



**US Army Corps
of Engineers**
Hydrologic Engineering Center

HEC-RAS

River Analysis System

Release Notes

Version 5.0.4
March 2018

Introduction

Version 5.0.4 of the River Analysis System (HEC-RAS) is now available. This Version supersedes Version 5.0.3, and all previous versions.

A list of the bugs fixed between versions 5.0.3 and 5.0.4 can be found below under the “Problems Repaired” section of this document. Several new features were added to HEC-RAS Version 5.0.4. These features are the following:

- 1. New RAS Mapper Pre-Processor Tools:** New tools have been added to RAS Mapper that will allow users to layout and extract one-dimensional (1D) rivers, cross sections, storage areas, etc., and two-dimensional (2D) model elements. Users will no longer need to use HEC-GeoRAS for developing models.
- 2. Variable Time Step Capabilities:** Some new variable time step capabilities have been added to the unsteady flow engine for both 1D and 2D unsteady flow modeling. Two new options are available. One option is to set a variable time step based on monitoring Courant numbers, while the second method allows users to define a table of dates and time step divisors. These new time step options can be used to improve model stability, as well as reduce computational time (however, not all models will be faster with the use of the variable time step).
- 3. Increased Computational Speed:** In addition to variable time step capabilities (which can reduce computational time), the HEC-RAS Version 5.0.4 computational engine has been further parallelized. In previous versions of HEC-RAS the 2D matrix solver was parallelized, but everything else was not. Moreover, the HEC-RAS Version 5.0.4 code has been further parallelized to include matrix setup, matrix coefficient computations, hydraulic computations between time steps, and more. This additional parallelization has dramatically sped up the code and will result in reduced run times for all data sets.

To illustrate the value of the new parallelization and the variable time step capability, the table below displays run times from Version 5.0.3 and 5.0.4 for the European Environmental Agency 2D test data sets, as well as several other 2D data sets used for testing the change in computational speed. Only the European data sets (labeled EU Test #) used the variable time step. All other data sets used the same fixed time step. As displayed in the table, the HEC-RAS software is much faster with this release. All times are for full St. Venant equations. The Full St. Venant equations will see the greatest change in computational speed. The diffusion wave equations are also faster, but the change is not as great as with the Full St. Venant equations. Also, the larger the data set (increased No. of Cells) the greater the benefit will be.

2D Test Name	Version 5.0.3 Compute time	Version 5.0.4 Compute time	Speed Ratio Old/New
EU Test No 2 10,000 cells	1min 6s	31s	2.1
EU Test No 4 80,000 cells	1 min 27s	56s	1.6
EU Test No 4 20,000 cells	27s	13s	2.1
EU Test No 5 7,460 cells	1min 40s	48s	2.1
EU Test No 5 1,809 cells	24s	13s	1.8
EU Test No 6 36,492 cells	2 min 41s	1 min 18s	2.1
EU Test No 7 16,590 cells	38 min 46s	15 min 35s	2.5
EU Test No 7 4,195 cells	15 min 47s	3 min 48s	4.2
Muncie 25ft Grids 21,724 cells	19 min 10s	8 min 52s	2.2
Cherry Cr Dambrk 55,931 cells	43 min 15s	14 min 35s	3.0
Yolo Bypass 17,141 cells	17 min 13s	9 min 15s	1.9
Boise River 10,423 cells	28 min 2s	10 min 46s	2.6
Oroville Dam Brk 133,368 cells	5 hr 46 min 29s	1 hr 51 min 36s	3.1
Bald Eagle Detailed 87,022 cells	3 hr 36 min 9s	1 hr 29 min 55s	2.4
2D Bridge Wrkshp 62,670 cells	9 min 50s	4 min 0s	2.5
Orleans Ave Canal 41,766 cells	26min 45s	12 min 28s	2.1
Miss/Ohio 1D/2D 23,087 cells	23 min 01s	11 min 34s	2.0

4. **Enhancements to SA/2D Hydraulic Connections:** The hydraulic structures capabilities for the SA/2D Hydraulic Connection has been upgraded to include all of the same capabilities includes in the Inline and Lateral Hydraulic structures. Users can now have spillways, weirs, gates, culverts, rating curves, and time series outlets all in the same structure. Additionally, users can now specify an X and Y coordinated for the upstream and downstream ends of each hydraulic outlet (culverts, gates, rating curves, and time series outlets). Also, the routines have been modified so users can pre-compute curves for the portions of the structure that are fixed openings (overflow weir and culverts), and still have gates that are computed on the fly.
5. **New 2D Polygon Mesh Refinement Tool:** Within RAS Mapper there is a new tool under the 2D Flow Areas portion of the geometry. This tool is called “**Refinement Regions**”. The Refinement Regions tool allows the user to draw a polygon within a 2D Flow Area and then define a new cell size for inside of that polygon, as well as along the boundary of the polygon. The tool also gives the user control of how the refined region will transition from the polygon boundary to the internal cell size and to the external cell size. This tool is only available in RAS Mapper, as the HEC-RAS team is transitioning all of the model layout tools into RAS Mapper. The previous tools that were in the Geometric Data editor for model layout and editing are still there.
6. **Internal Boundary Condition Lines for 2D Areas:** A new internal boundary condition option has been added for 2D areas. Users can now draw boundary

condition lines inside of 2D Flow Areas (across multiple cells) and then attach flow hydrographs to these internal boundary condition lines.

