viewed and edited directly in Excel rather than the older, more cumbersome bathymetry file format. The new csv format is shown in a file named **bth1.csv** in the **Spokane River csv input format** directory. An example of the bathymetry format for a csv file for a reservoir is shown below. More details are provided in the CE-QUAL-W2 User Manual.

$1981 Bluestone Reservoir Bathymetry																															
SEG: I	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
DLX	1046.4	1046.4	1046.4	965.9	965.9	764.7	764.7	1046.4	1046.4	1073.2	1073.2	1073.2	1126.9	1126.9	1180.5	1180.5	1180.5	912.2	912.2	912.2	804.9	804.9	804.9	804.9	804.9	858.5	858.5	858.5	1006.1	1006.1	457.3	457.3
ELWS	430.1	430.1	430.1	430.1	430.1	430.1	430.1	430.1	430.1	430.1	430.1	430.1	430.1	430.1	430.1	430.1	430.1	430.1	430.1	430.1	430.1	430.1	430.1	430.1	430.1	430.1	430.1	430.1	430.1	430.1	430.1	430.1
PHIO	3.142	3.142	3.142	3.142	3.142	3.142	3.142	3.142	3.142	3.142	3.142	3.142	3.142	3.142	3.142	3.142	3.142	3.142	3.142	3.142	3.142	3.142	3.142	3.142	3.142	3.142	3.142	3.142	3.142	3.142	3.142	3.142
FRICT	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70
LAYERH	BR1																															
0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.5	0	335	335	335	335	364	364	362	362	327	327	327	423	423	438	438	438	472	472	472	490	490	457	457	457	501	501	501	516	516	487	0
0.5	0	231	231	231	231	254	254	255	255	312	312	312	406	406	426	426	426	466	466	466	486	486	453	453	453	498	498	498	509	509	483	0
0.5	0	228	228	228	228	243	243	248	248	298	298	298	388	388	413	413	413	460	460	460	482	482	449	449	449	494	494	494	502	502	480	0
0.5	0	224	224	224	224	231	231	241	241	285	285	285	370	370	400	400	400	453	453	453	477	477	444	444	444	491	491	491	495	495	476	0
0.5	0	220	220	220	220	219	219	233	233	272	272	272	351	351	387	387	387	446	446	446	472	472	440	440	440	487	487	487	488	488	473	0
0.5	0	215	215	215	215	206	206	225	225	259	259	259	332	332	373	373	373	439	439	439	467	467	435	435	435	484	484	484	481	481	467	0
0.5	0	202	202	202	202	188	188	208	208	247	247	247	324	324	359	359	359	431	431	431	462	462	430	430	430	480	480	480	473	473	465	0
0.5	0	192	192	192	192	161	161	199	199	234	234	234	291	291	345	345	345	422	422	422	457	457	425	425	425	476	476	476	465	465	461	0
0.5	0	173	173	173	173	142	142	189	189	222	222	222	269	269	330	330	330	414	414	414	451	451	420	420	420	472	472	472	458	458	457	0
0.5	0	0	0	130	130	130	130	178	178	208	208	208	247	247	315	315	315	404	404	404	445	445	415	415	415	468	468	468	450	450	453	0
0.5	0	0	0	0	125	125	125	166	166	195	195	195	223	223	298	298	298	395	395	395	440	440	409	409	409	465	465	465	442	442	449	0
0.5	0	0	0	0	0	0	120	120	153	153	181	181	199	199	282	282	282	384	384	384	433	433	404	404	404	460	460	460	434	434	445	0
0.5	0	0	0	0	0	0	0	110	139	139	167	167	167	173	173	265	265	265	372	372	372	427	427	397	397	397	456	456	456	426	426	440	173
0.5	0	0	0	0	0	0	0	0	135	135	151	151	151	145	145	246	246	246	360	360	360	419	419	391	391	391	451	451	451	417	417	436	0
0.5	0	0	0	0	0	0	0	0	0	130	134	134	134	116	116	227	227	227	346	346	346	412	412	384	384	384	447	447	447	408	408	431	0
0.5	0	0	0	0	0	0	0	0	0	0	114	114	114	100	110	209	209	209	330	330	330	404	404	377	377	377	442	442	442	400	400	426	0
0.5	0	0	0	0	0	0	0	0	0	0	0	40	100	90	100	184	184	184	311	311	311	396	396	369	369	369	436	436	436	391	391	422	0
0.5	0	0	0	0	0	0	0	0	0	0	0	0	40	80	90	160	160	160	288	288	288	386	386	361	361	361	431	431	431	381	381	417	0
0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	40	80	134	134	134	258	258	258	376	376	352	352	352	426	426	426	372	372	411	0
0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	75	104	104	104	215	215	215	364	364	342	342	342	420	420	420	362	362	406	0
0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	100	90	146	146	146	351	351	330	330	330	413	413	413	352	352	401	0
0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	90	80	83	83	83	334	334	317	317	317	407	407	407	342	342	394	0
0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	44	44	44	313	313	302	302	302	400	400	400	331	331	388	0
0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	40	279	279	282	282	282	392	392	392	320	320	382	0
0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	68	68	251	251	251	384	384	384	308	308	375	0
0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	39	39	72	72	72	375	375	375	297	297	368	0
0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	34	34	54	365	365	365	284	284	360	0
0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	30	40	353	353	353	271	271	352	0
0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	30	30	340	340	340	257	257	344	0
0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	322	322	322	243	243	334	0
0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	296	296	296	227	227	324	0
0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	134	134	210	210	312	0
0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	130	130	191	191	299	0	
0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	171	171	285	0			
0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	147	147	266	0		
0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	117	117	241	0			
0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	75	75	197	0			
0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	57	50	0			
0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

How does one develop the bathymetry file?

a. Obtain x,y,z topographic data
b. For reservoirs or rivers one can take DEM data and merge it with x,y,z topographic data of your waterbody in GIS or Surfer
c. Create centerline and grid spacing in x for each model branch
d. Draw polygons around each model segment and create a Volume-area-elevation curve for each segment.
e. After choosing an appropriate vertical layer spacing, compute segment widths for each vertical layer for each segment using for example that B= [Volume in layer]/($\Delta x \Delta z$)
f. Assemble all the layer widths for each segment into the file compatible with the CE-QUAL-W2 model

Note also that using cross-sections directly for computing segment widths at various elevations is also appropriate if the cross-section is representative of the model segment.

3. **Edit the Control File**
   The main control file, **w2_con.npt**, is the central file for describing how the model will run. This file tells the code when the model starts, ends, where the inflows/outflows are located, names of files, kinetic parameters, and items you cannot even imagine. Open this file in a text editor or open it using the GUI **W2Control37.exe**

4. **Run the Preprocessor**
   This file, **preW2-4_64.exe**, checks for model errors in the control file, bathymetry file, and all boundary condition files. Double click on the executable and look at the preprocessor screen. This file writes out between 1 and 3 files: **pre.opt** (an echo of input data and other useful items), **pre.err** (if fatal errors), and **pre.wrn** (if warnings). Make sure you look at **pre.wrn** and **pre.err** files.

5. **Run the W2 Model**
   The file **w2_v4_64.exe** is the W2 model code. Double click on the w2 executable and notice the dialog box and the dynamic animation boxes for the simulation.

6. **Evaluate OUTPUT files or Model Results**
   CE-QUAL-W2 outputs files have an extension 'opt'. Open the file **snp.opt** (a snapshot file) using a text editor. There are other files you can use with Excel for easy plotting, such as TSR files and Spreadsheet files. The CPL output from the model can also be used directly with Tecplot360 from www.tecplot.com for animating the results. Animation of results and contour plots can also be shown using the free w2tools post-processor.

How to Use Batch Processing and the Command Line with CE-QUAL-W2

The W2 model preprocessor and executable are both command line aware meaning that users can execute the programs from any directory and set the default model directory. This might be especially helpful if one has 2 linked models that one wants to run independently rather than in one large model.

So let's say that you have 2 directories: **c:\w2\LakeA** and **c:\w2\RiverBelowLakeA** that have all the required input files. If you have the W2 model and preprocessor executable in the **c:\w2** directory, you can execute the preprocessor using a batch file, let's say **checkW2.bat**, that contains the following lines of text:

```
prew2-v4_64.exe "c:\w2\LakeA"
prew2-v4_64.exe "c:\w2\RiverBelowLakeA"
```

Executing this batch file would run the preprocessor for both directories. In each case the model user must close the dialog box for the next command to be executed. This is by design since we want you to look at the results of the preprocessor to see if anything is amiss.

Since the outflow from LakeA goes into the RiverBelowLakeA, the following batch file, let's say **runW2.bat**, runs the models and copies files from one directory to the other:

```
w2_v4_64.exe "c:\w2\LakeA"
copy " c:\w2\LakeA\qwd.opt" "c:\w2\RiverBelowLakeA\qin.npt" /Y
copy " c:\w2\LakeA\twd.opt" "c:\w2\RiverBelowLakeA\tin.npt" /Y
copy " c:\w2\LakeA\cwd.opt" "c:\w2\RiverBelowLakeA\cin.npt" /Y
w2_v4_64.exe "c:\w2\ RiverBelowLakeA"
```

Note that by setting the parameter **CLOSEC** to **ON** in **w2_con.npt**, the dialog boxes close when a simulation is completed (and no user intervention is required). The quotation marks are there in case you have any spaces in your file names or directories. The '/Y' flag means that the copy command overwrites the file in the target directory without prompting the model user for permission.

HOW TO INCLUDE RELATIVE DIRECTORY PATHS FOR INPUT AND OUTPUT FILES

Instead of having all your model files in one directory, one can organize some of them by subdirectories. You can specify relative paths in the control file w2_con.npt for both input and output files. Let's say that your model directory is **c:\w2\LakeA** and you want to create a subdirectory for the input files and some of the output files. So create subdirectories such as:

c:\w2\LakeA\Inflows -- the flow, temperature and concentration input files for both the branch inflow, tributaries, and distributed inflow
c:\w2\LakeA\Inputs -- shading file, bathymetry file, wind sheltering file
c:\w2\LakeA\output_tsr -- tsr file outputs
c:\w2\LakeA\output_snp – snapshot file outputs

So in the section of the control file, w2_con.npt, where filenames are given, use the '**.**' to specify a file directory starting from the current directory. Hence, for the shading and wind sheltering file, you would specify

```
WSC FILE.................................WSCFN.............................
        .\Inputs\wsc.npt

SHD FILE.................................SHDFN.............................
        .\Inputs\shade.npt
```

And similarly for branch inflows:

```
QIN FILE.................................QINFN.............................
BR1     .\Inflows\qP88_2012.npt

TIN FILE.................................TINFN.............................
BR1     .\Inflows\tin_P88_2012.npt
```

```
CIN FILE.................................CINFN.............................
BR1     .\Inflows\cP88_2012_updated.npt
```

And similarly for output file paths:

```
SNP FILE.................................SNPFN.............................
WB 1    .\output_snp\snp_wb1.opt

…

TSR FILE.................................TSRFN.............................
        .\output_tsr\tsr.opt
```

USING THE GUI W2CONTROL FOR TOUCHSCREEN LAPTOPS AND MONITORS

The software, W2Control, is a GUI preprocessor for the W2 model. It works fine on non-touch enabled monitors. But for touch screen monitors, like many of the latest laptops, the opening "treeview" menu does not work because of a software incompatibility with VB6, the source code. W2Control can though be used on a touch screen laptop by doing the following:

Go to Services by typing 'Services' in the command line or Cortana line. In the list choose 'Touch keyboard and Handwriting Panel Service'. Right click your mouse and choose Properties and change 'Automatic' to 'Disabled'. Then click STOP in the Service Status to stop the service. Click APPLY. The W2Control then works as expected.

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 well high-head, high-speed, dynamic flow conditions in a pipe as a result of numerical stability.
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 for sorption is currently constant for all organic and inorganic compartments

#	Item	Description
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. Keep in mind that the segment widths from the top layer then extend upward at that same width.
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 or in W2 preprocessor of in W2 model	Sometimes the control file or bathymetry file or an input file cannot be read properly. This can be a result of the text editor used to produce the file or file conversions that occur when transferring files from workstations running Linux or from email. There may be a problem with the end of line character in the file. For Windows files, the standard end of line is a carriage return followed by a line feed: <CR><LF>. For UNIX systems it is usually only a Line Feed <LF>. To convert this from a UNIX system to a Windows system text file, use Notepad++ (a free windows text editor), go to EDIT/EOL Conversion and select Windows. Another issue common in reading text files is that the editor adds ‘tabs’. All ‘tabs’ must be converted to ‘spaces’ for the file to be read properly.

W2 V4.1 Bug Fixes, Enhancements, and User Manual Changes

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Fixed or Enhancement added
1	PREW2	Additional checks	Additional checks were added to the preprocessor for sediment decay temperature coefficients and stoichiometric coefficients. Concentration summaries in downstream and upstream head boundary conditions were added to the pre.opt file.	5/19/2017

2	W2	DO Saturation	The equation for computing dissolved oxygen saturation was a function of elevation and temperature. If the user set the water body type to SALT, the TDS or salinity was used to correct the dissolved oxygen saturation. The TDS correction for dissolved oxygen saturation was added to the fresh water computation also. The new code is highlighted below:
			`SATO = EXP(7.7117-1.31403*(LOG(T+45.93)))*P`
			`IF (SALT_WATER) THEN`
			`SATO = EXP(LOG(SATO)-SAL*(1.7674E-2-1.0754E1/(T+273.15)+2.1407E3/(T+273.15)**2))  ! SAL is in ppt`
			`ELSEIF(SAL > 100.)THEN`
			`SATO = EXP(LOG(SATO)-(SAL/1000.)*(1.7674E-2-1.0754E1/(T+273.15)+2.1407E3/(T+273.15)**2))  ! SAL is in mg/l`
			`ENDIF`
				5/21/2017

3	W2	Sediment diagenesis output	Another line was added to the sediment diagenesis input file for the frequency of output. Prior to this it used the TSR output frequency and wrote out duplicate results if there was more than 1 waterbody.	5/25/2017
4	W2	Initialize variables	DLVOL, VOLTBR, EVBR, and QSUM were added to the initialized variables in INIT.F90. This only affects the Fortran compiler when it is in debug model. In the release executable all variables are initialized to zero even if not explicitly set to zero.	7/24/2017

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

5	W2	Sediment diagenesis code updates	We have deleted unused variables and array initializations. This has improved the speed of running the model with sediment diagenesis. These code areas are:
			`!SP CEMA`
			`  if(sediment_diagenesis)then`
			`    If(CEMARelatedCode .and. IncludeBedConsolidation)Call ComputeCEMARelatedSourceSinks`
			`  !  If(CEMARelatedCode .and. IncludeCEMASedDiagenesis)Call ComputeCEMADiagenesisSourceSinks  SW 6/27/2017`
			`  end if`
			`!End SP CEMA`
			
			`      !SP CEMA`
			`      !if(sediment_diagenesis)then`
			`      !  If(CEMARelatedCode .and. IncludeBedConsolidation)TSS       = 0.0  ! SW 7/27/2017`
			`      !end if`
			`      !End SP CEMA`
			
			`!SP CEMA`
			`!if(sediment_diagenesis)then`
			`!  CEMATSSCopy = TSS`
			`!end if`
			`!End SP CEMA`
				7/24/2017

6	PREW2	Sediment diagenesis	Additional error checking for the sediment diagenesis model was added to the preprocessor. In this case, whenever SOD was not set to zero, an error is displayed.	7/24/2017
7	W2	Assorted code improvements	Stewart Rounds of the USGS suggested a few minor updates: eliminated extra right-parentheses in a format description for time series output (the Intel compiler allowed them!), added WARNING_OPEN and ERROR_OPEN = .TRUE. in several cases where output is written to these files, and eliminated a situation where the derived output file at a withdrawal point was not written out if the file is empty. Also, for water age, evaporation should not concentrate the 'age'. Hence code was added to recognize water age and to eliminate the effect of evaporation on water age.	7/27/2017
8	W2	Branch active or inactive	In the W2 model, if a model branch became dehydrated, the model would not continue running. In order to allow for wide varieties of water levels, users would often have to add numerous deep fictitious layers to keep a branch hydrated. Now the model can handle branches becoming active or inactive automatically. Code was added to allow branches to become active as they fill up or to become inactive if they lose their water. Also, any branch inflows or tributaries entering inactive branches are automatically moved to the current active segment of the nearest hydrated branch.	7/27/2017

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

9	W2	RPOMN	Stewart Rounds, USGS, found this one. The if test below used NRPOMP rather than NRPOMN. Usually both NRPOMN and NRPOMP are both 'ON', so for most applications this should not affect the model user.
			OLD Code:
			IF(CAC(NRPOMP) == ' ON')THEN
			IF(RPOM(K,I).GT.0.0)THEN
			ORGNRP(K,I)=RPOMN(K,I)/RPOM(K,I)
			NEW Code:
			IF(CAC(NRPOMN) == ' ON')THEN
			IF(RPOM(K,I).GT.0.0)THEN
			ORGNRP(K,I)=RPOMN(K,I)/RPOM(K,I)
				8/2/2017

