

# What's New In Version 6.0

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## General

The Aquifer<sup>Win32</sup> update provides automated support for image well theory. With previous versions, the user could manually maintain image wells to simulate boundary conditions but it was a labor intensive process. In Version 6.0 the process has been made very simple, although this technology is not without caveats. Every attempt has been made to make the application more user-friendly and full featured. If we have missed something you feel is important, let us know. We will be enhancing Aquifer<sup>Win32</sup> in the future and all interim releases will be free and downloadable from the internet until Version 7.0 is available.

The major changes are summarized below:

- **New analyses**
  - No new analyses have been added although the addition of image wells allows analysis of more complex systems for those analyses provided for flow models.
- **New functionality**
  - A rectangular boundary has been defined each side of which can be made a constant head or no flow boundary. This allows zero to four boundaries. Each boundary can be displayed using a customizable labeled line.
  - Defined boundaries are simulated by a group of image wells generated by the software to a nesting level defined by the user. The display characteristics of image wells are linked to the parent well and can be customized.
  - Image wells are checked at calculation time to identify those that associated with wells outside the defined boundary rectangle.

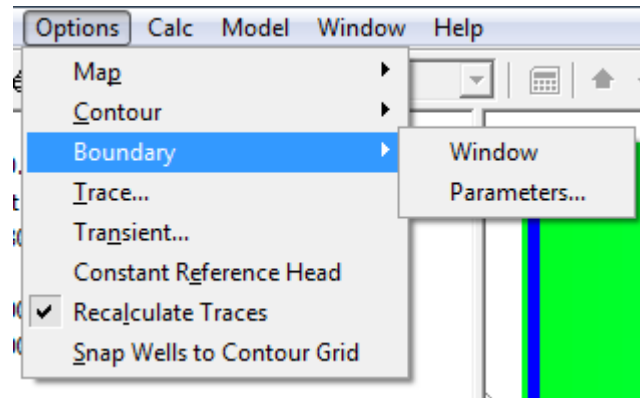
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## New Functionality

### Boundary Rectangle

Previous versions of Aquifer<sup>Win32</sup> have a contour window and a map window. The contour window defines the area within which the model is calculated and

contoured. The map window is the area over which maps are displayed and defines the area displayed when you zoom to the full screen. The new boundary rectangle is defined and maintained in a similar fashion to the other windows with a Boundary/Window menu allowing the user to drag a rectangle to define it. Also, the Boundary/Parameters menu displays a property sheet to allow direct entry of the origin and size of the window. The boundary window will typically be larger than the contour window to exclude the contours of the image wells which are added to the system only because of their influences inside the boundary widow. The user can zoom out to show the placement of the image wells if desired.



Display of the boundary and image wells is controlled by the **View->Display Boundary** and **View->Display Image Wells** menu. This controls overall display of the feature. The *Boundary Information* property sheet allows further customization of the display characteristics.

## Boundary Information

**Boundary Information**

Window | Display | Symbol

Boundary Window

Origin X: 40211.1    Origin Y: 4441.59

Height: 1086.01    Width: 1536.36

Boundary Types

North: None     Display

South: None     Display

East: No Flow     Display

West: Constant Head     Display

Nesting Depth: 5    10 images per well

OK    Cancel    Help

### Boundary Window

Origin X	The x-coordinate of the origin of the boundary window in map units
Origin Y	The y-coordinate of the origin of the boundary window in map units
Height	The height of the boundary window in map units
Width	The width of the boundary window in map units.

### Boundary Types

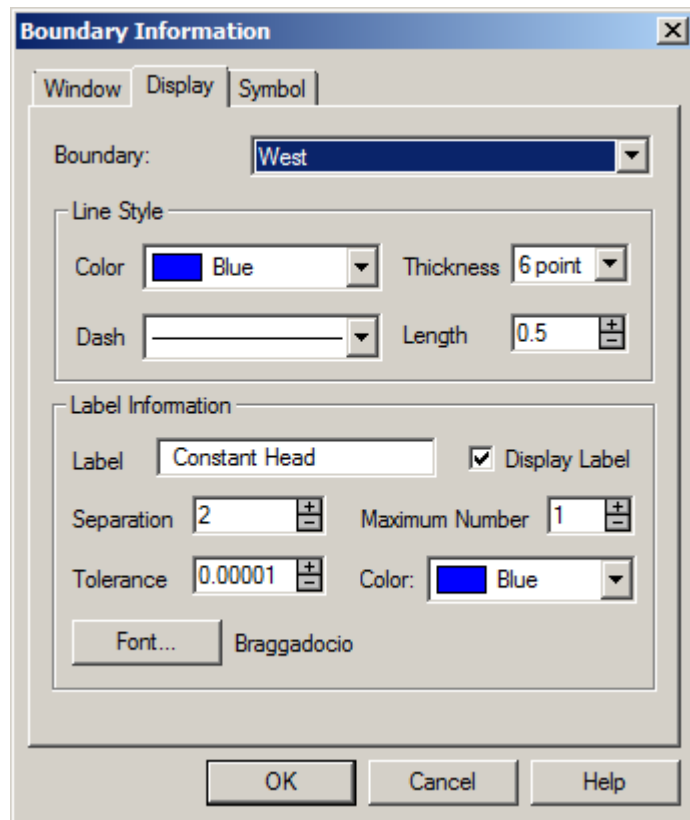
North: Sets the type of boundary on the northern (top) of the boundary rectangle

**Display** If checked, the northern boundary is displayed on the map window

South: Sets the type of boundary on the southern (bottom) of the boundary rectangle

**Display** If checked, the southern boundary is displayed on the map window

East:	Sets the type of boundary on the eastern (right) of the boundary rectangle
<b>Display</b>	If checked, the eastern boundary is displayed on the map window
West:	Sets the type of boundary on the western (left) of the boundary rectangle
<b>Display</b>	If checked, the western boundary is displayed on the map window
Nesting Depth:	Sets the depth of nesting used for image wells. Each successive depth includes the image wells for the previous depth.