Warning!

Because users can now have both internal and external Boundary Condition Lines (BC Lines), external boundary condition lines must be entirely outside of the 2D polygon. If the drawn external BC lines are not completely outside of the 2D polygon, the software will not run and it will give an error message listing the external BC lines which need to be fixed.

- 7. New Velocity Term for 2D Flow Area Boundary Conditions:** Flow hydrograph boundary conditions and 1D to 2D direct connections now have a velocity computed at the boundary. Previously, flow was just dropped into the cells that the BC line was connected too, without any velocity. Now a velocity is also computed in addition to the flow for each cell. For upstream flow hydrograph boundary conditions, the velocity is based on the user entered energy slope, and using Manning's equation to compute the water surface, flow, and velocity across each cell. So if the velocity at this boundary is computed too high (water surface low), then decrease the user entered energy slope. If the velocity is too low (water surface too high), then increase the user entered energy slope.

There is also a new tailwater (TW) check for upstream flow boundaries. This check computes a water surface based on Manning's equation, but then compares it to the water surface in the boundary cells. If the boundary cell water surface is higher, the HEC-RAS software will use those water surfaces for distributing the flow and computing the velocity.

- 8. 64-bit Version of RAS Mapper:** There is now a 64-bit version of RAS Mapper, which will allow users to work with much larger data sets. This will allow for larger terrain models, larger 2D Flow Areas (more cells and larger areas), and much better post map processing of results (more RAM for producing maps).
- 9. 64-bit 2D Pre-Processor:** A 64-bit version of the 2D Flow Area pre-processor has also been developed. This will allow for much larger 2D Flow Areas and many more cells. The 64-bit pre-processor is also faster at processing the hydraulic property tables for 2D Flow Areas.
- 10. Improved Terrain Generation Utility:** The utility that builds terrain models for use in HEC-RAS has been improved. The utility can now handle extremely huge data sets (i.e., large areas as well as many separate files). For example, a terrain model was built for the entire Sacramento valley that was made up of over 50 GB of data (3700 LIDAR files; several USGS 10m DEM's; and channel data from a 1D HEC-RAS model cross sections).
- 11. Improved Manning's n Layer Development:** The creation of a Manning's n layer has been made much easier and more flexible: This is because a Landcover layer is

no longer required to make a Manning's n layer. RAS Mapper now allows users to create polygon Manning's n shapefiles. A Manning's n layer can still be made from any combination of shapefile polygon layers and raster layers (i.e., landcover, Manning's n shapefile, etc.). Therefore, it is still possible to use landcover data sets for creating Manning's n shapefile layers.

12. **Sediment – New Options in the User Defined Grain Class Editor:** The user Defined Grain Class editor has changed to allow users to define unit weight by grain class and turn off the “adjacent-non-overlapping” requirement for grain class sizes. The improvements to the editor allows grain classes to be more flexible. However, if the classes do not increase in size, then problems with the mixing methods could be produced. Also, Version 5.0.4 has very slight differences in the default grain sizes, which can cause minor divergence from HEC-RAS Version 5.0.3 results. This editor includes a button to go back to the Version 5.0.3 sizes.
13. **Sediment – New Transport Function Calibration Options:** HEC-RAS Version 5.0.4 added options to the transport calibration editor. Now, instead of defining the coefficients of 4 equations directly (which sometimes overwrites functions), users can apply linear scaling factors on the overall transport (for any equation) or on the “mobility parameter” (e.g., critical shear, reference shear, etc.) of AW, LC, WC, and MPM.
14. **Quasi-Unsteady Flow:** The quasi-unsteady flow editor in Version 5.0.4 now includes an internal stage time series boundary condition. This allows users to define a reservoir stage at an internal model cross section throughout a simulation. This is primarily used to define reservoir stages associated with inline weirs and allows users to simulate a dam operation in the middle of their model or a multiple-dam cascade.

Installation

The installation program and all documentation for HEC-RAS Version 5.0.4 are available on the HEC website at <http://www.hec.usace.army.mil>. This new release is installed independently of any previous versions of the software. Users may have the new version and previous versions of HEC-RAS software installed simultaneously for parallel use or testing. HEC-RAS Version 5.0.4 is fully compatible with projects developed in any previous version of the software.

Warning!

Once a project has been opened in HEC-RAS Version 5.0.4 and saved, it may not be possible to open the project with an older version of the software and reproduce the old results. Therefore, users should make a copy of their project before opening it in 5.0.4.