10	W2	Screen Dialog Box	Under some unique conditions, exiting the W2 dialog box reinitializes some of the output files. Added code was inserted to STOP program execution after closing the dialog box.	8/23/2017
11	W2	Sediment Diagenesis	Flux rates for P, NH3, and NO3 were added to the MASSBAL output file from sediment diagenesis so that a complete N and P balance can be evaluated for a waterbody.	8/31/2017
12	W2	Particle Tracking	Particle tracking algorithm has been added and documentation in a separate report added to the model release	8/31/2017
13	W2	Opt to csv file	Changed flowbal.opt and massbal.opt to flowbal.csv and massbal.csv in order to facilitate opening inn Excel.	8/31/2017
14	W2	Gate file	The gate file was inadvertently not converted over to a csv format in the earlier Version 4.0 code. The 4.1 code was updated to include csv gate files.	9/26/2017

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

15	W2	Shading	Added code to allow for a canopy shading in addition to dynamic shading. The DYNSH in the shade input file can now be a negative number between -1 and 0. This will activate dynamic shading and taking the absolute value of this number will reduce the short wave solar radiation by a fixed fraction as if some of the channel has a canopy. Of course canopy cover is more complex than this small correction since it also affects long-wave radiation transfer. New code is highlighted below:
			
			`SN = MIN (HT*ABS (SIN (ABS (PHI0(I)-AZ00)))/TAN (A0)-EDGE,BI(KT,I))`
			`SFACT = SRED*SN/BI(KT,I)`
			`100 CONTINUE`
			`SHADE(I) = MAX (0.0,1-SFACT)`
			`SHADE(I) = MIN(ABS(SHADEI(I)),SHADE(I))`
			`! SW 10/2/2017 Allows for fixed canopy cover over top of channel - only used if shade is less than shadei only valid for -0.99 and 0.0`
			
			Hence if DYNSH (or SHADEI) in the code were -0.9 and the dynamic shading algorithm computed the shade factor as 0.95 (which is a 5% reduction in short wave solar), the code would use 0.9 or a 10% reduction in short-wave solar. If the dynamic shade algorithm computes a shade greater than the fixed rate, the minimum of these is used.
				10/3/2017

16	W2	Sediment Diagenesis	Changed back to the original segment width at the bottom for sediment diagenesis so that this algorithm replicates the original CEMA sediment diagenesis algorithm. Pulled out the CellArea as a dimensioned variable computed only once rather than for each cell at each time step. Also, added a control variable to turn ON/OFF Bubbles calculation. This saves much computational time and until the Bubbles subroutine is vetted we do not recommend its use. Also several code fixes were made in the sediment diagenesis module for mistakes in the original algorithm.	10/3/2017, 10/22/2017
17	W2	User Manual	The User Manual was updated fixing minor errors and typos and adding discussion of new features of Version 4.1. This is Revision 1 of the 4.1 Manual but includes updates and fixed typos from the Version 4.0 Manual and explanations of new features.	10/3/2017

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

18	W2	Kinetic fluxes for ADD Layer	A bug was corrected in the Kinetic Flux layer addition code as shown below:
			`KFS(KT,I,KFCN(1:NAF(JW),JW)) = KFS(KT+1,I,KFCN(1:NAF(JW),JW))`
			`!KF(KT+1,I,KFCN(1:NAF(JW),JW)) CODE ERROR FIX SW 10/24/2017`
			This does not affect fluxes in the TSR file, only the cumulative fluxes (KFS) during an add layer event for the surface layer only.
				10/24/2017

19	W2	Header	Changed header for flux for DO reaeration from just source to source/sink which can occur during super-saturation. `KFNAME(64) = 'DO reaeration - source/sink, kg/day '`	10/24/2017

20	W2	Fluxes	In the file, kfl_wbX.opt where X is the waterbody number, the fluxes are presented in the same format as a snapshot file. The headers showed fluxes in kg/d but they were in kg. This has been corrected. The fluxes in kg/d in the file kflux_wbX.opt were already in the correct units of kg/d. Also, added the following code since KT would have been from the prior waterbody rather than the current waterbody:
			`DO JW=1,NWB`
			`KT = KTWB(JW) ! SW 10/25/2017`
			`IF (FLUX(JW)) CALL KINETIC_FLUXES`
			`END DO`
				10/24/2017

21	W2	Pumps	Changed some of the logic for pumps to avoid settings for older values influencing the current settings. The following code was added to hydroinout.f90:
			`ILAT = 0`
			`JWW = NWD`
			`withdrawals = jww > 0`
			`if(nwdt>nwd)qwd(nwd+1:nwdt)=0.0 ! SW 10/30/2017`
			`JTT = NTR`
			`tributaries = jtt > 0`
			`if(ntrt>ntr)qtr(ntr+1:ntrt)=0.0 ! SW 10/30/2017`
			`JSS = NSTR`
				10/30/2017

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

22	W2	TDG at spillway	Since the new implementation of the TDG algorithm, the withdrawal.f90 algorithm at spillways had not been updated properly. This fix applies to the computation of TDG at spillways and gates. The old and new code are shown below:
			
			`!if(tdgon)then ! cb 11/6/17`
			`!cdavg(js,jb,16) = (cavg(js,jb,ndo)/exp(7.7117-1.31403*(log(tavg(js,jb)+45.93)))*palt(id))*100.0`
			`dosat=exp(7.7117-1.31403*(log(tavg(js,jb)+45.93)))*palt(id)`
			
			`cdavg(js,jb,16)=(cavg(js,jb,ndo)/dosat)*100.0`
			`IF(ngctdg /= 0)THEN`
			`EA = DEXP(2.3026D0*(7.5D0*TDEW(JW)/(TDEW(JW)+237.3D0)+0.6609D0))*0.001316 ! in mm Hg 0.0098692atm=7.5006151mmHg`
			`!cdavg(js,jb,NDC) = (cavg(js,jb,NGN2)/(1.5568D06*0.79*(PALT(ID)-EA)*(1.8816D-5 - 4.116D-7 * Tavg(js,jb) + 4.6D-9 * Tavg(js,jb)**2)))*100.0 ! SW 10/27/15`
			`n2sat=1.5568D06*0.79*(PALT(ID)-EA)*(1.8816D-5 - 4.116D-7 * Tavg(js,jb) + 4.6D-9 * Tavg(js,jb)**2)`
			`cdavg(js,jb,NDC) = 100.*(0.79*(cavg(js,jb,NGN2)/n2sat) + 0.21*(cavg(js,jb,ndo)/dosat))`
			`ENDIF`
			`!end if`
				11/8/2017

23	W2 Control	Updated GUI	A new version of W2Control has been made to account for a large number of small refinements in the control file to bring it up to Version 4.1. Otherwise, some of these changes had to be implemented by editing the text file, w2_con.npt. Also, guidance was added to the release notes how to use the GUI with a touch-screen laptop or desktop.	3/10/2018

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

24	W2	Csv file input for shade file	Updated reading in csv file for shade file to be compatible with preprocessor. Sometimes one needs in a csv file input to add an extra column of commas.
			
			New code:
			`IF(INFORMAT=='$')THEN`
			`READ(SHD,'(/)')`
			`DO I=1,IMX`
			`READ (SHD,*)J,SHADEI(I) ! SW 3/14/2018 ADDED TO BE COMPATIBLE WITH PREPROCESSOR`
			`IF(SHADEI(I)<0.0)THEN`
			`BACKSPACE(SHD)`
			`READ (SHD,*) J,SHADEI(I),TTLB(I),TTRB(I),CLLB(I),CLRB(I),SRLB1(I),SRLB2(I),SRRB1(I),SRRB2(I),(TOPO(I,J),J=1,IANG),SRFJD1(I),SRFJD2(I)`
			`ENDIF`
			`ENDDO`
				3/14/2018

25	W2	TSR file output	When the model user sets the elevation as a negative value, the model outputs variables at that layer only. When the water level went below that layer, the output was fixed at the old value of the variable until the water level rose into the layer. To eliminate issues with misinterpreting or having to edit out constant values, whenever the water level is below the layer, now a -99 is written out showing that there is no water in the layer specified.	4/5/2018
26	PREW2	More checks	Added checks for NaN in input files for meteorological files and flow, temperature and concentration files for inflows, distributed tributaries, precipitation, and tributaries. Previously, the preprocessor read input files even with NaN without reporting an error since this is a proper numerical value.	4/10/2018
27	W2	WDO output	The Withdrawal files are often used for downstream models. The withdrawal output frequency is in days. In order to make this more precise numerically, the output frequency can also be entered in hours and seconds. The problem was that 1 hour is 0.04167 days and due to round off error for long term runs of many years, the hourly frequency output would not be at the same hour. The variable WDOC now can be ON/OFF/ONS/ONH where ONS means the output frequency is in sec and ONH means the output frequency is in hours. The User Manual, GUI, and Preprocessor have been updated.	4/10/2018

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Fixed or Enhancement added
28	Water-balance	Water-balance	A new waterbalance utility was released that is a console application and can be used in batch file processing. It also has more features than the old water balance utility allowing the use of multiple waterbodies in the calculation of flows. There is a new file directory for this application in the download section as well as executables and a User Manual for this utility.	4/10/2018

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

W2 PLANNED ENHANCEMENTS

The following list shows planned enhancements:

- 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.
- W3, 3D version of W2 (in development and testing)
- Hypoheric flow algorithm, Groundwater-surface water interaction (in research code)
- Sediment channel bottom heating algorithm, Dynamic heat transfer between channel bottom and stream (in research code)
- A smarter wind fetch calculation algorithm
- Updates to the selective withdrawal algorithm for multiple withdrawals
- Fish bioenergetics model and fish volitional movement model (in research code)

DIFFERENCES BETWEEN VERSION 4.1 AND VERSION 4.0

Version 4.1 is compatible with Version 4.0. There are no changes in the main control file. There is only 1 new input file, 'particle.csv', that serves as an input file to the particle tracking algorithm.

DIFFERENCES BETWEEN VERSION 4.0 AND VERSION 3.72

Version 4 is file compatible with Version 3.72, even though there are new options in the main control file, w2_con.npt, and new input files whose presence or absence is detected by the model. For example, for ICEC control the options now include ON, ONWB, and OFF, where ONWB is a new option. New input files include a file for sediment diagenesis, 'W2_CEMA_Input.npt', and a file for the dynamic alkalinity calculation, 'pH_buffering.npt'

Control file differences are in the Generic Constituent Section of the Code where new variables were added to the control file to allow for phot-degradation and the new N2 state variable for TDG:

```
GENERIC    CGQ10   CG0DK   CG1DK     CGS    CGLDK   CGKLF     CGS
CG 1     0.00000 0.00000 0.00000 0.00000 0.00000 1.03400 -1.0000     ! TDG
CG 2     0.00000 -1.0000 0.00000 0.00000 0.00000 0.00000 0.00000
CG 3     1.04000 0.00000 1.40000 0.00000 0.00000 0.00000 0.00000
```

DIFFERENCES BETWEEN VERSION 3.72 AND VERSION 3.71

These 2 codes are file compatible. Besides a few bug fixes since the last release of Version 3.71, Version 3.72 includes the USGS automatic port selection code. This can be activated by setting SELECTC='USGS' in the control file w2_con.npt. In Version 3.71, only 'ON' or 'OFF' were input variables for SELECTC. If one sets SELECTC='USGS', the format of the file w2_selective.npt is also changed from Version 3.71. Details of this and examples are provided in the User's Manual and on-line.

DIFFERENCES BETWEEN VERSION 3.71 AND VERSION 3.7

There is only one change in the control file between Version 3.7 and 3.71. There is a new option for outlet structures – dynamic centerline elevation. In the control file, there is an ON/OFF option after declaring the # of structures for each branch:

```
EDDY VISC     AZC    AZSLC    AZMAX      FBC        E    ARODI STRCKLR BOUNDFR  TKECAL
WB 1          TKE      IMP 1.00000        3 9.53500 0.43100 0.00000 0.00000     IMP

N STRUC      NSTR DYNELEV
BR1            17       ON
BR2             0      OFF
BR3             0      OFF

STR INT     STRIC    STRIC    STRIC    STRIC    STRIC    STRIC    STRIC    STRIC    STRIC
```

If these fields are missing the model will assume that DYNELEV=OFF.

DIFFERENCES BETWEEN VERSION 3.7 AND VERSION 3.6

Even though there are some cases where a Version 3.7 executable will run Version 3.6 and Version 3.5 files fine, there are updates required to the w2_con.npt file that need to be made. The preprocessor will catch these errors.

Control file changes: w2_con.npt

The main changes to the W2 control file are additional flags to turn ON/OFF new control file options and the addition of new state variables for water quality, BOD-N and BOD-P for each BOD group.

Below is a list of changes in the control file with the card image header for each line changed (highlighted options are new in V3.7). Descriptions of these new features are in the W2 User's Manual.

1. MISCELL

```
MISCELL      NDAY SELECTC HABTATC ENVIRPC AERATEC INITUWL
              100      OFF       ON       ON       ON     OFF
```

Five new variables, SELECTC, HABITATC, ENVIRPC, AERATEC, and INITUWL, are 5 new control variables that turn ON/OFF the use of automatic selective withdrawal, fish habitat volumes, environmental performance criteria, artificial aeration, and the initial water surface and velocity computations, respectively. If using an old Version 3.6 control file, all of these would default to 'OFF' if they were left blank. Also the model preprocessor would flag these are missing variables.

2. DLT CON

```
DLT CON       NDT  DLTMIN DLTINTR
                1 1.00000      OFF
```

where DLTINTR is a control for interpolating the the time step DLTMAX and DLTF rather than use as a step function

3. BRANCH G

```
BRANCH G      US       DS      UHS      DHS      UQB      DQB    NLMIN    SLOPE   SLOPEC
Br 1           2       59        0        0        0        0        1      0.0      0.0
```

where SLOPEC is the hydraulic equivalent slope for a river channel that affects the momentum equation.

4. GATE WEIR

```
GATE WEIR    GTA1     GTB1     GTA2     GTB2  DYNVAR     GTIC
Gate1     1.00000 1.50000 1.00000 1.50000    FLOW       ON
```

where GTIC is an interpolation control for the specified DYNVAR for the GATE-WEIR.

5. Dynamic pipe

```
PIPES       IUPI     IDPI     EUPI     EDPI      WPI    DLXPI      FPI  FMINPI   LATPIC DYNPIPE
Pi 1          24       28     28.0     27.0      0.5    230.0    0.065     0.1     DOWN       ON
```

where DYNPIPE controls whether the pipe is controlled by time series of an ON/OFF or partially open gate

6. Dynamic pump

```
PUMPS 1      IUPU     IDPU      EPU   STRTPU    ENDPU    EONPU   EOFFPU      QPU    WTHLC DYNPUMP
              111        0     440.     1.00     366.    441.0    435.0      1.0     DOWN       ON
```

where DYNPUMP controls the EPU, EONPU, EOFFPU, and QPU over time by reading in a time series file

7. INIT CND

```
INIT CND    TEMPI     ICEI   WTYPEC    GRIDC
WB 1      -1.0000 0.00000    FRESH     RECT
```

where GRIDC controls whether the grid is interpreted as rectangular in depth or trapezoidal.