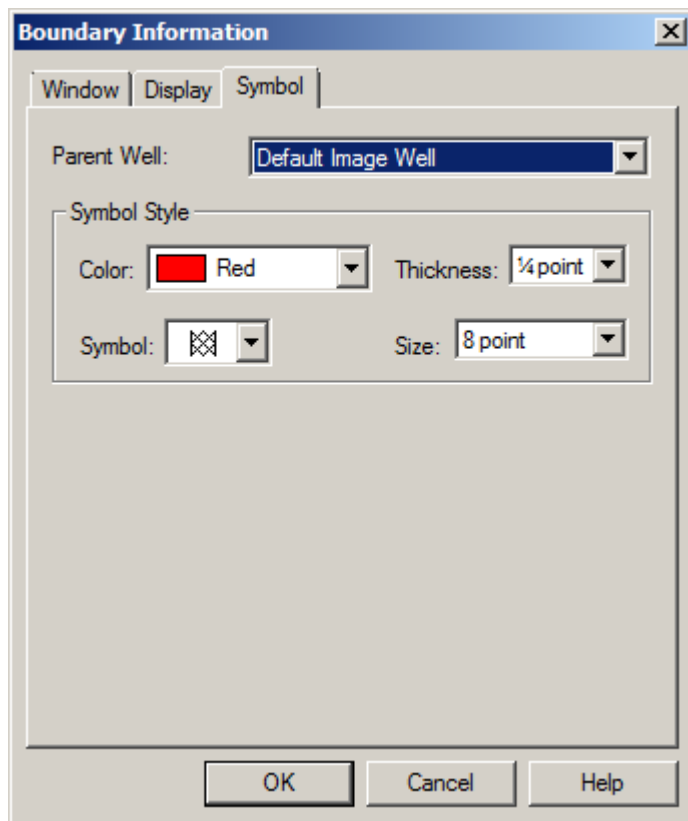
Boundary:	Specifies which boundary segment the display settings apply to
<b>Line Style</b>	
Color:	Sets the color of the boundary line
Thickness:	Sets the thickness in points of the boundary line
Dash:	Sets the dash pattern to use for the boundary line
Length:	Sets the length in inches of the dash pattern for the boundary line

### Label Information

Label:	The text to be displayed as the label on the boundary line
Separation:	The minimum distance in inches between labels
Maximum Number:	The maximum number of labels to display
Tolerance:	The maximum difference in inches between the total distance along the data curve where the label is to be displayed and the length of the label
Color	Sets the color of the label displayed on the boundary line

**NOTE: The value for tolerance determines how straight the section of the curve has to be for the label to be displayed. If the tolerance is exceeded the label will be advanced forward until an acceptable section of the curve is found.**

Font:	Defines the font, font style, size, effects and color for the label
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Data Set:	Specifies which parent well the display settings apply to
Default ImageWell -	Defines the values used when a new well is added

### Symbol Style

Color:	Sets the color of the symbol displayed at each image well location
Thickness:	Sets the thickness in points of the line used to draw the symbol
Symbol:	Sets the symbol to display at each image well location
Size:	Sets the size in points of the symbol to display at each image well location

## Implementation

Image well implementation was based on Theory of Aquifer Tests, U.S. Geological Survey Water-Supply Paper 1536-E. The appropriate section is Theory of Images and Hydrologic Boundary Analysis. For each well in the model, an image well is created on the opposite side of each boundary at a distance equal to the distance of the well from the boundary. Distance calculations are perpendicular to an infinite extension of each boundary segment. A nesting depth of 1 would create one image well for each boundary segment. Each subsequent nesting depth would create image wells for each of the previous nesting depths image wells.

If only one boundary segment is active, only one image well would be created regardless of nesting depth. If two perpendicular boundary segments are active, two image wells would be created for nesting level 1 and 1 more for nesting level 2. If two or more boundary segments are active and at least two are parallel, an infinite series of image wells can be created constrained by the nesting level chosen.

The magnitude of the pumping rate for any given image well is the same as the parent well. Whether it is extracting or injecting is determined by the type of boundary it is a reflection of and the parent well.

The caveat mentioned at the beginning of this section is that image well implementations are not as predictable as a numerical model. Care must be taken when multiple boundaries are active. When using such an analysis the closer the stresses from pumping come to the boundaries the farther the results will deviate from reality.

## Example

The example file modelimage.aqf demonstrates this functionality. The first image displays the contour and boundary windows which are the same. The second image is zoomed out to display the image wells used to define the boundaries. The specifics of the analysis are discussed in the tutorial on Image Wells.