The new installation package for HEC-RAS Version 5.0.4 is designed to be easy to use. Installation process includes steps of selecting a directory for the HEC-RAS Version 5.0.4 software files and making other settings (e.g., creating a desktop shortcut, if

desired). Use the following steps to install the program on the Microsoft Windows® operating system:

1. Download the HEC-RAS Version 5.0.4 installation package from the HEC website to a temporary folder on the computer.
2. Run the installation program. In Windows Explorer, double-click the icon for the installation program. Note, administrator privileges is required to run the installer.
3. Follow the on-screen prompts to install the program.

Problems Repaired

This section provides all of the bugs found in a previous version of HEC-RAS and the fix included in the subsequent version of HEC-RAS. The bugs and fixes provided are listed in descending order beginning with the fixes made for HEC-RAS Version 5.0.4 from the bugs found in Version 5.0.3, and finishing with the fixes made for Version 5.0 from the bugs found in Version 4.1.

Repaired for HEC-RAS Version 5.0.4

The following is a list of bugs that were found in HEC-RAS Version 5.0.3 and fixed for Version 5.0.4:

1. **2D Full Saint Venant Equations:** In the shallow water 2D solver, it was noticed that some simulations had flattened velocity profiles across the direction of flow. Numerical diffusion in the advection terms was identified as the cause of the problem, particularly the scheme used for tracking velocity and velocity interpolation in the middle of cells. The interpolation formula was changed and is now computed using a more compact stencil, resulting in less numerical diffusion and more accurate results. This issue “may” change the results of previously developed models.

WARNING!

In general, the new formulation will have less numerical diffusion, and therefore potentially higher velocities and lower water surface elevations. Previously developed/calibrated models may need to have minor Manning’s n value adjustments (increased Manning’s n values) and/or increased turbulent diffusion coefficient (or turn turbulence on if it was not previously on) in order to reproduce previous version results. Additionally, due to possible higher velocities and lower water surfaces, the user may need to use a smaller computation interval to maintain model stability. Keep in mind that Version 5.0.4 now has a variable time step that can be used to improve model stability and reduce run times.

- 2D Turbulence Modeling:** In the shallow water 2D solver, the algorithm used to compute the Laplacian terms in the turbulent dissipation term was found to be numerically sensitive to abrupt changes in the flow field and the boundary conditions. This problem became more evident when the numerical dissipation in the advection was reduced (see item 1 above). Complications arose from the fact that the numerical solver relies mainly on normal velocities across faces while tangential velocities are back-calculated. The discretization of the Laplacian was reformulated in the field and near boundaries, resulting in a smoother more realistic turbulent dissipation.

WARNING!

This change may cause answers from previous runs to be different. Users may need to adjust the turbulence coefficients to get the similar results as the previous version. Additionally the new turbulence formulation is more sensitive to the time step, and may require the user to use a smaller time step to keep the calculations stable.

- 2D Diffusion Wave Equations:** In the Diffusion Wave solver, it was noted that the solution was not accurate near dry cells or wet cells that were separated by dry faces. It was discovered that water surface gradients were computed in those cases as if the cells were hydraulically connected. Special cases were added to the gradient calculation to deal with dry regions.
- Connections to 2D Flow Areas:** A bug was found in both the Lateral Structure (LS) and the SA/2D Hydraulic Connection for connections to 2D Flow Areas. If the length of the structure was significantly greater than or less than the length of the 2D flow area boundary that it was connected too, the partitioning of the structure length that was connected to each individual cell was not correct. The net effect of this is that either too much, or not enough of the structure was being attached to the correct cells. The beginning and the end connection were always correct, it was just the stationing in the middle that had some error in it.

WARNING!

This bug correction may cause data sets to get different results, especially in the area of where the structure is connected to the 2D Flow Area.

- 2D Rating Curve Boundary Condition:** For the rating curve boundary condition connected to a 2D area, all previous versions of HEC-RAS would compute a conveyance weighted water surface from all the wet cells along the boundary condition. That water surface was used to then go to the rating curve and get a flow rate to use to pull flow out of the 2D area. It was discovered that this caused a problem for data sets that were using rainfall. For a dry 2D flow area, in which rainfall is applied, all of the boundary cells have a small amount of water. The conveyance average water surface was being computed as a high water surface: This was because the terrain varied underneath the boundary condition. The net effect is that it was computing way to high of a flow from the rating curve, due to a bad computed water surface elevation. So the rating curve boundary condition has been

changed, such that it only uses the water surface elevation from the lowest wet cell along the boundary condition line. Then that water surface is used to get a flow from the rating curve.

WARNING!

This software change will potentially cause different answers to be computed for data sets that used downstream rating curves connected to 2D Flow Areas. If the water surface in that area was highly one dimensional, the difference will be small. If the water surface along the 2D boundary was highly multi-dimensional (i.e., the water surface varied a lot along the boundary condition, then the differences may be more significant).