8. CST ACTIVE [Note that this change only appears if NBOD>0]

```
CST ACTIVE   CAC
TDS           ON
Gen1          ON
Gen2         OFF
Gen3         OFF
Gen4         OFF
Gen5         OFF
ISS1          ON
PO4           ON
NH4           ON
NO3           ON
DSI          OFF
PSI          OFF
FE           OFF
LDOM          ON
RDOM          ON
LPOM          ON
RPOM          ON
1CBOD         ON
2CBOD         ON
```

```
3CBOD           ON
4CBOD           ON
5CBOD           ON
6CBOD           ON
7CBOD           ON
8CBOD           ON
9CBOD           ON
10CBOD          ON
1CBODP          ON
2CBODP          ON
3CBODP          ON
4CBODP          ON
5CBODP          ON
6CBODP          ON
7CBODP          ON
8CBODP          ON
9CBODP          ON
10CBODP         ON
1CBODN          ON
2CBODN          ON
3CBODN          ON
4CBODN          ON
5CBODN          ON
6CBODN          ON
7CBODN          ON
8CBODN          ON
9CBODN          ON
10CBODN         ON
ALG1            ON
ALG2            ON
ALG3            ON
DO              ON
TIC             ON
ALK             ON
ZOO1           OFF
LDOM_P          ON
RDOM_P          ON
LPOM_P          ON
RPOM_P          ON
LDOM_N          ON
RDOM_N          ON
LPOM_N          ON
RPOM_N          ON
```

9. CST ICON, CST PRIN, CIN CON,CTR CON, CDT CON and CPR CON

```
CST ICON    C2IWB    C2IWB    C2IWB    C2IWB    C2IWB    C2IWB    C2IWB    C2IWB    C2IWB
TDS           0.0
AGE           0.0
TRACER        0.0
COL1          0.0
Conduct       0.0
Chlorine      0.0
ISS1          0.0
PO4          0.03
NH4          0.01
NOx           0.3
DSi           0.0
PSi           0.0
TFe           0.0
LDOM          0.1
RDOM          0.1
```

```
LPOM          0.1
RPOM          0.1
1CBOD         0.0
2CBOD         0.0
3CBOD         0.0
4CBOD         0.0
5CBOD         0.0
6CBOD         0.0
7CBOD         0.0
8CBOD         0.0
9CBOD         0.0
10CBOD        0.0
1CBODP        0.0
2CBODP        0.0
3CBODP        0.0
4CBODP        0.0
5CBODP        0.0
6CBODP        0.0
7CBODP        0.0
8CBODP        0.0
9CBODP        0.0
10CBODP       0.0
1CBODN        0.0
2CBODN        0.0
3CBODN        0.0
4CBODN        0.0
5CBODN        0.0
6CBODN        0.0
7CBODN        0.0
8CBODN        0.0
9CBODN        0.0
10CBODN       0.0
ALG1          0.1
ALG2          0.1
ALG3          0.1
DO           12.0
TIC           5.0
ALK          19.8
ZOO1          0.0
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           ON
AGE           ON
TRACER        ON
COL1          ON
Conduct       ON
Chlorine      ON
ISS1          ON
PO4           ON
NH4           ON
NOx           ON
DSi          OFF
PSi          OFF
TFe          OFF
LDOM          ON
```

```
RDOM            ON
LPOM            ON
RPOM            ON
1CBOD           ON
2CBOD           ON
3CBOD           ON
4CBOD           ON
5CBOD           ON
6CBOD           ON
7CBOD           ON
8CBOD           ON
9CBOD           ON
10CBOD          ON
1CBODP          ON
2CBODP          ON
3CBODP          ON
4CBODP          ON
5CBODP          ON
6CBODP          ON
7CBODP          ON
8CBODP          ON
9CBODP          ON
10CBODP         ON
1CBODN          ON
2CBODN          ON
3CBODN          ON
4CBODN          ON
5CBODN          ON
6CBODN          ON
7CBODN          ON
8CBODN          ON
9CBODN          ON
10CBODN         ON
ALG1            ON
ALG2            ON
ALG3            ON
DO              ON
TIC             ON
ALK             ON
ZOO1           OFF
LDOM_P          ON
RDOM_P          ON
LPOM_P          ON
RPOM_P          ON
LDOM_N          ON
RDOM_N          ON
LPOM_N          ON
RPOM_N          ON

CIN CON   CINBRC  CINBRC  CINBRC  CINBRC  CINBRC  CINBRC  CINBRC  CINBRC  CINBRC
TDS             ON      ON
AGE            OFF     OFF
TRACER         OFF     OFF
COL1           OFF     OFF
Conduct         ON      ON
Chlorine       OFF     OFF
ISS1            ON      ON
PO4             ON      ON
NH4             ON      ON
NOx             ON      ON
DSi            OFF     OFF
PSi            OFF     OFF
TFe            OFF     OFF
```

```
LDOM            ON       ON
RDOM            ON       ON
LPOM            ON       ON
RPOM            ON       ON
1CBOD           ON       ON
2CBOD           ON       ON
3CBOD           ON       ON
4CBOD           ON       ON
5CBOD           ON       ON
6CBOD           ON       ON
7CBOD           ON       ON
8CBOD           ON       ON
9CBOD           ON       ON
10CBOD          ON       ON
1CBODP          ON       ON
2CBODP          ON       ON
3CBODP          ON       ON
4CBODP          ON       ON
5CBODP          ON       ON
6CBODP          ON       ON
7CBODP          ON       ON
8CBODP          ON       ON
9CBODP          ON       ON
10CBODP         ON       ON
1CBODN          ON       ON
2CBODN          ON       ON
3CBODN          ON       ON
4CBODN          ON       ON
5CBODN          ON       ON
6CBODN          ON       ON
7CBODN          ON       ON
8CBODN          ON       ON
9CBODN          ON       ON
10CBODN         ON       ON
ALG1            ON       ON
ALG2            ON       ON
ALG3            ON       ON
DO              ON       ON
TIC             ON       ON
ALK             ON       ON
ZOO1           OFF      OFF
LDOM_P          ON       ON
RDOM_P          ON       ON
LPOM_P          ON       ON
RPOM_P          ON       ON
LDOM_N          ON       ON
RDOM_N          ON       ON
LPOM_N          ON       ON
RPOM_N          ON       ON

CTR CON    CTRTRC   CTRTRC   CTRTRC   CTRTRC   CTRTRC   CTRTRC   CTRTRC   CTRTRC   CTRTRC
TDS             ON       ON
AGE            OFF      OFF
TRACER          ON       ON
COL1            ON       ON
Conduct         ON       ON
Chlorine        ON       ON
ISS1            ON       ON
PO4             ON       ON
NH4             ON       ON
NOx             ON       ON
DSi            OFF      OFF
PSi            OFF      OFF
```

```
TFe           OFF      OFF
LDOM           ON       ON
RDOM           ON       ON
LPOM           ON       ON
RPOM           ON       ON
1CBOD          ON       ON
2CBOD          ON       ON
3CBOD          ON       ON
4CBOD          ON       ON
5CBOD          ON       ON
6CBOD          ON       ON
7CBOD          ON       ON
8CBOD          ON       ON
9CBOD          ON       ON
10CBOD         ON       ON
1CBODP         ON       ON
2CBODP         ON       ON
3CBODP         ON       ON
4CBODP         ON       ON
5CBODP         ON       ON
6CBODP         ON       ON
7CBODP         ON       ON
8CBODP         ON       ON
9CBODP         ON       ON
10CBODP        ON       ON
1CBODN         ON       ON
2CBODN         ON       ON
3CBODN         ON       ON
4CBODN         ON       ON
5CBODN         ON       ON
6CBODN         ON       ON
7CBODN         ON       ON
8CBODN         ON       ON
9CBODN         ON       ON
10CBODN        ON       ON
ALG1           ON       ON
ALG2           ON       ON
ALG3           ON       ON
DO             ON       ON
TIC            ON       ON
ALK            ON       ON
ZOO1          OFF      OFF
LDOM_P         ON       ON
RDOM_P         ON       ON
LPOM_P         ON       ON
RPOM_P         ON       ON
LDOM_N         ON       ON
RDOM_N         ON       ON
LPOM_N         ON       ON
RPOM_N         ON       ON

CDT CON    CDTBRC   CDTBRC   CDTBRC   CDTBRC   CDTBRC   CDTBRC   CDTBRC   CDTBRC   CDTBRC
TDS            ON       ON
AGE           OFF      OFF
TRACER         ON       ON
COL1           ON       ON
Conduct        ON       ON
Chlorine       ON       ON
ISS1           ON       ON
PO4            ON       ON
NH4            ON       ON
NOx            ON       ON
DSi           OFF      OFF
```

```
PSi           OFF      OFF
TFe           OFF      OFF
LDOM           ON       ON
RDOM           ON       ON
LPOM           ON       ON
RPOM           ON       ON
1CBOD          ON       ON
2CBOD          ON       ON
3CBOD          ON       ON
4CBOD          ON       ON
5CBOD          ON       ON
6CBOD          ON       ON
7CBOD          ON       ON
8CBOD          ON       ON
9CBOD          ON       ON
10CBOD         ON       ON
1CBODP         ON       ON
2CBODP         ON       ON
3CBODP         ON       ON
4CBODP         ON       ON
5CBODP         ON       ON
6CBODP         ON       ON
7CBODP         ON       ON
8CBODP         ON       ON
9CBODP         ON       ON
10CBODP        ON       ON
1CBODN         ON       ON
2CBODN         ON       ON
3CBODN         ON       ON
4CBODN         ON       ON
5CBODN         ON       ON
6CBODN         ON       ON
7CBODN         ON       ON
8CBODN         ON       ON
9CBODN         ON       ON
10CBODN        ON       ON
ALG1           ON       ON
ALG2           ON       ON
ALG3           ON       ON
DO             ON       ON
TIC            ON       ON
ALK            ON       ON
ZOO1          OFF      OFF
LDOM_P         ON       ON
RDOM_P         ON       ON
LPOM_P         ON       ON
RPOM_P         ON       ON
LDOM_N         ON       ON
RDOM_N         ON       ON
LPOM_N         ON       ON
RPOM_N         ON       ON

CPR CON    CPRBRC   CPRBRC   CPRBRC   CPRBRC   CPRBRC   CPRBRC   CPRBRC   CPRBRC   CPRBRC
TDS            ON       ON
AGE           OFF      OFF
TRACER         ON       ON
COL1           ON       ON
Conduct        ON       ON
Chlorine       ON       ON
ISS1           ON       ON
PO4            ON       ON
NH4            ON       ON
NOx            ON       ON
```

```
DSi            OFF      OFF
PSi            OFF      OFF
TFe            OFF      OFF
LDOM            ON       ON
RDOM            ON       ON
LPOM            ON       ON
RPOM            ON       ON
1CBOD           ON       ON
2CBOD           ON       ON
3CBOD           ON       ON
4CBOD           ON       ON
5CBOD           ON       ON
6CBOD           ON       ON
7CBOD           ON       ON
8CBOD           ON       ON
9CBOD           ON       ON
10CBOD          ON       ON
1CBODP          ON       ON
2CBODP          ON       ON
3CBODP          ON       ON
4CBODP          ON       ON
5CBODP          ON       ON
6CBODP          ON       ON
7CBODP          ON       ON
8CBODP          ON       ON
9CBODP          ON       ON
10CBODP         ON       ON
1CBODN          ON       ON
2CBODN          ON       ON
3CBODN          ON       ON
4CBODN          ON       ON
5CBODN          ON       ON
6CBODN          ON       ON
7CBODN          ON       ON
8CBODN          ON       ON
9CBODN          ON       ON
10CBODN         ON       ON
ALG1            ON       ON
ALG2            ON       ON
ALG3            ON       ON
DO              ON       ON
TIC             ON       ON
ALK             ON       ON
ZOO1           OFF      OFF
LDOM_P          ON       ON
RDOM_P          ON       ON
LPOM_P          ON       ON
RPOM_P          ON       ON
LDOM_N          ON       ON
RDOM_N          ON       ON
LPOM_N          ON       ON
RPOM_N          ON       ON
```

New control files

Based on the options the user turns ON or OFF, new control files are required. These new control files are named:

1. w2_selective.npt – new variables controlling the selective withdrawal algorithm to select temperature targets
2. w2_habitat.npt – new variables controlling fish habitat limits for temperature and dissolved oxygen and surface and segment volume weighted eutrophication state variables
3. w2_envirpf.npt – new variables controlling setting environmental performance criteria

4. w2_aerate.npt – variables describing use of dissolved oxygen addition to enhance dissolved oxygen levels through diffusers

Details of these new control files are in the CE-QUAL-W2 User Manual.

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
```

Lines removed from the V3.2 control file: 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
```

Graph.npt file changes. 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
```