6. **3-Dimensional (3D) Cross Section (XS) Plot Button Error:** If the user has a data set with no 1D reaches, and the 3D Multi Cross Section plotting button is clicked, then the entire program would crash. This issue has been fixed.
7. **Background Maps Window:** When selecting the Background Map button the editor was going behind all of the open windows. This has been fixed so the editor now opens on top.
8. **Boundary Condition (BC) Line Flow and Stage Plots:** In the Geometry Data editor when a BC Line was selected and the Stage/Flow Hydrograph plot was clicked, the window opened, but the plot was the wrong plot "Type" and did not have the requested location. This issue has been fixed.
9. **Steady Flow Velocity Output in RAS Mapper:** The velocity maps were not working correctly for steady flow hydraulic models that were in metric units. This issue has been fixed.
10. **1D Velocity Mapping.** There was a bug in the mapping of the 1D cross section velocity in RAS Mapper. The velocity profile for the main channel was actually being put into only half of the channel. The remainder of the velocity mapping was actually the velocities in the overbank area. This was only a plotting issue and not a computational issue. Computed water surfaces and velocities were correct, just not being mapped correctly in RAS Mapper.
11. **2D Unsteady Lateral Structures Using 2D Equation Domain:** The following user-entered mistake did not have a check/error flag in HEC-RAS Version 5.0.3: It is a mistake to have two different lateral structures (1D river to 2D area) connected to the same 2D area at the exact same cell (so that a specific cell gets flow from two different lateral structures) and either (or both) lateral structures using the Normal 2D Equation domain. (This issue may have resulted in a large volume error being reported). The user would fix this issue by either setting both lateral structures to use the weir equation, or, by breaking up the cell so that no one cell does not receive flow from both lateral structures.

12. **Steady Flow (Multiple Opening/RAS Mapper):** The water surface just downstream of a multiple opening was not being plotted correctly in RAS Mapper.
13. **Steady Flow (Mixed Flow):** The water surface at a hydraulic jump was not being plotted correctly in RAS Mapper.
14. **Unsteady (Lateral Structure Gates):** For a lateral structure with gates, the gate flow was not being computed correctly if there was reverse flow (i.e., the tailwater is higher than the headwater).
15. **Volume Accounting:** The method for performing the volume accounting was modified. For instance, if a dam break model had very little inflow/outflow, but large internal flows (large initial conditions in reservoir and stream), the volume accounting was reporting much larger volume errors than were truly happening.
16. **Double Counting Quasi-Unsteady Lateral Sediment Loads:** All HEC-RAS 5.0.x versions, including Version 5.0.3 introduced lateral sediment loads (from rating curves or time series) twice, once upstream and once downstream of the specified cross section, double counting these loads. HEC-RAS Version 5.0.4 only brings the load in downstream of the cross section (making it more like unsteady flow), while previous versions brought the sediment load in upstream of the XS.
17. **USDA-ARS Bank Stability and Toe Erosion Model (BSTEM):** Several bugs were fixed in the BSTEM algorithms and BSTEM output. Primarily, the material that failed from the bank was not added to the main sediment transport model correctly. Additionally, bank failure/toe scour could stall when the bank became vertical and the longitudinal cumulative volume curve was not computing volume change correctly for bank failures.

Repaired for HEC-RAS Version 5.0.3

The following is a list of bugs that were found in HEC-RAS Version 5.0.1 (and Version 5.0.2) and fixed for Version 5.0.3:

1. **Floodway Encroachments at Culverts:** Floodway Encroachments method 1 was not working correctly for culverts. This bug was introduced in Version 5.0.1 when a previous problem with encroachments at bridges was fixed. Both culverts and bridges are now working correctly with all encroachment methods.
2. **2D Turbulence Modeling:** There was a bug in the Turbulence modeling in all previous versions to Version 5.0.2. The X component of the turbulence was unfortunately using the Y component of the velocity instead of the X component. This was fixed before the release of Version 5.0.2.
3. **Flow Distribution at Bridges:** The flow distribution output was not working correctly for the cross sections inside of a bridge.