```
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
```

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.

BUG FIXES AND ENHANCEMENTS BETWEEN VERSIONS

There have been many updates and bug fixes between model versions. Even though some model updates have not been documented, we have tried to be diligent in outlining code updates since Version 3.7 between model versions. We have included below a series of tables with code fixes for multiple versions of CE-QUAL-W2 as a reference to earlier versions.

W2 V4.0 BUG FIXES, ENHANCEMENTS, AND USER MANUAL CHANGES

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Fixed or Enhancement added
1	PREW2	Additional model checks	Additional model checks were added for Profile and Spreadsheet output model segments	6/7/16
2	User Manual	Updated	User Manual Rev 6 was released with many minor updates and better explanatory text	6/7/16
3	W2	Restart	Fixed restart to work for epiphyton and macrophytes. This was broken in case a model user used RESTART. Fixed restart for mass balance for nutrients output in the file massbal.opt.	6/7/16
4	W2	Location of compiler info file	Fixed location of W2 compiler information in case of using command line aware directory. File was written to the location of the model executable rather than the command line aware directory.	6/7/16
5	Waterbalance	Update for Version 4	The waterbalance utility uses a model tsr file for reading in water level over time. Since the Version 4 file format was updated with comma delimeted output files, the waterbalance utility has been updated. This utility is not compatible with earlier versions.	6/10/16
6	W2	Sediment Diagenesis	Initialized the sediment width (sedcellwidth) in subroutine `CEMASedimentDiagenesis.`	6/11/16
7	W2	Screen output	The text fields in the Windows dialog box may 'overflow' if you have more than 160 tributaries. The field size was increased to avoid this possibility. Old code: CHARACTER(1000) :: TEXT1 New code: CHARACTER(1700) :: TEXT1	6/24/16
8	W2	Profile output	The longitudinal profile output added depth at a segment as part of the longitudinal output. User Manual updated also.	7/11/2016
9	W2	Profile output	Changed file name of longitudinal file output from integer of the Julian day to Julian day in F8.2 format in case of multiple outputs on one day	7/16/2016

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Fixed or Enhancement added
10	W2	TSR output	Changed TSR file so that the first 11 lines of header are eliminated to facilitate graphing. Also, the name of the filetype in the control file is now read and used for the output file. Hence, using the TSR FILENAME of 'tsr.csv' will produce csv files that are immediately opened in Excel for viewing again making it easier for post-processing.	8/1/2016
11	PRE	Met file checks	The preprocessor has been enhanced with more model file checks. This program now has summaries of meteorological data (min, max, average) for each waterbody in the pre.opt file as well as further logical checks on values of these averages. These summaries are another check on the correctness of the input met data file. A typical result in pre.opt is shown below: Meteorological Data Input Summary Parameter Waterbody Average Value Maximum Minimum TAIR(C) 1 10.553 37.780 -11.940 TDEW(C) 1 6.935 19.500 -17.670 WIND(m/s) 1 1.337 12.440 0.000 PHI(rad) 1 3.426 6.280 0.000 CLOUD(0-10) 1 7.367 9.720 0.000 SRO(W/m2) 1 0.000 0.000 0.000 TAIR(C) 2 10.553 37.780 -11.940 TDEW(C) 2 6.935 19.500 -17.670 WIND(m/s) 2 1.337 12.440 0.000 PHI(rad) 2 3.426 6.280 0.000 CLOUD(0-10) 2 7.367 9.720 0.000 SRO(W/m2) 2 0.000 0.000 0.000	10/30/16
12	PRE	Distributed concentration checks	Added checks for average, min, and max inflow concentrations for all distributed tributaries. These are written out to the pre.opt file	11/1/16
13	PRE	LPR input	For LPR file inputs for temperature, the preprocessor reports an error when using LPR input. The code incorrectly used KT rather than KTWB(JW). [This also affects V3.7 preprocessor.]	11/9/2016
14	W2	Model update	The model executables were updated from Intel Fortran Compiler # 14 to Intel Fortran compiler # 17. Also, the flag to initialize all variables to zero was enforced. There are many variables in the new sediment diagenesis model that need to be explicitly set to zero. These initializations will be made in the code in the future so that setting this flag will be unnecessary.	11/17/2016
15	W2 and PRE	Code updates	A couple code updates were made as a result of using the Intel Fortran Version 17 compiler. The new compiler did not like some of the older implementations. These were minor updates.	11/22/2016
16	W2	Output	Improved clarity of output headers for flux outputs, including units of kg/d in all header titles	11/28/2016

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Fixed or Enhancement added
17	W2	Output header	The order of the flux headings in the file 'kflux_jwX.opt' were switched. The header showed DOAP, DOAR, DOEP, DOER but it should have been DOAP, DOEP, DOAR, DOER. This is determined from the order in the example problem control files and the User Manual. The example problems and User Manual have all been updated.	11/28/2016
18	W2	Example problems	Updated example problems using FIX #10 above where tsr.opt filename was changed to tsr.csv allowing tsr files to open directly in Excel.	11/28/2016

19	W2	Algae-Si	The flux of Si from dying algae was incorrectly computed. This bug has existed since Version 3.0 when the algorithm was first added to W2. Below is the code fix:
			
			`ENTRY PARTICULATE_SILICA`
			`  PSIAM(:,IU:ID) = 0.0`
			`  DO I=IU,ID`
			`    DO K=KT,KB(I)`
			`      DO JA=1,NAL`
			`      IF(ALG_CALC(JA))THEN`
			`        PSIAM(K,I) =`
			`PSIAM(K,I)+AMR(K,I,JA)*ALG(K,I,JA)*ASI(JA)      !`
			`PSI(K,I)   HA-Z  12/2016`
			`      ENDIF`
				12/5/2016

20	W2	WDO output	Enhancement: The Withdrawal output file name WDOFN was unused in the main program. Now the model reads this file and uses the file type for all WDO output files. Previously this was hard-wired to 'opt' output. Now if the user sets WDOFN to 'wdo.csv' all the files will be written with the 'csv' file type facilitating opening in Excel. The files are already in comma delimited format.	12/8/2016
21	W2	DLT INTER	There was a problem computing the interpolated value of DLTMAX and DLTF when the first value of DLTD was earlier than the start date of the model. This bug was fixed.	12/9/2016
22	User Manual	Updates	Assorted typos fixed, better explanatory text added, and added definitions and units of model parameters. This is REV8.	1/6/2017, 2/10/2017
23	W2	Output format	Output format changed for Bioenergetics output file	1/6/2017
24	W2	TECPLOT output	Added derived variables to TECPLOT output files (See Contour Plot in User Manual). User Manual updated.	1/17/2017
25	PREW2	ENVIRPC	Checks were added for the ENVIRPC input file in the preprocessor.	2/16/2017

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Fixed or Enhancement added
25	W2	ENVIRPC	Fixed several minor bugs in the ENVIRPC subroutine and added an enhancement to perform a histogram analysis of water depth. The User Manual was updated to reflect this new enhancement as well as the new csv output format and file names. The example problems were updated with new w2_envirprf.npt files.	2/16/2017
26	W2	Head BC input files	For head boundary condition input files (both upstream and downstream), the W2 code was updated to include new file formats for these boundary conditions (BCs). They include the older format, a new csv format and a new csv format in case conditions are not stratified at the BC. The User Manual was updated to show these new file formats.	3/3/2017
27	PREW2	Head BC checks	With the new file format for head BCs in #26 above, the preprocessor was updated to check these new input file formats. Also, additional checks were added to the head BCs.	3/3/2017
28	Water-balance	Bug fixes/updates	The water balance utility was updated because of the new input format of TSR output files. See fix #10. Also, a bug was fixed in this code that affected cases when the water level was above the top of the grid.	3/17/2017
29	W2	CPL Tecplot	The CPL Tecplot output sometimes did not update the month in the contour plot text files. This has been fixed – thanks to Jung Ma, Hubei University of Technology in Wuhan, for finding it!	4/4/2017
30	Water-balance	Waterbalance manual	The waterbalance manual was updated for Version 4.	4/14/2017
31	W2	TSR output	Refined the TSR output so that flux terms that were not specified are no longer written out. This cleans up the TSR output and reduces the active number of flux variables when sediment diagenesis is not on.	4/15/2017
32	W2	Derived variables	Fixed a code regression for derived variable TDG when the user stopped the code and pressed restart	4/15/2017
33	W2	Withdrawal output	When a user pressed restart and he/she specified withdrawal output files, the restarted files ignored the filetype of the WDO specification in the control file and used 'opt'.	4/15/2017

W2 V3.7 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	Fish habitat limits	Changed temperature and DO criteria from
			
			`t2(k,i)<fishtemph(ii).and.t2(k,i)>fishtempl(ii).and.o2(k,i)>fishdo(ii)`
			
			to
			
			`t2(k,i)<=fishtemph(ii).and.t2(k,i)>fishtempl(ii).and.o2(k,i)>=fishdo(ii)`
			
			This update is reflected in the manual. Hence the high temperature limit and the dissolved oxygen minimum is less than or equal to given value rather than less than.
				8/7/2012

2	W2	Structure, gate, pump, pipe, withdrawal output files	Added code to ensure that if flow is '0' in an outlet structure, that the corresponding temperature and concentration in the outlet file is written as '-99.0'. Previously this was not fully implemented in the code. Code such as this was inserted in several places in the subroutine outputa2.f90:
			
			`IF(QGT(JS)==0.0)THEN`
			`TAVGW(JWD)=-99.0`
			`CAVGW(JWD,:)=-99.0`
			`CDAVGW(JWD,:)=-99.0`
			`ENDIF`
				8/13/2012

3	PREW2	Format updates	Several output updates were made for warnings and errors	8/16/2012
4	Resource files for W2	Compiling files	Updated some corrupted resource files that were used to compile the source code. Also, zipped up source code and compiler settings together so that file locations are correct for using the Intel compiler.	9/12/2012

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added
5	W2 and PREW2	Read csv files	By inserting the character '$' as the first character of the first line, the following files can now be read in free-format or csv format: met, lpr, vpr, wsc, met, cin, ctr, cdtr, cpre, qot, and qwd. This is described in a Word document that accompanies the download package. The preprocessor has also been updated for file checks. This is part of the Version 3.71 update.	9/12/2012

6	W2	Read input file	An input format bug was fixed for a system with more than 9 waterbodies.
			
			`DO JD=1,NDC`
			`!READ (CON,'(A8,(:9A8))') CDNAME2(JD),(CDWBC(JD,JW), JW=1,NWB)`
			`READ (CON,'(A8,(:9A8):/(8X,(:9A8)))') CDNAME2(JD),(CDWBC(JD,JW), JW=1,NWB)`
			`!cb 9/13/12`
			`END DO`
			`READ (CON,'(/)')`
			`! DO JF=1,NFL`
			`do jf=1,73 ! Fix this later`
			`!READ (CON,'(A8,(:9A8))') KFNAME2(JF),(KFWBC(JF,JW), JW=1,NWB)`
			`READ (CON,'(A8,(:9A8):/(8X,(:9A8)))') KFNAME2(JF),(KFWBC(JF,JW), JW=1,NWB)`
			`!cb 9/13/12`
			`END DO`
			
			This had the effect of turning OFF output for derived constituents for waterbody 10.
				9/13/2012

7	GUI	Time series elevation	The GUI read in values of ETSR as integers rather than real numbers. This was fixed.	10/30/12
8	W2	Spillways Lateral	Lateral spillways when connected to other model segments were sometimes not connecting as a tributary to the downstream segment. This has been fixed.	10/30/12
9	W2	W2Tools output	In place of the Vector Plot Output (VPL), a new output was added that allows use of the W2Tools post-processing package. This is part of the Version 3.71 update.	10/30/12
10	W2	User Manual	The User Manual has been updated with the new model features as shown in 5 and 9 above. In addition a separate user manual file shows how to use the w2tools post-processor. This is in the directory for W2tools. This is the version 3.71 update.	10/30/12

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added
11	W2	Water quality and temperature	A new calculation technique was added that eliminates calling the Tri-diagonal subroutine. These were built into the temperature and water quality subroutines. This change results in improvements in computational speed of from less than 5% to over 20% for water quality models with lots of water quality state variables.	10/30/2012
12	PREW2	More checks	Added more error trapping for input files. This is an effort for the error trapping to occur before the code bombs. Fixed a couple of regression errors as a result of this fix.	11/2/2012, 11/5/2012
13	Excel macro utility		Added an Excel macro utility to aid in writing out input files to CE-QUAL-W2	11/5/2012

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

14	W2	Withdrawal subroutine	Fixed an IF test that used the wrong variable in the dynamic port allocation algorithm. Also added code to allow the code to test for temperatures at the outlet levels specified.
			
			Deleted line of code is underlined followed by the fix.
			
			DO J=1,NUMTSPLT !REODERING OUTLETS SO THAT HIGHEST ELEVATION STRUCTURE ON TOP (ASSUMING 2 SPLIT OUTLETS)
			! IF(TCNTR(J) == ' ST')THEN
			IF(TSPLTCNTR(J) == ' ST')THEN
			! cb 11/11/12
			IF(ESTR(JSTSPLTT(J,1),TSPLTJB(J)) < ESTR(JSTSPLTT(J,2),TSPLTJB(J)))THEN
			JSTSPLT(J,1)=JSTSPLTT(J,2)
			JSTSPLT(J,2)=JSTSPLTT(J,1)
			END IF
			! ELSE IF(TCNTR(J) == ' WD')THEN
			ELSE IF(TSPLTCNTR(J) == ' WD')THEN
			! cb 11/11/12
			IF(EWD(JSTSPLTT(J,1)) < EWD(JSTSPLTT(J,2)))THEN
			
			…
			IF(TSPLTJB(J) == JB .AND. TSPLTCNTR(J) == ' ST')THEN
			QALL=0.0
			DO JJ=1,NOUTS(J)
			
			QALL=QALL+QSTR(JSTSPLT(J,JJ),TSPLTJB(J)) ! SUM UP ALL THE FLOWS
			ELR = SINA(JB)*DLX(DS(JB))*0.5
			DO K=KTWB(JW),KB(DS(JB))
			IF (EL(K,DS(JB))-ELR < ESTR(JSTSPLT(J,JJ),TSPLTJB(J))) EXIT !SW 10/17/01