4. **2D Flow Area Internal Hydraulic Structures.** Previously internal hydraulic structures with culverts or gates was attempting to compute a sloping water surface upstream and downstream of the culvert/gate, based on the water surface in all the cells connected to and just outside of the culvert/gate entrance and exit. This was causing many instability problems with internal culverts/gates inside of 2D Flow Areas. This has been changed to just use a flat water surface inside of each cell connected to the upstream and downstream end of any culvert/gate inside of a 2D Flow Area.
5. **SA/2D Area Connection and Rules.** If the user tried to use rules for controlling gates in a storage area/2-dimensional (SA/2D) area connection, when connecting a storage area to another storage area, the Operating Rules editor would not allow the user to put in the initial conditions of the gate, as well as the gate opening and closing rates.
6. **Simplified Physical Breaching.** If the simplified physical breaching option was selected, and the mass wasting option was not being used, there was a bug and the breach would not start correctly.
7. **Simplified Physical Breaching.** For some data sets this option was producing no breach at all when it should have produced a breach. This was a Version 5.0.2 bug.
8. **Breach with a Restart File Option.** An Unsteady flow run that started with a restart file was not breaching correctly.
9. **Breaching with Lateral Structures.** The flow through the breach was not being displayed correctly in the detailed Lateral Structure output table. It was being computed correctly.
10. **Zero Manning's n Value in 2D Flow Areas.** Users were allowed to enter a zero value for Manning's n values within a 2D Flow Area. This is no longer allowed.
11. **Unsteady Flow Encroachment Editor.** The Unsteady Flow Encroachment editor would not allow the user to leave a left or right encroachment as a blank (meaning no encroachment on that side).
12. **RAS Mapper.** Several minor RAS Mapper interface and plotting bugs were fixed.
13. **RAS Mapper- Exporting 1D Cross Sections as Terrain.** There was a bug when exporting 1D cross sections as a terrain file. If the user had a system with a river reach on a sharp bend, and very few cross sections had been drawn through the bend, then RAS Mapper would not stay within the main channel bank stations for the 1D terrain export.

RAS Mapper – Inundation Mapping Around Culverts. There was a mistake in outputting a water surface for the cross section just upstream of a culvert. The software was writing a zero water surface elevation for the output that is used to perform the inundation mapping. This was causing the mapping to show up as being dry at the culvert and just upstream of the culvert.

Repaired for HEC-RAS Version 5.0.1

The following is a list of bugs that were found in HEC-RAS Version 5.0 and fixed for Version 5.0.1:

1. **Unsteady Flow with Pumps:** A pumping station that is connected "From" a storage area had a bug that could generate an "access violation" error.
2. **Unsteady Flow with Rating Curves at Structures:** The rating curves for: inline structure outlet rating curve, lateral structure outlet rating curve, and user defined gate rating curves (both inline and lateral) have been changed so that unsteady will no longer extrapolate past the top or bottom of the curve. A warning will be generated the first time this happens.
3. **Unsteady Flow with an SA/2D Hydraulic Conn between two 2D Areas:** There was a bug when a SA/2D connector has a 2D area on the upstream side. This bug would sometimes show up as an "access violation" error.
4. **Steady Flow Analysis (Encroachments at Bridges):** There was a bug when type 1 encroachments were specified immediately adjacent to a bridge opening. The encroachment was being set to the opening. The left encroachment was set to the left side of the bridge opening and the right encroachment was being set to the right edge of the opening.
5. **Unsteady Flow with 2D Areas/Internal Hydraulic Connector:** For a hydraulic connector inside of a 2D area, the DSS output for headwater and tailwater had a bug. The reported values were "one cell" away from the intended values. For a connection that was entirely inside of a single cell, this resulted in a reported water surface of "0.0". This was only a reporting issue.
6. **1D Velocity Plotting in RAS Mapper for Metric Data Sets:** 1D RAS Mapper maximum velocity plot was wrong for SI data sets.
7. **Unsteady flow Lateral Structure connected to a 2D flow area:** For a lateral structure connected between a 1D river and a 2D area, the lateral structure was pulling the water out of the river at the wrong cross section location. The flow was being removed from the 1D river upstream of the location it should have been removing it from.

8. **User Interface – Right Bank of Main channel:** If the project had a cross section with a vertical wall at the right bank of the main channel, the interface was displaying the main channel bank station at the bottom of the vertical wall. The computations were correct, this was just a visual problem in the interface.
9. **User Interface – Storage Area Elevation Volume Curves:** A new option to compute elevation vs volume curves for storage areas was occasionally coming up with negative volumes.
10. **User Interface – FIPS Compliance:** The interface was using a routine to compare data that was determined to not be FIPS compliant. This routine has been removed and replaced with one that is FIPS compliant.

Repaired for HEC-RAS Version 5.0

The following is a list of bugs that were found in HEC-RAS Version 4.1 and fixed for Version 5.0:

1. **Unsteady (User Defined Gate Curves):** User defined gate curves for storage area connections were not working.
2. **Unsteady Flow Post Processing (Pump):** If a pump group had more than one pump that was on, only the flow from one pump was being summed. So the total flow of the pump group was wrong as was the total flow of the pump station. This bug did not affect the unsteady flow pump computations nor the pump DSS output.
3. **Steady Flow (Bridges/Cross Sections with Lids):** For the internal bridge cross sections (or other cross sections with lids), if there was more than one Manning's n value in the channel, the program was not correctly compositing the channel Manning's n value. For bridges, this would only affect the answers using the energy method (the other methods, such as pressure/weir were not affected).
11. **Unsteady Flow Post Processing:** The inline structure output was not showing the breach flow and breach velocity. This has been fixed.
12. **Steady Flow (Bridge/WSPRO):** The WSPRO method uses its own methodology to compute the friction/expansion loss between the exit cross section and the cross section immediately downstream/outside of the bridge. This computation was not correct and tended to slightly over predict the energy losses.
13. **Steady flow (bridge/WSPRO):** For the WSPRO bridge method, the energy downstream of the bridge was not being correctly outputted. (The WSPRO method recomputed the downstream water surface. The displayed/outputted energy did not reflect the recomputed water surface.)

14. **Unsteady Flow Post processing (overflow gate):** For lateral structures, the flow through an overflow gate was not always being output.
15. **SI Sediment Volume Bug:** HEC-RAS Version 4.1 did not convert sediment mass into volume correctly in SI units, generally under predicting deposition volume substantially.
16. **Wilcock Transport Function:** HEC-RAS Version 4.1 included a bug in the Wilcock transport function that generally caused it to substantially under predict transport.
17. **Lateral Structures:** A lateral structure that is connected “to a point between two XS’s” could get a wrong error message that the "the distance to the upstream cross section is greater than cross section length".
18. **Unsteady Flow (Advanced Rules):** For the advanced rules, using the "lookback" option (lag, average, etc.) was not working for storage areas.
19. **Steady Flow (Inline Structures):** The program was not allowing the water surface upstream of an inline structure to be less than water surface downstream. In rare cases, it is possible that the hydraulic computations should give an answer where the upstream energy is higher than the downstream energy, but the upstream water surface is lower than the downstream. This can happen for a weir that is highly submerged but still has a high enough velocity that the upstream velocity head is significantly larger than the downstream velocity head.
20. **Steady Flow (Bridges):** If the edge of the bridge opening is a vertical wall, and the water surface is within this vertical wall (that is, the water surface is above the bottom of the wall and below the top of the wall), the wetted perimeter of this wall was not being included in the computations).
21. **Steady Flow (Weir):** For highly submerged, sharp crested weirs the program was computing slightly too much flow.
22. **Steady Flow (Lateral Structures):** A lateral structure that only has a rating curve (no weir, culvert, no gates) had an output problem that could cause the output for the next cross section downstream to be wrong.
23. **Steady flow (culvert):** If the elevation of the road/weir dropped below the bottom/invert of the lowest culvert, the program could not converge on a "weir only" solution.
24. **Unsteady flow HTAB (culvert):** If the elevation of the road/weir dropped below the bottom/invert of the lowest culvert, the curves were not correct.
25. **Steady flow (culvert storage connector):** For a storage area connector where the water surface in the two storage areas was less than 0.5 feet and there were at least

two culverts with an invert (minimum elevation for flow) greater 0.5 feet, the program could lock up.

26. **Steady flow (blocked obstruction with bridge/lid):** If a cross section with a lid (or a bridge cross section) had a blocked obstruction that "poked through" the lid, the wetted perimeter was not being computed correctly.
27. **Unsteady flow (junctions):** The "Energy Balance Method" for a junction flow split (the flow splits into multiple reaches in the downstream direction), was not always working correctly.
28. **Unsteady flow (roughness factors):** The flow roughness factor and the seasonal roughness factor associated with geometric data had a bug that caused them to be applied to the wrong range of cross sections. This bug did not affect the roughness factors that were entered as part of the Plan data, only those entered in the geometric editor.
29. **Unsteady flow (Modpuls/Hydrologic routing):** Having both multiple Modpuls regions and lateral inflows in the same reach was causing a bug that was screwing up the lateral inflows.
30. **Unsteady flow (Navigation Dams):** For navigation dams, the starting gate open was being set to the minimum which usually caused a very high starting water surface behind the dam. The gate setting is now being determined based on the target water surface.
31. **Unsteady flow (Advanced Rules):** If an advanced rule operation had been used to set a desired flow (for a given gate group) and then a later rule operation set a specific gate opening height (for that gate group) the program was continuing to use the desired flow operation instead of overwriting it with the designated gate opening height.
32. **Steady flow (culvert):** For a steep culvert, where the flow at the inlet starts out supercritical (and the inlet is not submerged) but the flow has a hydraulic jump (and the outlet is submerged) the program was using the outlet answer (and reporting outlet control) when it should have been using the inlet control answer.
33. **Steady flow (culvert):** For a steep culvert, where the outlet is submerged and the original, subcritical outlet answer, shows that the inlet is not submerged, but the inlet answer shows a submerged inlet and "drowned" hydraulic jump, the program was not reporting the correct, full flowing outlet answer.
34. **Unsteady flow (hydraulic curves):** For the hydraulic bridge curves and hydraulic rating curves, the program was sometimes incorrectly reporting a, "extrapolated above rating curves" when in fact it had not had to extrapolate.