			END DO
			KSTR = K-1
			KSTRSPLT(JJ) = MIN(KSTR,KB(DS(JB)))
			ENDDO
			DO JJ=1,NOUTS(J) ! cb 11/11/12 dividing total flow between outlets for temperature test
			
			QSTR(JSTSPLT(J,JJ),TSPLTJB(J)) = qall/real(nouts(j))
			ENDDO
				11/13/12

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

15	W2	Reading in names of WQ variables	In case a user does not enter the units in graph.npt, the code improperly parses the WQ variable name. In this case the output name is a blank. To avoid this issue, extra code was added to preserve the variable name even if no units were added to the graph.npt list.
			
			`L1 = SCAN (CNAME(JC),',')+2`
			`IF(L1 == 2)L1=43 ! SW 12/3/2012 Implies no comma found`
			`L2 = SCAN (CNAME(JC)(L1:43),' ')+L1`
			`IF(L2 > 43)L2=43 ! SW 12/3/2012`
			`CUNIT(JC) = CNAME(JC)(L1:L2)`
			`CNAME1(JC) = CNAME(JC)(1:L1-3)`
			`CNAME3(JC) = CNAME1(JC)`
			`DO WHILE (L3 < L1-3)`
				12/3/2012

16	PREW2	SEDS and SEDK	The variable names were switched in reading the control file in the preprocessor perhaps leading to incorrect warnings/errors being tagged.
			
			The proper order was restored:
			`!READ (CON,'(/A8/(8X,2A8,6F8.0,A8))', ERR=400) AID, (SEDC(JW), PRNSC(JW), SEDCI(JW), seds(jw), SEDDK(JW), FSOD(JW), &`
			`! FSED(JW), sedbr(jw), DYNSEDK(JW), JW=1,NWB) !`
			`SW 6/1/07`
			`READ (CON,'(/A8/(8X,2A8,6F8.0,A8))', ERR=400) AID, (SEDC(JW), PRNSC(JW), SEDCI(JW), SEDDK(JW),seds(jw), FSOD(JW), &`
			
			`FSED(JW), sedbr(jw), DYNSEDK(JW), JW=1,NWB) !`
			`cb 12/30/12`
				12/30/12

17	Excel macro utility w2tool	Integer/Long variables	Some loose ends were corrected in the Visual Basic code built into the Excel macros.	1/2/2013
18	W2	TDG output	A series of code changes were made to fix some issues that arose for computing the impact of a structure on downstream TDG. These fixes were made in subroutines Withdrawal, outputa2w2tools, w2modules, and hydroinout. These affected calculation of output of dissolved gas concentration for output files for spillways or gates that had dissolved gas equation.	1/23/2013

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

19	W2	Reading in dynamic extinction coefficient	For temperature only studies, the model did not update the dynamic light extinction coefficient correctly. This has been fixed by the added code below:
			
			`DO JW=1,NWB`
			`  IF (READ_EXTINCTION(JW))GAMMA(:,US(BS(JW)):DS(BE(JW))) = EXH2O(JW)  ! SW 1/28/13`
			`  KT = KTWB(JW)`
			`  IF (.NOT. NO_HEAT(JW)) THEN`
				1/28/2013

20	W2	Input format when 9 WBs	A specific input read error occurred when 9 waterbodies were present as a result of an earlier bug fix: The new read statements occur in 2 places:
			
			`READ (CON,'(A8,9A8,/(:8X,9A8)))')`
			`CDNAME2(JD),(CDWBC(JD,JW), JW=1,NWB)`
			`!cb 9/13/12  sw 2/18/13`
			
			`READ (CON,'(A8,9A8,/(:8X,9A8)))')`
			`KFNAME2(JF),(KFWBC(JF,JW),  JW=1,NWB)`
			`!cb 9/13/12  sw2/18/13`
				2/18/13

21	PREW2	More checks added	Additional checks were added to warn users of gaps in meteorological data when interpolation may be inappropriate.	2/20/2013
22	W2 User Manual	Updated	Updated User Manual – many small additions and edits – REV3.	2/20/2013
23	PREW2	Improved an error check	Updated an error check for choosing inactive segments for ISNP output	3/21/2013
24	PREW2	More checks added	Added checks for inflow temperature and tributary temperatures	3/28/2013

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

25	W2	Initial WL Calculation	Changed SLOPE to SLOPEC in init—u-elws.f90 routine since the normal depth should be based on SLOPEC.
			
			END IF
			FUNCVALUE=FLOW-XAREA*HRAD**0.6667*SLOPEC(JB)**0.5/FMANN
			! SW 4/5/2013
			
			RETURN
			END SUBROUTINE MANNINGS_EQN
			
			Also changed KB(I)-1 to KB(I)+1 for ELWS:
			
			IF(ABS(DX).LT.XACC .OR. FMID.EQ.0.)THEN
			ELWS(I)=RTBIS+EL(KB(I)+1,I)
			! SW 4/5/13
			RETURN
			
			Also changed KTTOP from REAL to an INTEGER:
			REAL :: XAREA, WSURF ! 4/5/13 SW
			INTEGER :: KTTOP ! 4/5/13 SW
				4/5/2013

25	W2	Output for pumps, spillways, gates	If the LAT option was chosen, the output files index for JWD was incorrect. This may have affected output temperatures and concentrations.	5/17/2013
26	PRE-W2	Mass loading calculation	There were cases where the preprocessor bombed while calculating the mass loading for output to the pre.opt file. This error has been fixed.	6/21./2013
27	W2	Assorted code updates	Minor format errors (that were ignored by compiler), update to code comments, and faster code initializations to speed up model performance were performed in several subroutines: input_PAR.f90, temperature_PAR.f90, transport_PAR.f90, update.f90, and w2_37_win.f90. An example of an initialization code speed up from temperature_PAR.f90: New code: DO K=KT,KB(I) AT(K,I) = 0.0D0; CT(K,I) = 0.0D0; VT(K,I) = 0.0D0 ! SW CODE SPEEDUP 6/15/13 ENDDO Old code AT(:,I) = 0.0D0; CT(:,I) = 0.0D0; VT(:,I) = 0.0D0	6/21/2013

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added
28	W2 tools Excel macro	Update	More robust tools release	6/21/2013
29	PRE-W2	Label error	A label error for one spillway error was fixed. It mistakenly used 'gate'.	7/2/2013
30	W2	CPL output	A slight change in output format for the 'raw' cpl output file format was made. No change was made in the tecplot output format. DO I=CUS(JB),DS(JB) WRITE (CPL(JW),'(A38/(9(F10.3,2X)))') CDNAME(CDN(JD,JW)),(CD(K,I,CDN(JD,JW))*CDMULT(C DN(JD,JW)), K=KTWB(JW),KB(I)) ! cb 6/28/13 end do !WRITE (CPL(JW),'(A38/(9(F10.3,2X)))') CDNAME(CDN(JD,JW)),((CD(K,I,CDN(JD,JW))*CDMULT(CDN(JD,JW)), & ! SW 8/12/06 !K=KTWB(JW),KB(I)),I=CUS(JB),DS(JB)) ! CB 1/03/05	7/31/13

31	W2	Read input file	A regression error that cropped up when there were 9 or greater than 10 waterbodies has been fixed. This had to do with reading in derived and flux variables in the control file.
			
			DO JD=1,NDC
			If(nwb < 10)READ (CON,'(A8,(:9A8))')
			CDNAME2(JD),(CDWBC(JD,JW), JW=1,NWB)
			If(nwb >= 10) READ
			(CON,'(A8,9A8,/(:8X,9A8))')
			CDNAME2(JD),(CDWBC(JD,JW), JW=1,NWB)
			!cb 9/13/12 sw 2/18/13 6/16/13
			END DO
			READ (CON,'(/)')
			! DO JF=1,NFL
			do jf=1,73 ! Fix this later
			If(nwb < 10)READ (CON,'(A8,(:9A8))')
			KFNAME2(JF),(KFWBC(JF,JW), JW=1,NWB)
			If(nwb >= 10) READ
			(CON,'(A8,9A8,/(:8X,9A8))')
			KFNAME2(JF),(KFWBC(JF,JW), JW=1,NWB)
			!cb 9/13/12 sw2/18/13 6/16/13
				8/13/13

32	W2	New compiler	Upgraded to the Intel XE 13.1.3.198 compiler. New W2 executables for 32 bit and 64 bit.	8/13/13

33	W2	INIT WL	An error was fixed in the initial water level computation program for rivers. The code below should have the subscript JB instead of J.
			
			DO JJW=1,NWB
			DO JJB=BS(JJW),BE(JJW)
			IF(DHS(JB) > US(JJB) .AND.
			DHS(J) < DS(JJB))THEN
			JBD=JJB
			END IF
			END DO
				8/20/13

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

34	W2	INIT WL	There was an index error with gates in the initial water level computation. The old code is shown below:
			
			`IF(ELWS(ID) < WSUP)THEN`
			`IF(ELWS(IDSP(JS)) > WSUP) WSUP = ELWS(IDSP(JS)) ! CHECKING TO SEE IF DOWNSTREAM WS ELEVATION ISN'T ALREADY 'HIGH'`
			`ELWS(ID)=WSUP`
			
			The new code is
			
			`IF(ELWS(IDGT(JG)) > WSUP) WSUP = ELWS(IDGT(JG)) ! CHECKING TO SEE IF DOWNSTREAM WS ELEVATION ISN'T ALREADY 'HIGH' WX 8/21/13`
				8/21/2013

35	W2	GATE	Cleaning up some code in the gate algorithm.
			Old code:
			
			`IF (A2GT(JG) /= 0.0 .AND. IDGT(JG) /= 0.0) THEN`
			
			New code:
			
			`IF (A2GT(JG) /= 0.0 .AND. IDGT(JG) /= 0) THEN`
				8/21/2013

36	W2	TSS computation	Updated the computation for the derived variable TSS to include zooplankton and the particulate form of CBOD. A formula was added to the User Manual reflecting this change. New code includes
			
			`IF(CBODS(IBOD)>0.0)TOTSS(K,I) = TOTSS(K,I)+CBOD(K,I,IBOD)/O2OM(JW)`
			`! SW 9/5/13 Added particulate CBOD to TSS computation`
			
			`TOTSS(K,I) = TOTSS(K,I)+ZOO(K,I,JZ) ! SW 9/5/13 Added zooplankton to TSS computation`
				9/6/2013

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

37	W2	Spillway-LAT	When a spillway was defined with IDSP=0 and LAT, a tributary was defined incorrectly. The new code is shown below:
			
			`IF (IDSP(JS) /= 0)then  ! cb 9/11/13`
			`JTT = JTT+1`
			`QTR(JTT) = QSP(JS)`
			`ITR(JTT) = IDSP(JS)`
			`PLACE_QTR(JTT) = PDSPC(JS) == 'DENSITY'`
			`SPECIFY_QTR(JTT) = PDSPC(JS) == 'SPECIFY'`
			`IF (SPECIFY_QTR(JTT)) THEN`
			`ELTRT(JTT) = ETDSP(JS)`
			`ELTRB(JTT) = EBDSP(JS)`
			`END IF`
			`JBTR(JTT) = JBD`
			`end if  ! cb 9/11/13`
				9/11/2013

38	W2	32 bit exe on XP	Recompiled with new settings from Visual Studio 2012 to (hopefully) run on XP systems with 32 bit OS	9/11/2013

39	W2	End Simulation	Added new close open files in the end_simulation subroutine. This is merely cleaning up the code to be consistent in closing all open files when a 'Stop' is executed. This should have no effect on the end user. Part of this new code is shown below:
			`IF(SELECTC == '  ON')then  ! SW 9/25/13 New Section on closing files`
			`ifile=1949`
			`do jb=1,nbr`
			`if(nstr(jb) > 0)then`
			`ifile=ifile+1`
			`close(ifile)`
			`endif`
			`enddo`
			`if(nwd > 0)then`
			`ifile=ifile+1`
			`close(ifile)`
			`endif`
			`endif`
			
			`IF (DOWNSTREAM_OUTFLOW) THEN`
			`JFILE=0`
			`DO JWD=1,NIWDO`
			`CLOSE(WDO(JWD,1))`
			`CLOSE(WDO(JWD,2))`
			`IF (CONSTITUENTS) THEN`
			`CLOSE (WDO(JWD,3))`
			`END IF`
			`IF (DERIVED_CALC) THEN`
			`CLOSE(WDO(JWD,4))`
			`END IF`
				9/25/13

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

40	W2	Pumps – Lateral	Fixed several sections of code in the PUMP algorithm in the hydroinout.f90 routine. Under some conditions such as specifying "Lateral", the PUMP algorithm may not have moved the water from the upstream to the downstream segment correctly. This has been fixed and tested. Part of the code changes are shown below:
			`IF (LATERAL_PUMP(JP)) THEN`
			`ELW = EL(KTWB(JWU),IUPU(JP))-Z(IUPU(JP))*COSA(JBU)`
			`! JWW = JWW+1 ! SW 9/25/13`
			`! JBWD(JWW) = JBU`
			`! IWD(JWW) = IUPU(JP)`
			`ELSE`
			`ELW = EL(KTWB(JWU),IUPU(JP))-Z(IUPU(JP))*COSA(JBU)-SINA(JBU)*DLX(IUPU(JP))*0.5`
			`! JSS(JBU) = JSS(JBU)+1 ! SW 9/25/13`
			`END IF`
			…
			`IF (PUMPON(JP)) THEN`
			`IF (LATERAL_PUMP(JP)) THEN`
			`JLAT = 1`
			`JWW = JWW+1`
			`! SW 9/25/13`
			…
			`CALL LATERAL_WITHDRAWAL ! (JWW)`
			`DO K=KTW(JWW),KBW(JWW)`
			`QSS(K,I) = QSS(K,I)-QSW(K,JWW)`
			`END DO`
			`IF (IDPU(JP) /= 0) THEN`
			`! MOVED CODE SW 9/25/13`
			`JTT = JTT+1`
			…
			`ELSE`
			`JSS(JBU) = JSS(JBU)+1 ! SW 9/25/13`
			`KTSW(JSS(JBU),JBU) = KTPU(JP)`
			…
				9/25/13

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

41	W2	Clean up memory issues	A series of minor memory issues were cleaned up. This should have no impacts on current model runs. These were usually uninitialized memory. Code changes made include:
			
			`READ (CON,'(/)')`
			`  KFNAME2='      '   ! SW 9/27/13 INITIALIZE ENTIRE ARRAY`
			`  KFWBC   ='      '   ! SW 9/27/13 INITIALIZE ENTIRE ARRAY`
			
			`READ (CON,'(//(:8X,9I8))')          (KBWD(JW), JW=1,NWD); TRC= '       '  ! SW 9/27/13 INITIALIZATION SINCE ALLOCATION IS TO NTRT`
			`  READ (CON,'(//(:8X,9A8))')          (TRC(JT), JT=1,NTR)`
			
			`    EHSN(JE),   EHSSI(JE), JE=1,NEPT)        !JE=1,NEP)  SW 9/27/13`
			`  READ (CON,'(//(8X,2F8.0,I8,F8.0))') (ESAT(JE), EHS(JE),    ENEQN(JE),  ENPR(JE), JE=1,NEPT)        !JE=1,NEP)  SW 9/27/13`
			`  READ (CON,'(//(8X,8F8.0))')         (ET1(JE), ET2(JE),    ET3(JE),    ET4(JE),    EK1(JE), EK2(JE),                          &`
			`                                       EK3(JE), EK4(JE), JE=1,NEPT)        !JE=1,NEP)  SW 9/27/13`
			`  READ (CON,'(//(8X,6F8.0))')         (EP(JE), EN(JE),     EC(JE),     ESI(JE),    ECHLA(JE), EPOM(JE),    JE=1,NEPT)        !JE=1,NEP)  SW 9/27/13`
			
			`READ (CON,'(//8X,A8,I8,A8)')         RSOC, NRSO,    RSIC; RSOD=0.0 ! SW 9/27/13 INITIALIZE SINCE ALLOCATED AS NOD BUT ONLY NRSO USED`
			`  READ (CON,'(//(:8X,9F8.0))')        (RSOD(J), J=1,NRSO)`
			
			`  READ (CON,'(//8X,I8,F8.0,a8)')         NDLT, DLTMIN, DLTINTER; DLTD=0.0  ! SW 9/28/13 INITIALIZE ARRAY TO NOD SINCE ONLY NDLT ASSIGNED`
			`  READ (CON,'(//(:8X,9F8.0))')        (DLTD(J), J =1,NDLT)`
			
			`   SINKC(1:NSTR(JB),JB) = SINKCT(1:NSTR(JB),JB)`
			`    POINT_SINK(1:NSTR(JB),JB) = SINKC(1:NSTR(JB),JB) == '   POINT'   ! SW 9/27/13`
			`  END DO`
			` ! POINT_SINK = SINKC == '   POINT'`
			
			`  COLDEP=ELWS(I)-COLB`
			`   !     MACT(J,KT,I)=MACT(J,KT+1,I)`
			`  IF(MACROPHYTE_ON)MACT(J,KT,I)=MACT(J,KT+1,I) ! SW 9/28/13`
			
			`!     SDKV(:,US(JB):DS(JB))=SDK(JW)`
			`       SDKV(:,US(JB)-1:DS(JB)+1)=SDK(JW)    ! SW 9/28/13`
				9/27/13

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

42	W2	CPL output	Code was added to eliminate writing out the habitat index to the CPL file for Tecplot when HABITATC is OFF.
			IF(I /= DS(JB)+1)THEN
			IF(HABTATC == ' ON')THEN
			WRITE (CPL(JW),9999)
			X1(I),ELWS(I),U(K,I),-
			W(K,I),T1(K,I),RHO(K,I),HAB(K,I),(C2(K,I,CN(JC))
			,JC=1,NAC)
			ELSE
			WRITE (CPL(JW),9999)
			X1(I),ELWS(I),U(K,I),-
			W(K,I),T1(K,I),RHO(K,I),(C2(K,I,CN(JC)),JC=1,NAC
			)
			ENDIF
			ELSE
			XDUM=-99.0
			WRITE (CPL(JW),9999)
			X1(I),ELWS(I),XDUM,XDUM,XDUM,XDUM,XDUM,(XDUM,
			JJ=1,NAC)
			ENDIF
			DO K=KTWB(JW),KMX-1
			IF(I /= DS(JB)+1 .AND. K <=
			KB(I))THEN
			IF(HABTATC == ' ON')THEN
			WRITE (CPL(JW),9999)
			X1(I),ELWS(I)-DEPTHM(K,I),U(K,I),-
			W(K,I),T1(K,I),RHO(K,I),HAB(K,I),(C2(K,I,CN(JC))
			,JC=1,NAC)
			ELSE
			WRITE (CPL(JW),9999)
			X1(I),ELWS(I)-DEPTHM(K,I),U(K,I),-
			W(K,I),T1(K,I),RHO(K,I),(C2(K,I,CN(JC)),JC=1,NAC
			)
			ENDIF
			IF(K == KB(I))THEN
			IF(HABTATC == '
			ON')THEN
			WRITE (CPL(JW),9999)
			X1(I),ELWS(I)-DEPTHB(K,I),U(K,I), -
			W(K,I),T1(K,I),RHO(K,I),HAB(K,I),(C2(K,I,CN(JC))
			,JC=1,NAC)
			ELSE
			WRITE (CPL(JW),9999)
			X1(I),ELWS(I)-DEPTHB(K,I),U(K,I), -
			W(K,I),T1(K,I),RHO(K,I),(C2(K,I,CN(JC)),JC=1,NAC
			)
			ENDIF
			WRITE (CPL(JW), *)'TITLE="CE-QUAL-W2"'
			IF(HABTATC == ' ON')THEN
			WRITE
			(CPL(JW),19233)(CNAME2(CN(JN)),JN=1,NAC)
			ELSE
			WRITE
			(CPL(JW),19234)(CNAME2(CN(JN)),JN=1,NAC)
			ENDIF ! sw 9/28/13
			19233
			FORMAT('VARIABLES="Distance, m","Elevation,
			m","U","W","T","RHO", "HABITAT"
			',<NAC>(',"',A8,'"'))
			19234 FORMAT('VARIABLES="Distance,
			m","Elevation, m","U","W","T","RHO"
			',<NAC>(',"',A8,'")) ! sw 9/28/13
				9/28/13

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

43	W2	SPECIFY TRIB	In specifying the elevation between top and bottom for an inflow tributary, the code put the inflow 1 layer below it should have been in many cases. This has been fixed by the additional code shown below:
			
			`IF (SPECIFY_QTR(JT)) THEN`
			`KTTR(JT) = 2`
			`! DO WHILE (EL(KTTR(JT),I) > ELTRT(JT))`
			`DO WHILE (EL(KTTR(JT),I) > ELTRT(JT) .and. EL(KTTR(JT)+1,I) > ELTRT(JT)) ! SW 10/3/13`
			`KTTR(JT) = KTTR(JT)+1`
			`END DO`
				10/3/2013

44	W2	CWO or CWDO output	Fixed a format overflow in writing out concentrations in a withdrawal output file.
			
			`IF (QWDO(J) /= 0.0) CWDO(CN(JC),J) = CWDO(CN(JC),J)/QWDO(J)`
			`WRITE (CWDOC(CN(JC)),'(F8.3)') CWDO(CN(JC),J) ! SW 9/23/13 Changed format from G8.3 to F8.3 to avoid format overflow`
			`CWDOC(CN(JC)) = ADJUSTR(CWDOC(CN(JC)))`
			
			`IF (QWDO(J) /= 0.0) CDWDO(CDN(JD,JW),J) = CDWDO(CDN(JD,JW),J)/QWDO(J)`
			`WRITE (CDWDOC(CDN(JD,JW)),'(F8.3)') CDWDO(CDN(JD,JW),J) ! SW 9/23/13 Changed format from G8.3 to F8.3 to avoid format overflow`
			`CDWDOC(CDN(JD,JW)) = ADJUSTR(CDWDOC(CDN(JD,JW)))`
				10/4/2013

45	W2 and PREW2	Inflow, Tributary, Distributary and Shade inputs	Added csv file format as a new file input format for flow and temperature files for inflows, tributaries and distributed tributaries. Also, the shade file is now in csv file format. This enhancement includes updates to the preprocessor and W2 codes. Also several minor bug fixes were made on the Preprocessor.	7/15/14

46	W2	Resuspension of inorganic solids	A resuspension formula was corrected. See the code change below:
			
			`HS = 0.283*U2/G*0.283*TANH(COEF1)*TANH(COEF2/TANH(COEF1))`
			`!TS = 2.0*PI*U2/G*1.2*TANH(COEF3)*TANH(COEF4/TANH(COEF3))`
			`TS = 2.0*PI*sqrt(U2)/G*1.2*TANH(COEF3)*TANH(COEF4/TANH(COEF3)) ! cb 5/9/14`
				7/15/14

47	W2	Tecplot output	When the user sets CPL output for Tecplot, the output format when HABITAC=OFF was incorrect. This has been fixed.	7/15/14

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

48	PREW2	Warnings	Fixed a name inconsistency for developing warnings for input concentrations
			
			`!    IF (NAME /= 'Residence time' .AND. NAME /= 'Water age') THEN`
			`          IF (NAME /= 'Residence time' .AND. NAME /= 'AGE') THEN     ! SW 7/15/14`
			`            CALL WARNINGS`
				7/15/14

49	W2	TSR filename	The filename in w2_con.npt for TSR is used for the output filenames. In order to account for complex paths that include more than one '.', the following change was made with the BACK=.TRUE. command which checks from the right-hand-side rather than left-hand-side of the character string
			
			`!       L1 = SCAN(TSRFN,'.')`
			`       L1 = SCAN(TSRFN,'.',BACK=.TRUE.)`
				8/22/14

50	PREW2	Hydraulic structure warnings	Added many new hydraulic structure warnings (gates, spillways, pumps, pipes, internal weirs) for cases where KBSTR was less than KB and fixed a few error messages for these structure checks.	9/10/14
51	W2	TSR output	The time series file has added the surface heat flux terms (net, short wave solar net, long wave radiation net, back radiation heat flux, evaporation heat flux, conductive heat flux) to the output. The manual was also updated.	1/15/15

52	W2	Interpolation of wind direction	In some cases, the wind direction interpolation was incorrect. Code was added to reduce the wind direction angle to less than 2*pi before the interpolation is performed and to consider another possible interpolation case. Thanks to Wenwei Xu for pointing this out. New code is shown below:
			
			`       ! CONVERT PHIO AND PHINX TO LESS THAN 2*PI     SW 2/13/15`
			`      DO WHILE(PHIO(JW)>2.*PI)`
			`          PHIO(JW)=PHIO(JW)-2.*PI`
			`      ENDDO`
			`      DO WHILE(PHINX(JW)>2.*PI)`
			`          PHINX(JW)=PHINX(JW)-2.*PI`
			`      ENDDO`
			`      IF (PHIO(JW)-PHINX(JW) > PI) THEN`
			`        PHI(JW) = (1.0-RATIO)*(PHINX(JW)+2.0*PI)+RATIO*PHIO(JW)`
			`      ELSEIF (PHIO(JW)-PHINX(JW) < -PI) THEN ! WX 2/13/15`
			`        PHI(JW) = (1.0-RATIO)*PHINX(JW)+RATIO*(PHIO(JW) +2.0*PI)    ! WX 2/13/15`
			`      ELSE`
			`        PHI(JW) = (1.0-RATIO)*PHINX(JW)+RATIO*PHIO(JW)`
			`      END IF`
				2/13/15

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

53	W2	Withdrawal	Stewart Rounds: Extra check to avoid divide by zero in withdrawal algorithm (this or similar code occurs in 4 subroutines in withdrawal.f90)
			
			IF ((ELSTR-HSWB) > EL(KBOT+1,ID)) THEN
			DLRHOB = ABS(RHO(KSTR,ID)-RHO(KBOT,ID))
			ELSE IF ((EL(KBOT+1,ID)-ELR) == ELSTR) THEN !SR 03/24/13
			DLRHOB = NONZERO !SR 03/24/13
			ELSE
			DLRHOB = ABS(RHO(KSTR,ID)-RHO(KBOT,ID))*HSWB/(ELSTR-(EL(KBOT+1,ID)-ELR))
				4/9/2015

54	W2	SELECTC	The USGS has developed a new automatic port selection algorithm. In the control file, w2_con.npt, one can use the new algorithm by setting SELECTC='USGS'. The old algorithm is used when this is set to SELECTC= 'ON'. There is new documentation in the User Manual for this new algorithm.	4/9/2015
55	W2	Restart output	Added code to write out a restart file (rso.opt) at the end of a run if restart_output is ON.	4/9/15
56	W2 Examples	Added example problems	Added new example problem for the Spokane River using new csv file inputs and 4 example problems for using the USGS auto-port algorithm	4/9/15

57	W2	Restart for file volume_wbX.opt	The file handler was not closed properly for volume_wbX.opt. Fixed it with additional code in endsimualtion.f90:
			`if(nwd > 0)then`
			`  ifile=ifile+1`
			`  close(ifile)`
			`endif`
			`do jw=1,nwb  ! sw 4/20/15`
			`  ifile=ifile+1  ! sw 4/20/15`
			`  close(ifile)  ! sw 4/20/15`
			`enddo  ! sw 4/20/15`
				4/20/15

58	W2	W2selective.npt	Changed input format for critical temperatures for the output file volume_wbX.opt from a maximum of 10 waterbodies to 100. `READ(1010,'(8X,100F8.0)')(TEMPCRIT(JW,J),JW=1,NWB)  ! NOTE MAX OF 100 WATERBODIES  sw 4/20/15`	4/20/15
59	W2	Resuspension of SS	Changed DO loop index in suspended solids resuspension in water_quality.f90 from DO K=KT-1,KB(I)-1 to DO K=KT+1,KB(I)-1 ! cb 9/29/14	5/14/2015

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added
60	W2	Wind at 2 m	The W2 model computes the wind at a 2 m height based on the used defined measurement height of the wind for evaporation computations. The formula for computing this variable was using a step function of the wind data rather than interpolation of the wind data when the user chose to interpolate meteorological data. For meteorological input data at short time intervals this is a very minor change. For meteorological data at large time intervals (like a day), this could affect the amount of evaporation. Hence, the calculation below was moved from the TVDS routine to the main routine so that the interpolated wind would be used. `WIND2(I)=WIND(JW)*WSC(I)*DLOG(2.0D0/Z0(JW))/DLOG(WINDH(JW)/Z0(JW))`	5/21/15
61	W2	TSR output	The TSR file output now also includes a volume weighted vertical average temperature for the segment that the TSR file is located. The manual has been updated also.	6/1/15

62	W2	Writing over output files	In some intermittent cases, when the dialog box closes, the model reinitializes some of the output files (effectively deleting the output). The following line of code was adding at the beginning of the main W2 code to prevent this:
			
			`!**`
			`Task 1: Inputs`
			`**`
			`!**********...`
			
			`INTEGER(4) length,istatus`
			`character*255 dirc`
			`! call omp_set_num_threads(4) ! set # of processors to NPROC Moved to INPUT subroutine`
			`IF(END_RUN)STOP ! SW 6/26/15 Added code to prevent a thread from reinitializing output files as dialog box is closing...intermittant error`
				6/26/15

63	W2	Output order for kinetic fluxes	The output columns for DOAR and DOER were switched in the output file kflux_jw*.opt. The model code was changed to fix this. ! DOAR => KF(:,:,56); DOEP => KF(:,:,57); DOER => KF(:,:,58); DOPOM => KF(:,:,59); DODOM => KF(:,:,60) DOEP => KF(:,:,56); DOAR => KF(:,:,57); DOER => KF(:,:,58); DOPOM => KF(:,:,59); DODOM => KF(:,:,60) ! cb 9/16/2015	9/16/15

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

#	Code: W2 or PREW2 or GUI	Fix or Enhancement Type	Description of Bug/Enhancement	Date Bug Fixed or Enhancement added
15	W2	Command line processing for windows	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: `W2_ivf.exe "C:\scott\w2workshop\2009 workshop\waterqual\problem3"` 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.	9/12/09

16	W2	W2 window closed at end of successful execution	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.
			
			`GRID NWB NBR IMX KMX`
			`NPROC CLOSEC`
			`1 1 23 22`
			`0 ON`
			
			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'.
				9/12/09

17	User Manual	Updates	Updates and changes to the control file (#13-#16) were reflected in an updated User Manual.	9/12/09

#	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

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

32	W2	Branch intersections with multiple waterbodies	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):
			
			`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)`
				10/30/2010

33	W2	SS resuspension	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:
			
			`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`
			
			Thanks to James Pasley for this bug report/fix.
				2/3/2012

W2 V3.5 Bug Fixes, Enhancements, and User Manual Changes

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added
1	W2	Zooplank-ton-algae	Sign error in the zooplankton grazing on algae term	8/23/06
2	W2	Input/output	Format for I/O was changed to allow better decimal precision of output	8/23/06

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

3	W2	Sediment settling rate	The sediment settling rate was accidentally used for POM settling. This was fixed. The old and new code lines are shown below:
			OLD:
			`sedsum = sedsum+seds(JW)*(LPOM(K,I)*lpomdk(jw)+ RPOM(K,I)*rpomdk(jw))*BI(K,I)/BH2(K,I) *(1.0-BI(K+1,I)/BI(K,I))`
			NEW:
			`sedsum = sedsum+poms(JW)*(LPOM(K,I)*lpomdk(jw)+ RPOM(K,I)*rpomdk(jw))*BI(K,I)/BH2(K,I) *(1.0-BI(K+1,I)/BI(K,I)) ! cb 10/22/06`
			
			This was an issue in the SEDIMENT, SEDIMENT C, SEDIMENT P, SEDIMENT N, and SEDIMENT DECAY RATE subroutines.
				10/26/06

4	W2	Sediment burial	An algorithm was added for sediment burial. This is now a new parameter in the sediment part of the control file. An updated user manual description is forthcoming. The sediment burial rate SEDB (day^{-1}) can be specified in the "SEDIMENT" card section of the control file. A different burial rate can be specified for each water body.
			
			OLD/NEW line (example):
			`! SED(K,I) = MAX(SED(K,I)+(LPOMEP(K,I)+SEDAS(K,I)+S EDOMS(K,I)+SEDNS(K,I)- SEDD(K,I))*DLT,0.0)`
			`SED(K,I) = MAX(SED(K,I)+(sedem+SEDAS(K,I)+sedcb(k ,i)+SEDOMS(K,I)+SEDNS(K,I)-SEDD(K,I)- sedbr(k,i))*DLT,0.0) ! cb 11/30/06`
				11/30/06

5	Control File	Add burial rate for sediment model	This is the change in #4 above implemented in the control file. The new variable SEDBR is added in f8 format after the FSED variable. SEDBR: sediment burial rate in units of per day.
			
			`SEDIMENT SEDC SEDPRC SEDCI SEDK SEDS FSOD FSED SEDBR`
			`WB 1 ON ON 0.00000 0.10000 0.1 1.00000 1.00000 1.0`	

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

6	W2	Sediment heating and sediment processes	If a model added and subtracted layers that resulted in segment addition and subtraction, there was the possibility that sediment fluxes were incorrectly computed.
			In the NO3 subroutine:
			Old code:
			`NO3SED(K,I) = NO3(K,I)*NO3S(JW)*NO3TRM(K,I)*(BI(K,I)-BI(K+1,I))/BH2(K,I)`
			New code:
			`if(k == kb(i)) then`
			`NO3SED(K,I) = NO3(K,I)*NO3S(JW)*NO3TRM(K,I)*(BI(K,I))/BH2(K,I)`
			`else`
			`NO3SED(K,I) = NO3(K,I)*NO3S(JW)*NO3TRM(K,I)*(BI(K,I)-BI(K+1,I))/BH2(K,I)`
			`endif`
			
			New code added in sediment routine:
			`if(k == kb(i))then ! SW 4/18/07`
			`SODD(K,I) = SOD(I)/BH2(K,I)*SODTRM(K,I)*BI(K,I)`
			`else`
			`SODD(K,I) = SOD(I)/BH2(K,I)*SODTRM(K,I)*(BI(K,I)-BI(K+1,I))`
			`Endif`
			New code added in suspended solids routine:
			`if(k == kb(i))then`
			`SSR = EPSILON*DLX(I)*BI(K,I)/VOL(K,I)`
			`else`
			`SSR = EPSILON*DLX(I)*(BI(K,I)-BI(K+1,I))/VOL(K,I)`
			`Endif`
				4/18/07

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

6	W2	(see above)	New code added for heat flux to channel bottom:
			`if(kt == kb(i))then ! SW 4/18/07`
			`SROSED = SROOUT*TSEDF(JW)`
			`else`
			`SROSED = SROOUT*(1.0-BI(KT+1,I)/BI(KT,I))*TSEDF(JW)`
			`Endif`
			
			`if(k==kb(i))then ! SW 4/18/07`
			`TFLUX = CBHE(JW)/RHOWCP*(TSED(JW)-T2(K,I))*BI(K,I)*DLX(I)`
			`else`
			`TFLUX = CBHE(JW)/RHOWCP*(TSED(JW)-T2(K,I))*(BI(K,I)-BI(K+1,I))*DLX(I)`
			`endif`
			
			New code added for sediment subroutine:
			`if(k == kb(i))then ! SW 4/18/07`
			`SEDAS(K,I) = SEDAS(K,I)+MAX(AS(JA),0.0)*ALG(K,I,JA)*BI(K,I)/BH2(K,I)*(1.0-BI(K+1,I)/BI(K,I))`
			`else`
			`SEDAS(K,I) = SEDAS(K,I)+MAX(AS(JA),0.0)*ALG(K,I,JA)*BI(K,I)/BH2(K,I)*(1.0-BI(K+1,I)/BI(K,I))`
			`endif`
			`if(k == kb(i))then ! SW 4/18/07`
			`SEDOMS(K,I) = POMS(JW)*(LPOM(K,I)+RPOM(K,I))*BI(K,I)/BH2(K,I)`
			`SEDSO = POMS(JW)*SED(K,I)*BI(K+1,I)/BH2(K,I)`
			`else`
			`SEDOMS(K,I) = POMS(JW)*(LPOM(K,I)+RPOM(K,I))*BI(K,I)/BH2(K,I)*(1.0-BI(K+1,I)/BI(K,I))`
			`SEDSO = POMS(JW)*SED(K,I)*BI(K+1,I)/BH2(K,I)*(1.0-BI(K+1,I)/BI(K,I))`
			`endif`
				4/18/07

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

7	W2	Zoo-plankton fixes	Several fixes in the zooplankton routine were made. Many thanks to Dr. Kellie Vache, Institute for Landscape Ecology and Resources Management (ILR) Justus-Liebig-University Giessen Heinrich-Buff-Ring 26 35392 Giessen, Germany, for finding these which are documented below:
			`DO K=KT,KB(I)`
			`do jz = 1, nzp`
			`zgztot=0.0`
			`!kv 5/9/2007`
			`do jjz = 1,nzp`
			`! zooss(k,i,jz)=`