35. **Sediment (Long Cum Mass Change):** minor bug when erosion punched through the cover layer and eroded down into the surface layer during a single computation increment.
36. **All (Rating Curve/Bridges):** If a cross section immediately upstream of a bridge has a rating curve, it was causing the program to crash.
37. **Sediment (Overbank Deposition):** Material that was being deposited in the overbank, outside of the moveable limit, was not being removed from the sediment going to the next cross section. Therefore, the sediment was being double accounted.
38. **Sediment (Dredging/Cumulative Out):** The longitudinal cumulative mass output was not correctly including dredged output. Output bug only.
39. **Sediment (Exner7):** The Exner7 bed mixing option had several bugs.
40. **Sediment (Hydraulic Averaging):** the hydraulic averaging between cross sections was improved so as to not allow hydraulic average over cross sections with big flow changes.
41. **Steady Flow (Culverts):** For a culvert that was partially filled in with sediment, the reported depths for critical depth and normal depths were not correct. The depths included the filled in depth. This was only a reporting error, not a computation error.
42. **Sediment (Scour Bottom):** If a cross section had a large amount of scour in a single computation interval, and this scour exceeded the scour bottom (maximum allowable scour) the extra scour was not being handled correctly (it was being allowed to "overshoot").
43. **Unsteady (Modified Puls):** If a model has multiple modified puls regions and the different modified puls regions have not been entered from upstream to downstream, this could have caused an error in RAS.
44. **Sediment (Mass Correction):** Didn't work correctly if XS was scouring and depositing at the same time (overbank deposition, channel scour).
45. **Sediment Hydraulic Design:** The hydraulic design computations for sediment transport capacity had a problem with transport through bridges.
46. **Sediment (Retention Option):** This option did not work at junctions.
47. **Unsteady (Levee Breaching and User Specified XS):** There was a bug if the user had entered a levee breach at a lateral structure that also had user specified cross sections on the tailwater side.

48. **Sediment (Active Method/Krone):** The Krone deposition method was not working correctly for the sediment active layer method.
49. **Geometry (Lateral Structure):** If the lateral structure (LS) was set up to have multiple cross sections on the tailwater (TW) side, and it was set to use default computed intersections (on the TW side), and the LS extended past the end of the reach, HEC-RAS was reporting the wrong error message.
50. **Unsteady (Levee and Dam breach):** For the levee and dam breach, the right side slope was being ignored. The left side slope was being applied to both the left and right sides.
51. **Unsteady (Navigation Dam):** If the user had selected to use a gate change time increment (e.g., only operate the gates every four hours), the gate(s) were incorrectly limited to moving only for a single time step. For instance, if the gate open rate was 0.5 feet/minute and the time step was set to one minute, when it came time to operate the gate, the gate would only raise a maximum of 0.5 feet. If the time step was thirty seconds, the gate would only raise a maximum of 0.25 feet (until the next time increment for the gate operations).
52. **Unsteady (Junctions):** For unsteady flow at junctions, if the user selected the energy balance method, RAS was computing the energy losses based on the downstream reach lengths entered in the cross section editor. This has been fixed so that it is now using the reach lengths entered in the junction editor.
53. **Unsteady (Dam/Levee breach):** The default growth shape was changed so that the vertical erosion rate is equal to the horizontal erosion rate for HEC-RAS Version 5.0. Version 4.1 used different erosion rates for vertical vs horizontal growth, and was computed to get to the maximum depth and width at the same time. This change can make a big difference to the computed peak flow vs the HEC-RAS Version 4.1. If users need to reproduce the Version 4.1 results, then the vertical/horizontal growth rate ratio can be specified.
54. **Steady Flow (Supercritical/Mixed Flow):** For supercritical flow, the reported friction loss was the friction loss between the current cross section and the upstream cross section (instead of the current and the downstream). This same issue also applied to reported headloss, friction slope and contraction and expansion losses. This was an output problem, and not a computational issue.
55. **Sediment (Exner5/Partheniades):** For the Exner5 bed mixing option, when using the Krone/Partheniades option, if the given cross section has more than 10% clay that was a bug that could artificially limit the amount of erosion or prevent erosion altogether.
56. **Unsteady (Post Processor):** Setting the Detailed Output Interval to "Max Only" did not work correctly. (Post processor would not run.)