			`(zmu(k,i,jz)*zeff(jz)-zrt(k,i,jz)-`
			`zmt(k,i,jz))*zoo(k,i,jz) -`
			`zgz(k,i,jz,jjz)*zoo(k,i,jz) !`
			`omnivorous zooplankton`
			
			`zgztot=zgztot+zgz(k,i,jz,jjz)*zoo(k,i,`
			`jz) !kv 5/9/2007`
			`end do`
			`zooss(k,i,jz)=`
			`(zmu(k,i,jz)*zeff(jz)-zrt(k,i,jz)-`
			`zmt(k,i,jz))*zoo(k,i,jz) - zgztot`
			`! kv 5/9/2007`
			`end do`
			
			`do jjz = 1, nzp`
			`! tgraze(k,i,jz) =`
			`tgraze(k,i,jz) +`
			`prefz(jz,jjz)*zoo(k,i,jjz)`
			`tgraze(k,i,jz) =`
			`tgraze(k,i,jz) +`
			`prefz(jjz,jz)*zoo(k,i,jjz) !cb`
			`5/17/2007`
			`end do`
			
			`do jjz = 1,nzp ! omnivorous zooplankton`
			`! ZGZ(k,i,jjz,jz)`
			`=`
			`Zmu(K,I,jz)*ZOO(K,I,jz)*prefZ(jz,jjz)/`
			`tgraze(K,I,jz)`
			`ZGZ(k,i,jjz,jz)`
			`=`
			`Zmu(K,I,jz)*ZOO(K,I,jz)*prefZ(jjz,jz)/`
			`tgraze(K,I,jz) !kv 5/9/2007`
			`end do`
				5/21/07

8	PRE	More checks	Added checks for Sediment burial rate and some further checks on grid geometry; added output on SEDS and SEDBR to the pre.opt file; fixed condition where NZP had to equal 1 to work.	6/2/2007

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added
9	W2	Array deallocation	The deallocate command on line 7557 was commented out to avoid a deallocation error when the 'STOP' button is pushed during execution on a PC. `! deallocate (sedbr,sedbrp,sedbrn,sedbrc) ! SW 6/4/07 No need to deallocate pointers`	6/4/2007

10	W2	Initialization of IUT	For code setting up an external head BC, the variable IUT was not initialized before it was used. This was fixed below:
			`!**** Boundary bottom layers`
			`! IF (UH_EXTERNAL(JB)) KB(IUT-1) = KB(IUT)`
			`IF (UH_EXTERNAL(JB)) KB(IU-1) = KB(IU) !cb 6/12/07`
			`IF (UH_INTERNAL(JB)) THEN`
			`IF (JBUH(JB) >= BS(JW) .AND. JBUH(JB) <= BE(JW)) THEN`
			`! KB(IUT-1) = MIN(KB(UHS(JB)),KB(IUT))`
			`KB(IU-1) = MIN(KB(UHS(JB)),KB(IU)) !cb 6/12/07`
			`ELSE`
			`! IF (EL(KB(IUT),IUT) >= EL(KB(UHS(JB)),UHS(JB))) THEN`
			`IF (EL(KB(IU),IU) >= EL(KB(UHS(JB)),UHS(JB))) THEN !cb 6/12/07`
			`! KB(IUT-1) = KB(IUT)`
			`KB(IU-1) = KB(IU)`
			`ELSE`
			`! DO K=KT,KB(IUT)`
			`! IF (EL(KB(UHS(JB)),UHS(JB)) >= EL(K,IUT)) THEN`
			`! KB(IUT-1) = K; EXIT`
			`DO K=KT,KB(IU) !cb 6/12/07`
			`IF (EL(KB(UHS(JB)),UHS(JB)) >= EL(K,IU)) THEN !cb 6/12/07`
			`KB(IU-1) = K; EXIT !cb 6/12/07`
			`END IF`
				6/17/2007

11	W2	CBOD settling	The CBOD settling rate earlier was not converted from m/d in the control file to m/s in the code. Added code: `cbods = cbods/day !cb 7/23/07`	7/23/07

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added
12	W2	TSR output	The surface width was not correctly being output. Changed BI(KT) to BI(KTWB(JW)). FIX: BI(KTWB(JW),I),SHADE(I),ICETH(I),(ADJU STR(C2CH(JAC)),JAC=1,NAC), & ! CB 7/26/07	7/26/07
13	PREW2	Pumps	The pump control for DOWN or LAT was not being checked properly, also a check on IUPUC was incorrect. Fixed.	8/14/07
14	W2	Algae	The logic for negative settling velocities for algae had an error. Old code: ! ASR(K,I,JA) = - AS(JA)*(ALG(K+1,I,JA)*B(K+1,I)/(B(K,I) *H2(K,I))- ALG(K,I,JA))*BI(K,I)/BH2(K,I) New code: ASR(K,I,JA) = - AS(JA)*(ALG(K+1,I,JA)*BI(K+1,I)/BH2(K, I)-ALG(K,I,JA)*BI(K,I)/BH2(K,I)) !SP 8/27/07 Shwet Prakash	8/27/07
15	GUI	NZOOP	When # of zooplankton was set equal to zero, there was an array dimensioning error that caused the writing of the control file to only proceed part way. Fixed.	9/17/07

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

16	W2	Open channel flow	Variable passed between subroutines had inconsistent declaration between routines.
			`! REAL, ALLOCATABLE, DIMENSION(:) :: Y, D, B, V, CAREA, TOPW, BELEV, Q, VOLD, YOLD`
			
			`REAL, ALLOCATABLE, DIMENSION(:) :: Y, B, V, CAREA, TOPW, BELEV, Q, VOLD, YOLD ! cb 10/1/07`
			
			`! ALLOCATE (Y(NN), V(NN), CAREA(NN), TOPW(NN), BELEV(NN), Q(NN), VOLD(NN), YOLD(NN), D(NN), B(NN))`
			
			`ALLOCATE (Y(NN), V(NN), CAREA(NN), TOPW(NN), BELEV(NN), Q(NN), VOLD(NN), YOLD(NN), B(NN)) ! cb 10/1/07`
			
			`! DEALLOCATE (Y, V, CAREA, TOPW, BELEV, Q, VOLD, YOLD, D, B, YT, VT, VPR, YPR, TAREA, TOPWT, RT, INDX, AL, DAA)`
			
			`DEALLOCATE (Y, V, CAREA, TOPW, BELEV, Q, VOLD, YOLD, B, YT, VT, VPR, YPR, TAREA, TOPWT, RT, INDX, AL, DAA) ! cb 10/1/07`
				10/4/07

17	W2	TKE model	The TKE algorithm had several bugs that have been fixed, these included making the loop over layers go to KBMIN (rather than KB), the original code overwrote the boundary conditions when using the Thomas algorithm, the original code overwrote vertical eddy viscosity at the bed during the averaging process, Δz_k changed to $\Delta z_{k+1/2}$, TKE array was initialized to zero, TKE was implemented in add/sub layers like AZ. Many of these fixes are a result of the work of Sam Gould (Gould, 2006) who wrote an MS project report at PSU entitled "k-e Turbulence Model." Further recommendations by Gould (2006) will be incorporated into the next version of CE-QUAL-W2. The old code is shown below as a reference to the new code in the release version. OLD CODE `ENTRY CALCULATE_TKE`	10/4/07

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

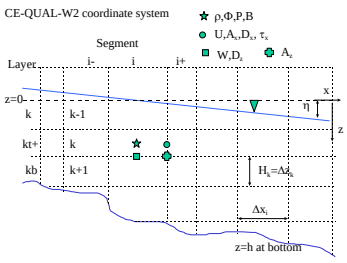
			USTAR = SQRT(1.25*CZ(I)*WIND10(I)**2/RHO(KT,I))
			IF (MANNINGS_N(JW)) THEN
			HRAD = BHR1(KT,I)/(BR(KTI(I),I)-BR(KT+1,I)+2.*AVH1(KT,I))
			if(macrophyte_on.and.mannings_n(jw))then
			call macrophyte_friction(hrad,fric(i),effric,kt,i)
			gc2=g*effric*effric/hrad**0.33333333
			else if(.not.macrophyte_on.and.mannings_n(jw))then
			gc2=g*fric(i)*fric(i)/hrad**0.33333333
			end if
			ELSE
			GC2 = 0.0
			IF (FRIC(I) /= 0.0) GC2 = G/(FRIC(I)*FRIC(I))
			END IF
			USTARB = SQRT(GC2)*ABS(0.5*(U(KT,I)+U(KT,I-1)))
			TKE(KT,I,1) = 0.5*(3.33*(USTAR*USTAR+USTARB*USTARB)+TKE(KT,I,1))*(BH2(KT,I)/BH1(KT,I))
			TKE(KT,I,2) = 0.5*(USTAR*USTAR*USTAR+USTARB*USTARB*USTARB*5.0/H1(KT,I)+TKE(KT,I,2))*(BH2(KT,I)/BH1(KT,I))
			DO K=KT+1,KB(I)-1
			BOUK = MAX(AZ(K,I)*G*(RHO(K+1,I)-RHO(K,I))/(H(K,JW)*RHOW),0.0)
			PRDK = AZ(K,I)*(0.5*(U(K,I)+U(K,I-1)-U(K+1,I)-U(K+1,I-1))/H(K,JW))**2.0
			PRHE = 10.0*GC2**1.25*ABS(0.5*(U(K,I)+U(K,I-1)))**4.0/(0.5*B(K,I))**2.0
			IF (MANNINGS_N(JW)) THEN
			! v3.5 start
			HRAD = BHR(K,I)/(BR(K,I)-BR(K+1,I)+2.0*H(K,JW))
			! GC2 = G*FRIC(I)*FRIC(I)/HRAD**0.333
			
			if(macrophyte_on.and.mannings_n(jw))then
			call macrophyte_friction(hrad,fric(i),effric,k,i)
			
			gc2=g*effric*effric/hrad**0.33333333
			else if(.not.macrophyte_on.and.mannings_n(jw))then
			
			gc2=g*fric(i)*fric(i)/hrad**0.33333333
			end if	

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

			! v3.5 end
			END IF
			PRHK = GC2/(0.5*B(K,I))*ABS(0.5*(U(K,I)+U(K,I-1)))**3.0
			UNST = PRDK-TKE(K,I,2)
			UNSE = 1.44*TKE(K,I,2)/TKE(K,I,1)*PRDK-1.92*(TKE(K,I,2)/TKE(K,I,1)*TKE(K,I,2))
			TKE(K,I,1) = TKE(K,I,1)+DLT*(UNST+PRHK-BOUK)
			TKE(K,I,2) = TKE(K,I,2)+DLT*(UNSE+PRHE)
			END DO
			USTARB = SQRT(GC2)*ABS(0.5*(U(KB(I),I)+U(KB(I),I-1)))
			TKE(KB(I),I,1) = 0.5*(3.33*USTARB*USTARB+TKE(KB(I),I,1))
			TKE(KB(I),I,2) = 0.5*(USTARB*USTARB*USTARB*5.0/H(KB(I),JW)+TKE(KB(I),I,2))
			AT = 0.0; CT = 0.0; VT = 0.0; DT = 0.0
			DO J=1,2
			DO K=KT,KB(I)
			AT(K,I) = -DLT/BH1(K,I)*BB(K-1,I)/SIG(J)*AZ(K-1,I)/AVH1(K-1,I)
			CT(K,I) = -DLT/BH1(K,I)*BB(K,I)/SIG(J)*AZ(K,I)/AVH1(K,I)
			VT(K,I) = 1.0-AT(K,I)-CT(K,I)
			DT(K,I) = TKE(K,I,J)
			END DO
			CALL TRIDIAG(AT(:,I),VT(:,I),CT(:,I),DT(:,I),KT,KB(I),KMX,TKE(:,I,J))
			END DO
			DO K=KT,KB(I)
			TKE(K,I,1) = MAX(TKE(K,I,1),TKEMIN1)
			TKE(K,I,2) = MAX(TKE(K,I,2),TKEMIN2)
			AZ(K,I) = 0.09*TKE(K,I,1)*TKE(K,I,1)/TKE(K,I,2)
			END DO
			! Center at cell faces
			DO K=KT,KB(I)-1
			AZ(K,I) = 0.5*(AZ(K,I)+AZ(K+1,I))
			AZ(K,I) = MAX(AZMIN,AZ(K,I))
			AZ(K,I) = MIN(AZMAX(JW),AZ(K,I))
			DZ(K,I) = MAX(DZMIN,FRAZDZ*AZ(K,I))
			END DO	

18	W2	Restart	Added TKE to restart variables written out and read in.	10/5/07

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added
19	GUI	ET	The equilibrium temperature option in the drop down menu was 'EQT' rather than 'ET'. Fixed.	10/9/07
20	W2	Sediment	The SEDIMENT subroutine did not have any computational mistakes, just an error in assigning all array variables to the value at K,I. This resulted in excessive computational time. The fix is shown below: OLD sedbr = sedb(jw)*sed(k,i) NEW sedbr(K,I) = sedb(jw)*sed(k,i)	10/15/07

21	W2	TKE	Turbulence model had an improper averaging between layers. A new temporary variable was defined to temporarily store the values for AZ prior to averaging to the bottom/top of the layers and the horizontal layers. This also affected the computation of DZ. Fixed.
			
			New code defined AZT and allocated memory for it, such that
			`AZT(K,I) = 0.09*TKE(K,I,1)*TKE(K,I,1)/TKE(K,I,2)`
			and
			`AZ(K,I) = 0.5*(AZT(K,I)+AZT(K+1,I))`
			
			Similarly for the horizontal averaging and for DZ. Also, the values of DZ were fixed to be at the bottom of a cell and AZ was fixed to be at the bottom right-hand edge of a cell as shown below:
			 
			
				12/17/07

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

22	W2	SS settling	The incorrect cell width was used for SSSO. BI(KT,I) was changed to BI(K,I).
			
			OLD CODE:
			`SSSO(K,I) = (TOTSS0+FES(JW)*FPFE(K,I))*BI(KT,I)/BH2(K,I)*DO1(K,I)`
			`FPSS(K,I) = FPSS(K,I)*TISS(K,I)`
			NEW CODE:
			`SSSO(K,I) = (TOTSS0+FES(JW)*FPFE(K,I))*BI(K,I)/BH2(K,I)*DO1(K,I)`
			`FPSS(K,I) = FPSS(K,I)*TISS(K,I)`
				12/17/07

23	W2	Initial-ization of one-layer	The definition of KBMIN was not updated if the model started out in some segments with only one_layer. This has been fixed.
			
			Added code highlighted:
			`DO I=IU,ID`
			`IF (KB(I)-KT < NL(JB)-1) IUT = I+1`
			`ONE_LAYER(I) = KT == KB(I)`
			`END DO`
			`CUS(JB) = IUT`
			`! reinitialize KBMIN`
			`DO I=IU-1,ID`
			`KBMIN(I) = MIN(KB(I),KB(I+1))`
			`END DO`
			`KBMIN(ID+1) = KBMIN(ID)`
			
			`!**** Areas and bottom widths`
			
			`IF (.NOT. TRAPEZOIDAL(JW)) THEN`
				12/17/07

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

24	W2	Bottom processes	This is a couple more fixes related to bug fix #6 above. The Denitrification rate and epiphyton burial rates could be affected based on unique combinations of adding/subtracting segments that left the value of BI in an inactive layer below KB defined incorrectly. In order to prevent the possibility of problems, the following fixes were made:
			
			Old Code:
			`sedNO3(K,I) = NO3(K,I)*NO3S(JW)*NO3TRM(K,I)*(BI(K,I)-BI(K+1,I))/BH2(K,I)`
			
			`EPM(K,I,J) = EPD(K,I,J)*(BI(K,I)-BI(K+1,I)+2.0*H1(K,I))*DLX(I)`
			
			New code:
			`if(k == kb(i)) then ! SW 12/16/07`
			`sedNO3(K,I) = NO3(K,I)*NO3S(JW)*NO3TRM(K,I)*(BI(K,I))/BH2(K,I)`
			`else`
			`sedNO3(K,I) = NO3(K,I)*NO3S(JW)*NO3TRM(K,I)*(BI(K,I)-BI(K+1,I))/BH2(K,I)`
			`endif`
			
			`if(k == kb(i)) then ! SW 12/16/07`
			`EPM(K,I,J) = EPD(K,I,J)*(BI(K,I)+2.0*H1(K,I))*DLX(I)`
			`else`
			`EPM(K,I,J) = EPD(K,I,J)*(BI(K,I)-BI(K+1,I)+2.0*H1(K,I))*DLX(I)`
			`endif`
				12/17/2007

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

25	W2	CBODS	If the user defined particulate CBOD that settles to the bottom and had SED turned ON, the conversion from oxygen to organic matter was missing in the accumulation on the channel bottom or sides.
			
			OLD
			`do jd=1,nbod`
			`SEDcb(K,I) = SEDcb(K,I)+MAX(cbods(jd),0.0)*cbod(K,I,Jd)*BI(K,I)/BH2(K,I)*(1.0-BI(K+1,I)/BI(K,I))`
			`end do`
			NEW
			`do jd=1,nbod`
			`SEDcb(K,I) = SEDcb(K,I)+MAX(cbods(jd),0.0)*(cbod(K,I,Jd)/O2OM(JW))*BI(K,I)/BH2(K,I)*(1.0-BI(K+1,I)/BI(K,I))`
			`! 1/16/08`
			`end do`
				1/18/08

26	W2	SEDBR	Eliminated a redundant definition of SEDBR in the Sediment routine since it is already defined in the Kinetic rates subroutine.	1/18/08

27	W2	SEDDK	The first order sediment decay rate is an average of the decay rates of all the influxes of organic matter and their respective decay rates. There was an error in computing this average decay rate for CBOD treated as particulate. Code fix is shown below:
			
			OLD
			`do jd=1,nbod`
			`sedsum = sedsum+MAX(cbods(jd),0.0)*cbod(K,I,Jd)*BI(K,I)/BH2(K,I)*(1.0-BI(K+1,I)/BI(K,I))`
			`end do`
			
			NEW
			`do jd=1,nbod`
			`sedsum = sedsum+MAX(cbods(jd),0.0)*cbod(K,I,Jd)*BI(K,I)/BH2(K,I)*(1.0-BI(K+1,I)/BI(K,I))*RBOD(JD)*CBODD(K,I,JD)/O2OM(JW)`
			`end do`
				1/18/08

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

28	W2	SRO	There are some cases when segments were added/subtracted that the value of BI was not correctly initialized. This code is a fix to prevent such occurrences:
			
			OLD CODE:
			SRONET = SROIN-SROOUT
			SROSED = SROOUT*(1.0-BI(K+1,I)/BI(K,I))*TSEDF(JW)
			
			NEW CODE:
			SRONET = SROIN-SROOUT
			if(k /= kb(i))then ! SW 1/18/08
			SROSED = SROOUT*(1.0-BI(K+1,I)/BI(K,I))*TSEDF(JW)
			else
			SROSED = SROOUT*TSEDF(JW)
			endif
				1/18/2008

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

29	W2	Water Quality	Added several calls to prevent computation of kinetic variables if epiphyton are defined in the control file with NEP=1 or more but is not ACTIVE or turned ON. If the kinetic expressions are non-zero and the initial concentration is given, then this could add source/sink terms to the oxygen balance.
			
			This is typical of the code changes – since several of this type were made:
			
			OLD CODE:
			DO JE=1,NEP
			PO4EG(K,I) = PO4EG(K,I)+EGR(K,I,JE)*EPC(K,I,JE)*EP(JE)
			PO4ER(K,I) = PO4ER(K,I)+ERR(K,I,JE)*EPC(K,I,JE)*EP(JE)
			END DO
			
			NEW CODE:
			IF (EPIPHYTON_CALC(JW,JE))then ! SW 1/18/2008
			PO4EG(K,I) = PO4EG(K,I)+EGR(K,I,JE)*EPC(K,I,JE)*EP(JE)
			PO4ER(K,I) = PO4ER(K,I)+ERR(K,I,JE)*EPC(K,I,JE)*EP(JE)
			endif
				1/18/2008

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

30	W2	Bottom processes	Continuation of bug fix #24 in such places as
			
			New code:
			`IF(K == KB(I))THEN`
			`  xdum=BI(K,I)/BH2(K,I)  ! SW 1/18/08`
			`  ELSE`
			`  xdum=BI(K,I)/BH2(K,I)*(1.0-BI(K+1,I)/BI(K,I))`
			`  ENDIF`
			
			`  SEDAS(K,I) = SEDAS(K,I)+MAX(AS(JA),0.0)*ALG(K,I,JA)*xdum  ! SW 1/18/08`
			
			`SEDOMS(K,I) = pomS(JW)*(LPOM(K,I)+RPOM(K,I))*xdum !sw 1/18/08 cb 10/22/06`
			`  IF(K==KB(I))THEN  ! SW 1/18/08`
			`  SEDSO = 0.0`
			`  ELSE`
			`  SEDSO = sedS(JW)*SED(K,I)*BI(K+1,I)/BH2(K,I)*(1.0-BI(K+1,I)/BI(K,I))`
			`  Endif`
			
			`DO K=KT,KB(I)`
			`  IF(K == KB(I))THEN`
			`  xdum=BI(K,I)/BH2(K,I)  ! SW 1/18/08`
			`  ELSE`
			`  xdum=BI(K,I)/BH2(K,I)*(1.0-BI(K+1,I)/BI(K,I))`
			`  ENDIF`
			`  DO JA=1,NAL`
			`  SEDASp(K,I) = SEDASp(K,I)+MAX(AS(JA),0.0)*ap(ja)*ALG(K,I,JA)*xdum  ! SW 1/18/08`
			`  END DO`
			`  DO JE=1,NEP`
			`  IF (EPIPHYTON_CALC(JW,JE))LPOMEPp(K,I) = LPOMEPp(K,I)+EPOM(JE)*ep(je)*(EMR(K,I,JE)*EPC(K,I,JE))`
			`  END DO`
			`  do jd=1,nbod`
			
			This code is repeated similarly in many of the sediment routines.
				1/18/2008

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added
31	W2	Add segment initial-ization	The DEPTHM and DEPTHB were not initialized correctly when a segment was added – this does not affect internal computations, just output for SPR and SNP files. OLD CODE: BKT(I) = BH1(KT,I)/H1(KT,I) DEPTHB(K,I) = H1(KT,I) ! DEPTHM(K,I) = H1(KT,I)*0.5 NEW CODE: BKT(I) = BH1(KT,I)/H1(KT,I) DEPTHB(KT,I) = H1(KT,I) ! SW 1/27/08 DEPTHM(KT,I) = H1(KT,I)*0.5 ! SW 1/27/08	1/27/08

W2 V3.2 BUG FIXES, ENHANCEMENTS, AND USER MANUAL CHANGES

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added
1	W2	Waterbody-waterbody connection	When there was negative velocities at a waterbody-waterbody connection, there was a possibility (dependent on the bathymetry of the connection at the waterbody-waterbody intersection) that there could be temperature or concentration anomalies.	8/31/04
2	W2	Lateral_ withdrawal	Added limit to the DLRHOMAX function: Old code: DLRHOMAX=MAX(DLRHOT,DLRHOB) New code: DLRHOMAX=MAX(DLRHOT,DLRHOB,1.0E-10)	1/25/05

3	W2	Branch connectivity	Logic in branch connectivity set-up was fixed
			Old code:
			IF(UHS(JB) == DS(JJJB))EXIT
			New code:
			IF(abs(UHS(JB)) == DS(JJJB))EXIT
				1/25/05

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

4	W2	Pumpback	Pumpback logic was corrected – this is legacy code that will probably be removed from later versions of W2
			Old code:
			DO JB=1,NBR
			IF (JB == JBP) JWBP = JW
			END DO
			New code:
			DO JW=1,NWB
			DO JB=BS(JW),BE(JW)
			IF(JB == JBP) JWBP = JW
			END DO
			END DO
				1/25/05

5	W2	CPL write	Switched order of implied DO loop on CPL write statement for output of constituents	1/25/05
6	W2	PRF write	Changed output format for PRF output for constituents from f10.2 to e13.6	1/25/05
7	W2	Heat balance	Added the Idso and Jackson long wave radiation equation when air temperatures are below 5C. The Swinbank model underpredicts long wave incoming radiation at low air temperatures by as much as 10%. The computation of long wave atmospheric radiation is done using the approach of Swinbank (1963) unless air temperatures are less than 5^{o}C, when the Idso and Jackson (1969) formula is used (Wells, et al., 1982). The Swingbank formula for clear sky long wave atmospheric radiation is $\phi_{ac} = 5.31E-13(T_a + 273)^6$ where units are W/m^2,^{o}C at 2 m height. Below 40^{o}F (5^{o}C) the formula of Idso and Jackson is recommended (above 10^{o}C both equations are almost identical): $\phi_{ac} = \sigma(T_a + 273)^4\left(1 - 0.261\exp(-7.77E-4T_a^2)\right)$ where units are W/m^2 and T_a is in units of ^{o}C. The Stefan-Boltzmann constant = 5.62E-8 W/m^2/(^{o}K)^4.	1/25/05

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

7	W2	Layer addition algorithm	Mistyped subscript K instead of I:
			Old code:
			`IF (KB(I) > KBI(I)) THEN`
			`B(KB(K),I) = 0.0`
			`DX(KB(I),I) = 0.0`
			`KB(I) = KB(I)-1`
			`IF (I /= DS(JB)+1) KBMIN(I) = MIN(KB(K),KB(I+1))`
			`IF (I /= US(JB)-1) KBMIN(I-1) = MIN(KB(I-1),KB(I))`
			
			New Code:
			`IF (KB(I) > KBI(I)) THEN`
			`B(KB(I),I) = 0.0 ! SW 3/2/05`
			`DX(KB(I),I) = 0.0`
			`KB(I) = KB(I)-1`
			`IF (I /= DS(JB)+1) KBMIN(I) = MIN(KB(I),KB(I+1)) ! SW 3/2/05`
			`IF (I /= US(JB)-1) KBMIN(I-1) = MIN(KB(I-1),KB(I))`
				3/2/05

8	W2	Variable initialize-tion	In some cases when there was a layer subtraction and a time step violation immediately afterward, the variable SW was not initialized properly. This caused problems in the Tomas Algorithm for the water surface computation. The following line of code was added to the SUB layer algorithm:
			`SW(KT-1,IU-1:ID+1) = 0.0 !TC 3/9/05`
			Also, the variable AVHR was defined in the Update variables for DS+1. The following new code was added:
			
			`AVHR(KT,DS(JB)+1)=H1(KT,DS(JB)+1) !SW 03/08/05`
				3/9/05

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

9	W2	Interpola-tion multipliers	Possible index error if there are multiple waterbodies.
			Old code:
			`RATZ(K,JW) = AVH2(K-1,I)/AVH2(K,I)`
			`CURZ1(K,JW) = 2.0*H(K,JW)**2/(AVH2(K-1,I)+AVH2(K,I))/AVH2(K-1,I)`
			`CURZ2(K,JW) = -2.0*H(K,JW)**2/(AVH2(K-1,I)*AVH2(K,I))`
			`CURZ3(K,JW) = 2.0*H(K,JW)**2/(AVH2(K-1,I)+AVH2(K,I))/AVH2(K,I)`
			`END DO`
			New code:
			`RATZ(K,JW) = AVH2(K-1,DS(BE(JW)))/AVH2(K,DS(BE(JW)))`
			`CURZ1(K,JW) = 2.0*H(K,JW)**2/(AVH2(K-1,DS(BE(JW)))+AVH2(K,DS(BE(JW))))/AVH2(K-1,DS(BE(JW)))`
			`CURZ2(K,JW) = -2.0*H(K,JW)**2/(AVH2(K-1,DS(BE(JW)))*AVH2(K,DS(BE(JW))))`
			`CURZ3(K,JW) = 2.0*H(K,JW)**2/(AVH2(K-1,DS(BE(JW)))+AVH2(K,DS(BE(JW))))/AVH2(K,DS(BE(JW)))`
				5/10/05

10	W2	Spillway and Gates	Older code in order to check if it was submerged or not used the elevation difference relative to the channel bed on either side of the weir, rather than the weir crest. Also removed code line: `IF(ELDN>ESP(JS))DH+ELUP-ELDN`	5/10/05

11	W2	Reaeration	Corrected formula errors in Thackston and Krenkel formula:
			Old code:
			`USTAR=SQRT(ADEPTH*SLOPE(JB)*32.2)**0.5`
			`REAER(I) = 24.88*(1.0+SQRT(0.176*UAVG/SQRT(ADEPTH)))*USTAR`
			New code:
			`USTAR=SQRT(ADEPTH*SLOPE(JB)*32.2)`
			`REAER(I) = 24.88*(1.0+SQRT(0.176*UAVG/SQRT(ADEPTH)))*USTAR/ADEPTH`
			Similar changes were made to the updated Thackston model (Eqn 10)
				5/10/05

12	W2	Violations NV	The variable BI and VOL was not initialized properly during a time-step violation.	8/25/05

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added
13	W2	ADD a layer	The variable BI was not initialized properly during an ADD layer.	8/25/05
14	W2	TRIDIAG subroutine	Insert Deallocate Statement in Tridiag SUBROUTINE TRIDIAG(A,V,C,D,S,E,N,U) USE PREC INTEGER, IN TENT(IN) :: S, E, N REAL(R8), DIMENSION(:), INTENT(IN) :: A(E),V(E),C(E),D(E) REAL, DIMENSION(:), INTENT(OUT) :: U(N) REAL(R8), ALLOCATABLE, DIMENSION(:) :: BTA, GMA ALLOCATE (BTA(N),GMA(N)) BTA(S) = V(S) GMA(S) = D(S) DO I=S+1,E BTA(I) = V(I)-A(I)/BTA(I-1)*C(I-1) GMA(I) = D(I)-A(I)/BTA(I-1)*GMA(I-1) END DO U(E) = GMA(E)/BTA(E) DO I=E-1,S,-1 U(I) = (GMA(I)-C(I)*U(I+1))/BTA(I) END DO Deallocate (BTA, GMA) <---- - ! SW 10/17/05 END SUBROUTINE TRIDIAG	10/17/05

15	W2	SUB layer	In SUB Layer/Sub Seg - eliminate parentheses which caused a sign error
			IF (.NOT. TRAPEZOIDAL(JW))
			THEN
			BI(KT,IU-1) = B(KTI(IU-
			1),I)
			H1(KT,IU-1) = H(KT,JW)-
			Z(IU-1)
			BH1(KT,IU-1) = B(KTI(IU-
			1),IU-1)*(EL(KT,IU-1)-EL(KTI(IU-1)+1,IU-
			1)-Z(IU-1)*COSA(JB))/COSA(JB) <----
			-- ! SR 10/17/05
			IF (KT >= KB(IU-1))
			BH1(KT,IU-1) = B(KT,IU-1)*H1(KT,IU-1)
			DO K=KTI(IU-1)+1,KT
			BH1(KT,IU-1) = BH1(KT,IU-
			1)+BH1(K,IU-1)
			END DO
			ELSE
				10/17/05

16	W2	SUB layer for shallow systems	Layer SUB - improve model running in shallow segments
			
			!** Water surface minimum thickness
			DO JW=1,NWB
			KT = KTWB(JW)
			ZMIN(JW) = -1000.0
			KTMAX = 2 <----- !
			SR 10/17/05
			DO JB=BS(JW),BE(JW)
			DO I=CUS(JB),DS(JB)
			IF(KB(I) > KTMAX) KTMAX = KB(I) <----- ! SR 10/17/05
			IF (Z(I) > ZMIN(JW)) THEN
			IZMIN(JW) = I
			JBIZ = JB
			END IF
			ZMIN(JW) = MAX(ZMIN(JW),Z(I))
			END DO
			END DO
			ADD_LAYER = ZMIN(JW) < -0.85*H(KT-1,JW) .AND. KT /= 2
			SUB_LAYER = ZMIN(JW) > 0.60*H(KT,JW) .AND. KT < KTMAX <-----
			! SR 10/17/05
			....
			!******** Upstream active segment
			IUT = US(JB)
			IF (SLOPE(JB) /= 0.0) THEN
			DO I=US(JB)-1,DS(JB)+1
			IF (KB(I) < KT)THEN <----------
			! SR 10/17/05
			KB(I) = KT
			B(KB(I),I) = 0.000001
			DX(KB(I),I) = DXI(JW)
			...
			!****** Additional layer subtractions
			ZMIN(JW) = -1000.0
			DO JB=BS(JW),BE(JW)
			DO I=CUS(JB),DS(JB)
			ZMIN(JW) = MAX(ZMIN(JW),Z(I))
			END DO
			END DO
			SUB_LAYER = ZMIN(JW) > 0.60*H(KT,JW) .AND. KT < KTMAX <------ ! SR 10/17/05
			END DO
			END DO
			
			Also done for the initial set-up of the branch geometry:
			!**** Upstream active segment and single layer
			
			IF (SLOPE(JB) /= 0.0) THEN
			DO I=US(JB)-1,DS(JB)+1
			IF (KB(I) < KT) THEN <----
			! .AND. I /= IZMIN(JW) SW 10/17/05
			B(KT,I) = 0.000001
				10/17/05

17	W2	Shade algorithm	No errors just an improvement in computational efficiency.	10/17/05

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

			Delete this from the SHADING subroutine:
			!** Set the angles for which topographic shade data are available
			DO II=1,IANG
			ANG(II)=((II-1)*(360.0/FLOAT(IANG)))*PI/180.0
			END DO
			GAMMA = (2*PI)/IANG
			and change the 2 occurrences of gamma to gama (only in shading subroutine):
			ANG2 = (TOPO(I,J+1)-TOPO(I,J))/GAMA <---- ! SW 10/17/05
			TOPOANG = TOPO(I,J)+ANG2*ANG1
			ENDIF
			END DO
			IF (AZ00 > ANG(IANG) .AND. AZ00 <= 2*PI) THEN
			ANG1 = AZ00-ANG(IANG)
			ANG2 = (TOPO(I,1)-TOPO(I,IANG))/GAMA <----! SW 10/17/05
			ADD a line to the module SHADEC:
			MODULE SHADEC
			PARAMETER (IANG=18)
			REAL, PARAMETER :: GAMA=(3.1415926*2.)/REAL(IANG) <--- ! SW 10/17/05
			REAL, DIMENSION(IANG):: ANG <----! SW 10/17/05
			REAL, ALLOCATABLE, DIMENSION(:) :: A00, DECL, HH, TTLB, TTRB, CLLB, CLRB <------- ! SW 10/17/05
			REAL, ALLOCATABLE, DIMENSION(:) ::
			SRLB1, SRRB1, SRLB2, SRRB2, SRFJD1, SRFJD2,SHADEI
			REAL,ALLOCATABLE, DIMENSION(:,:) :: TOPO
			LOGICAL, ALLOCATABLE, DIMENSION(:) :: DYNAMIC_SHADE
			DATA ANG /0.00000, 0.34907, 0.69813, 1.04720, 1.39626, 1.74533, 2.09440, 2.44346,&
			2.79253, 3.14159, 3.49066, 3.83972, 4.18879, 4.53786, 4.88692, 5.23599, 5.58505, 5.93412/ <----- ! SW10/17/05
			END MODULE SHADEC
			Delete allocation statement for ang:
			ALLOCATE (SRLB1(IMX), SRRB1(IMX), SRLB2(IMX), SRRB2(IMX), SRFJD1(IMX), SHADEI(IMX), SRFJD2(IMX))
			ALLOCATE (TOPO(IMX,IANG)) <---- !SW10/17/05
			ALLOCATE (QSW(KMX,NWDT), CTR(NCT,NTRT), HPRWBC(NHY,NWB))
			Delete ang from the deallocate statement:
			DEALLOCATE(TTLB, TTRB, CLLB, SRLB1, SRRB1, SRLB2, SRRB2, SRFJD1, SHADEI,SRFJD2, TOPO, QSW, CTR) <----! SW 10/17/05	

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added
18	W2	Epiphyton algorithm	Several changes were made that corrected errors in shallow systems where adding and subtracting layers did not reinitialize macrophyte layers when the current KT was below KB; the epiphyton burial rate was greater than specified in the control file; epiphyton that are buried become part of the 1st order organic sediment (as before); epiphyton mortality now becomes part of the LPOM pool (based on the EPOM fraction) and is settled and transported downstream rather than going into the organic 1st order sediment model directly. Currently this is non-photosynthesizing – but we will change in the next version.	5/26/06
19	W2	ADD/SUB layers	There was a bug in addition and subtraction of layers that led to water quality variables not being initialized correctly during riverine shallow flow	5/26/06
20	User Manual	Typos corrected	The manual had a few typos that were corrected.	6/11/2006
21	W2	Waterbody-waterbody connection	The subroutine Upstream_velocity under specific conditions did not maintain flwo continuity across a waterbody-waterbody connection	6/29/2006
22	W2	SNP output	The algal limiting nutrient SNP output had a bug under specific conditions in writing out the information.	6/30/2006

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

23	W2	Sediment heating and sediment processes	If a model added and subtracted layers that resulted in segment addition and subtraction, there was the possibility that sediment fluxes were incorrectly computed.
			
			In the NO3 subroutine:
			Old code:
			`NO3SED(K,I) = NO3(K,I)*NO3S(JW)*NO3TRM(K,I)*(BI(K,I)-BI(K+1,I))/BH2(K,I)`
			
			New code:
			`if(k == kb(i)) then`
			`NO3SED(K,I) = NO3(K,I)*NO3S(JW)*NO3TRM(K,I)*(BI(K,I))/BH2(K,I)`
			`else`
			`NO3SED(K,I) = NO3(K,I)*NO3S(JW)*NO3TRM(K,I)*(BI(K,I)-BI(K+1,I))/BH2(K,I)`
			`endif`
			
			New code added in sediment routine:
			`if(k == kb(i))then ! SW 4/18/07`
			`SODD(K,I) = SOD(I)/BH2(K,I)*SODTRM(K,I)*BI(K,I)`
			`else`
			`SODD(K,I) = SOD(I)/BH2(K,I)*SODTRM(K,I)*(BI(K,I)-BI(K+1,I))`
			`Endif`
			New code added in suspended solids routine:
			`if(k == kb(i))then`
			`SSR = EPSILON*DLX(I)*BI(K,I)/VOL(K,I)`
			`else`
			`SSR = EPSILON*DLX(I)*(BI(K,I)-BI(K+1,I))/VOL(K,I)`
			`Endif`
				4/18/07

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

23	W2	(see above)	New code added for heat flux to channel bottom:
			`if(kt == kb(i))then ! SW 4/18/07`
			`SROSED = SROOUT*TSEDF(JW)`
			`else`
			`SROSED = SROOUT*(1.0-BI(KT+1,I)/BI(KT,I))*TSEDF(JW)`
			`Endif`
			
			`if(k==kb(i))then ! SW 4/18/07`
			`TFLUX = CBHE(JW)/RHOWCP*(TSED(JW)-T2(K,I))*BI(K,I)*DLX(I)`
			`else`
			`TFLUX = CBHE(JW)/RHOWCP*(TSED(JW)-T2(K,I))*(BI(K,I)-BI(K+1,I))*DLX(I)`
			`endif`
			
			New code added for sediment subroutine:
			`if(k == kb(i))then ! SW 4/18/07`
			`SEDAS(K,I) = SEDAS(K,I)+MAX(AS(JA),0.0)*ALG(K,I,JA)*BI(K,I)/BH2(K,I)*(1.0-BI(K+1,I)/BI(K,I))`
			`else`
			`SEDAS(K,I) = SEDAS(K,I)+MAX(AS(JA),0.0)*ALG(K,I,JA)*BI(K,I)/BH2(K,I)*(1.0-BI(K+1,I)/BI(K,I))`
			`endif`
			`if(k == kb(i))then ! SW 4/18/07`
			`SEDOMS(K,I) = POMS(JW)*(LPOM(K,I)+RPOM(K,I))*BI(K,I)/BH2(K,I)`
			`SEDSO = POMS(JW)*SED(K,I)*BI(K+1,I)/BH2(K,I)`
			`else`
			`SEDOMS(K,I) = POMS(JW)*(LPOM(K,I)+RPOM(K,I))*BI(K,I)/BH2(K,I)*(1.0-BI(K+1,I)/BI(K,I))`
			`SEDSO = POMS(JW)*SED(K,I)*BI(K+1,I)/BH2(K,I)*(1.0-BI(K+1,I)/BI(K,I))`
			`endif`
				4/18/07

#	Code: W2 or PREW2 or GUI	Fix or Enhance-ment Type	Description of Bug/Enhancement	Date Bug Fixed or Enhance-ment Added

24	W2	Algae	The logic for negative settling velocities for algae had an error.
			Old code:
			`! ASR(K,I,JA) = -AS(JA)*(ALG(K+1,I,JA)*B(K+1,I)/(B(K,I)*H2(K,I))-ALG(K,I,JA))*BI(K,I)/BH2(K,I)`
			New code:
			`ASR(K,I,JA) = -AS(JA)*(ALG(K+1,I,JA)*BI(K+1,I)/BH2(K,I)-ALG(K,I,JA)*BI(K,I)/BH2(K,I))`
			`!SP 8/27/07`
			Shwet Prakash
				8/27/07