57. **Unsteady (Warmup):** The program previously did at least one warmup time step (even if number of warmup time steps was set to zero). This is no longer the case. If the number of warmup time steps is set to zero, the initial results/output (at time zero) are from the initial steady flow backwater.
58. **Unsteady (Flow vs. Roughness):** The flow roughness factors for negative flows (reverse flows) was not correct. The program will now take the absolute value of the flow before performing the roughness lookup.
59. **Unsteady (Flow Roughness):** If the flow was smaller than the first value in the table (the first value was not zero) then the program was transitioning the roughness to 1.0 (no change) as the flow went to zero. Instead, it now uses the bottom value in the table, and not transitioning.
60. **Steady/Unsteady (Rating Curve on Lateral Structure):** The distance field on the lateral rating curve (for a lateral structure) was not being used correctly. It is now being used (and the value is based on the lateral structure stationing not the distance to the upstream cross section).
61. **Unsteady (SA Connector with Breach):** If a storage area (SA) connection had a breach and the SA connector was set to "Compute Using Curves" the breach was being ignored.
62. **Unsteady (Pump Rules):** For the advanced pump rules (these are the rules specific to pumps, not the general Advanced Rules), there was a bug if a day of month was entered as a single digit. For example, "1Jan2012" would not work, but "01Jan2012" would work.
63. **Sediment (Concentration):** The sediment concentration output was wrong. This issue has been fixed.
64. **Unsteady (Navigation Dam):** The option to use both hinge control and pool control was sometimes not working.
65. **Steady and Geometric Preprocess (Bridges/Culverts):** Cross sections with ineffective flow areas can have multiple critical depths. The program was sometimes not using the best answer. The most likely situation that this bug would show up is for the unsteady flow preprocess internal boundary curves where the curve suddenly "shot up" for no apparent reason.
66. **Unsteady (IB Stage/Flow at Inline Structure with Elevation Controlled Gates):** When using the (internal boundary) IB Stage/Flow option at an inline structure to force a known stage or known flow, the program will now operate the gates in order to match the gate opening to the forced stage or flow. When the user entered IB Stage/Flow "runs out", the program will revert to "normal" gate flow for the inline

structure. For the case where the inline structure is using elevation controlled gates (as opposed to time series gates), the gate openings should match the flow condition when the IB runs out.

67. **Preprocess/Unsteady (HTAB Points):** The number of allowable points in the cross section lookup tables has been increased to 500.
68. **Converting Bridge to Cross Sections with Lids is No Longer Supported:** This option was causing stability problems in some unsteady flow models. For the next Version it was determined that computing the bridge curves was a much better option.
69. **Unsteady (Inline Culvert Flag Gates):** For culverts in an inline structure, the positive flap gate option was not working correctly.
70. **Unsteady/Steady (Lateral Structure Crossing Bridge):** A lateral structure that crossed a bridge showed flow leaving the river between the bridge sections when in fact flow was not being removed from the river. No lateral structure flow is removed between the bridge sections and the output now reflects this.
71. **Unsteady (Culvert/Encroachments):** For unsteady flow, encroachments adjacent to culverts were not working correctly causing the internal boundary curves to be incorrect.
72. **Unsteady Flow (Ungaged Area Computations):** If the pre-processor was run by itself, then unsteady was run by itself and that unsteady plan had ungaged areas, then the ungaged option may not work correctly.
73. **Unsteady Flow (Ungaged Area Computations):** If the gage for an ungaged area was next to a lateral structure that had user specified intersections, there was a problem with the unsteady flow computations.
74. **Unsteady Flow (Lateral Structures):** The computations (derivatives) for highly submerged lateral structures was adjusted for speed and stability. This may cause differences in answers for some data sets.
75. **Unsteady Flow (Ungaged Area Computations):** If the ungaged area option was used with a data set that had time slicing (and this includes the "Flow Monitor" on hydrographs) a bug would result.
76. **Unsteady Flow (IB Stage/Flow):** The internal boundary flow (IB stage/flow hydrograph) option was not using the user specified flow during the initial backwater.
77. **Unsteady Flow (SA to SA Connector):** The interpolation methodology was changed from a horizontal to a vertical method.

78. **Unsteady Flow (HTAB):** A bug in how the curves transitioned from open flow to pressure flow. (Subroutine HBS_LIM3)
79. **Unsteady Flow (Lateral Structure):** The user specified cross section intersections did not work for some data sets.
80. **Unsteady Flow (SA Connector with Culvert):** There was a bug for when the invert of a culvert was higher than the low point in the weir.
81. **Unsteady Flow (DSS Hydrograph Output):** Monthly DSS hydrograph output was not being output correctly to DSS.

Support Policy

Technical support for program users within the Corps of Engineers is provided through an annual subscription service. Subscribing offices can expect full support from HEC staff in the routine application of the program. Users are strongly urged to consult with HEC staff on the technical feasibility of using the program before beginning a project with unique requirements. Extended support for large or complex projects can be arranged under a separate reimbursable project agreement.

Reporting of suspected program errors is unrestricted and we will reply to all correspondence concerning such errors. We are continuously working to improve the program and possible bugs should always be reported. Reports should include a written description of the steps that lead to the problem and the effects that result from it. If we cannot reproduce the reported problem, we may ask you to send a copy of your project.

Report program errors through the following channels:

- Go to our web site at www.hec.usace.army.mil then go to the HEC-RAS support page.
- Send email to hec.ras@usace.army.mil on the internet.
- Write to:
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, CA 95616 USA.