Multi-Finger Caliper and Pipe Tally

The Warrior Logging Software supports imaging tools that include a wide range of multi-arm or multi-finger caliper tools supplied by different manufacturers such as Sondex, Hotwell, Probe, Katwell, GoWell, and Spartek Systems. The various caliper tools may have from 12 to 60 fingers. The Warrior software presents the readings from the fingers as radii or diameters. In addition, many presentations will also present a 3 dimensional image of the caliper log.

One of the problems with multi-finger caliper tools is when the tool is not centered in the wellbore, the readings of the diameters measured may not be correct. With the tool not centered, the diameters perpendicular to the high / low axis will read smaller than actual size, showing an eccentric pipe. Warrior Software has a Caliper Processing package available as a supplement to the Warrior 8 Software that corrects the eccentric caliper readings in real time. The Caliper Processing software would replace the third party software that is normally used after the well is logged as post processing in the office or processing center.

The example shown in Fig. 26.1 shows a log pass with uncorrected caliper image on the left and a corrected caliper image on the right. Fig. 26.2 shows a cross-section image of the caliper readings. Fig. 26.3 shows a 3 dimensional image of the uncorrected and corrected caliper readings.

For more information about the Caliper Processing Software contact Scientific Data Systems.

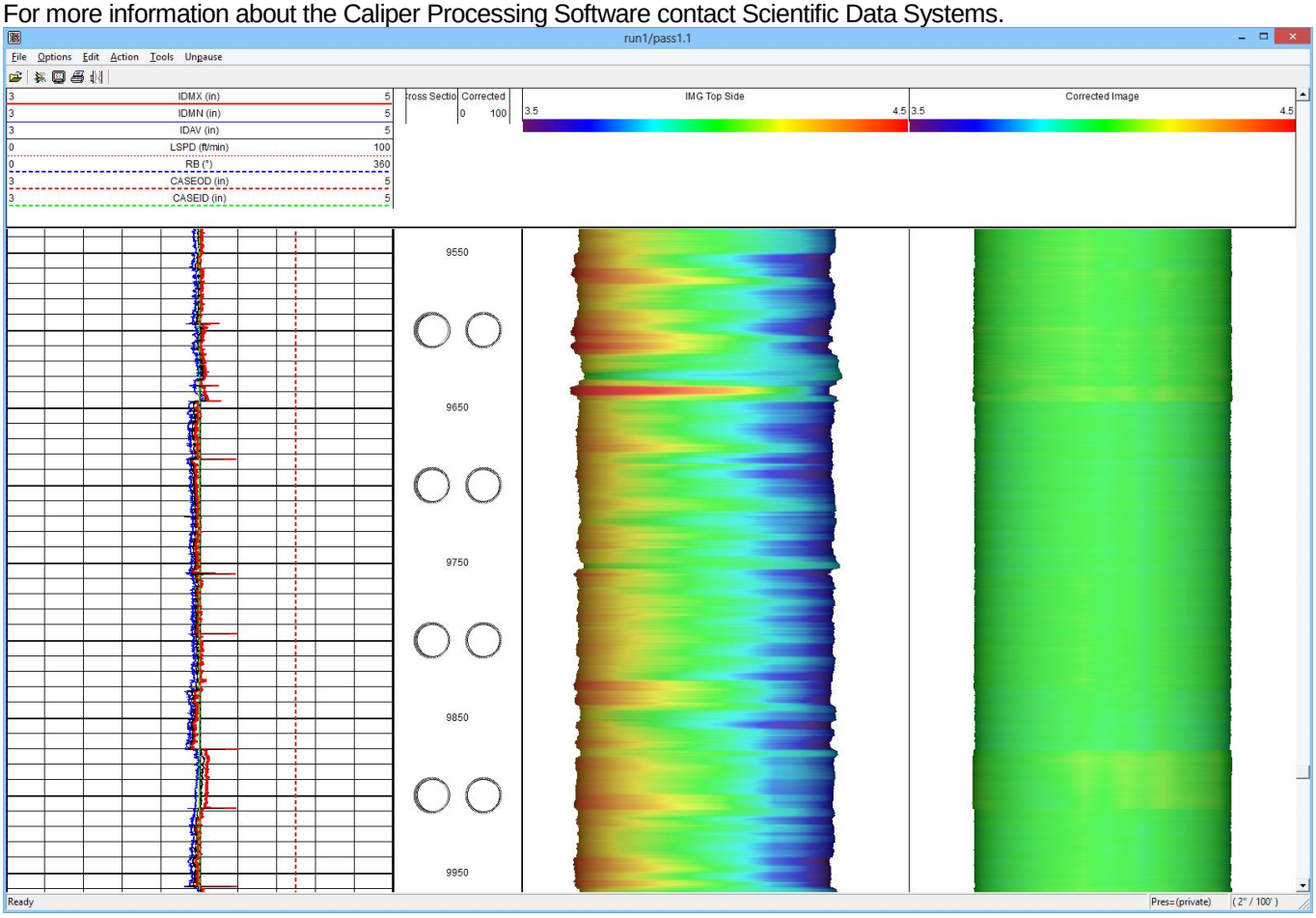


Fig. 26.1 Multi-finger Caliper Image Plot

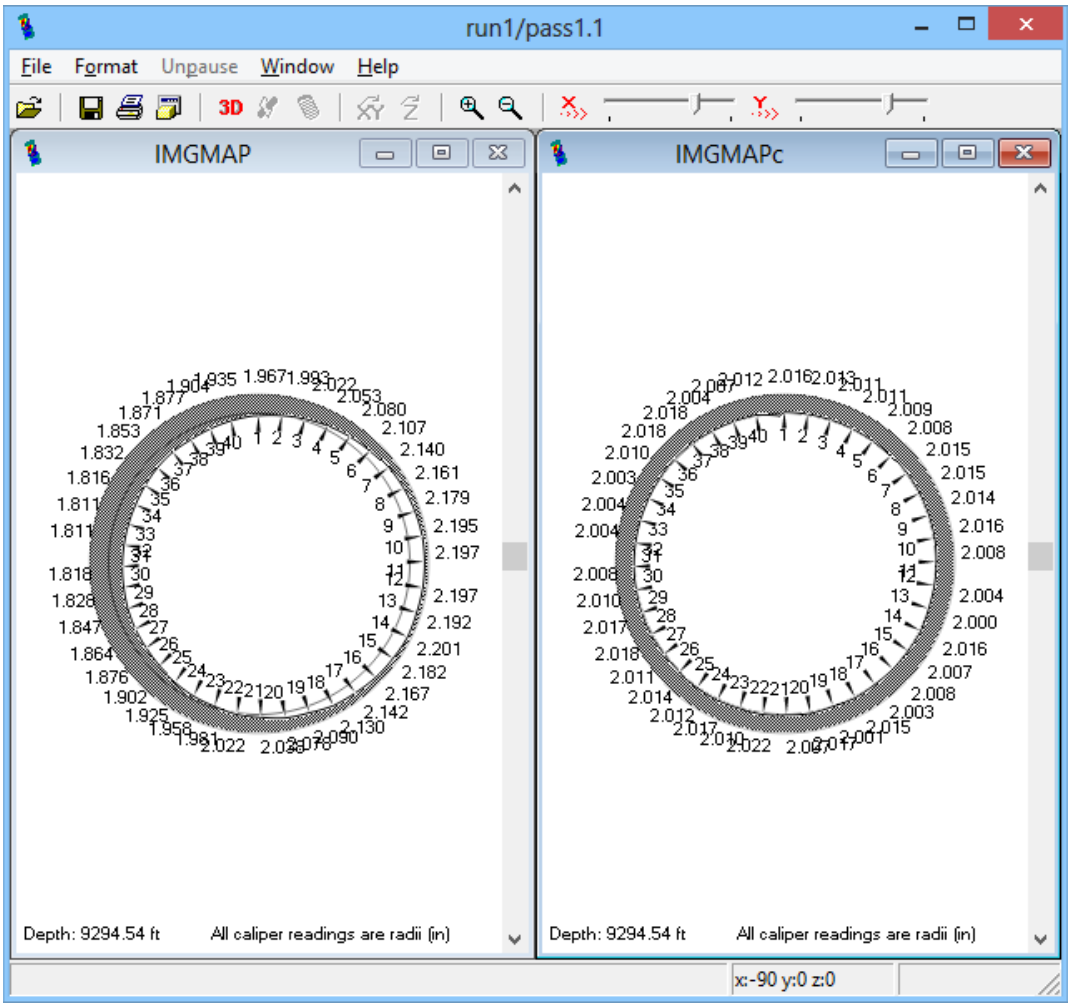


Fig. 26.2 Image map showing uncorrected and corrected caliper readings

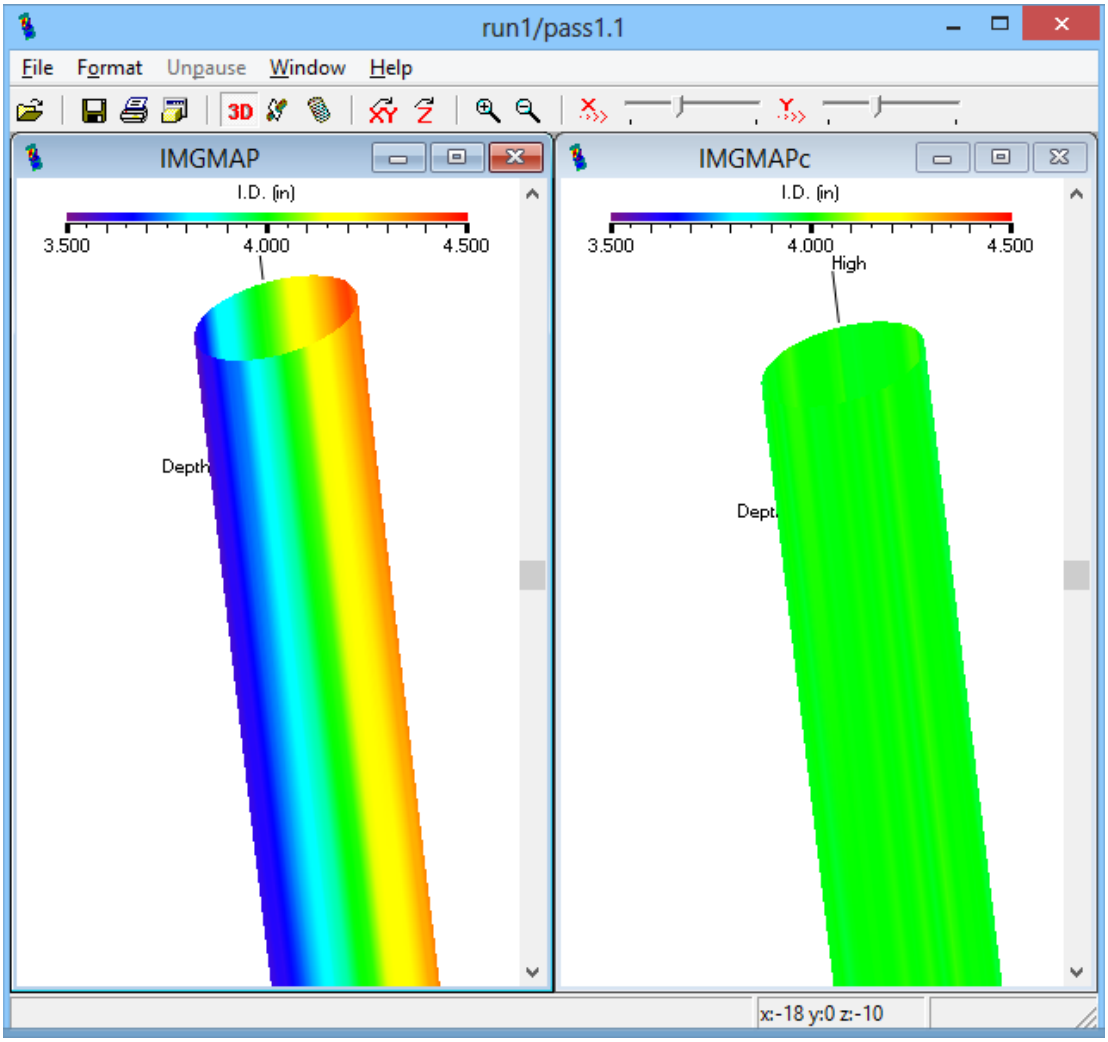


Fig. 26.3 3-D Image map showing uncorrected and corrected caliper readings

26.1 Pipe Tally Utility

The Warrior 8 software has an enhanced version of the Warrior Pipe Tally Utility. The utility provides a numerical table by joints of casing / tubing showing casing loss. In addition it provides capabilities for enhancing the log presentations.
The Pipe Tally Utility is accessed through the Warrior Database Utilities by clicking on the Pipe Tally selection button.

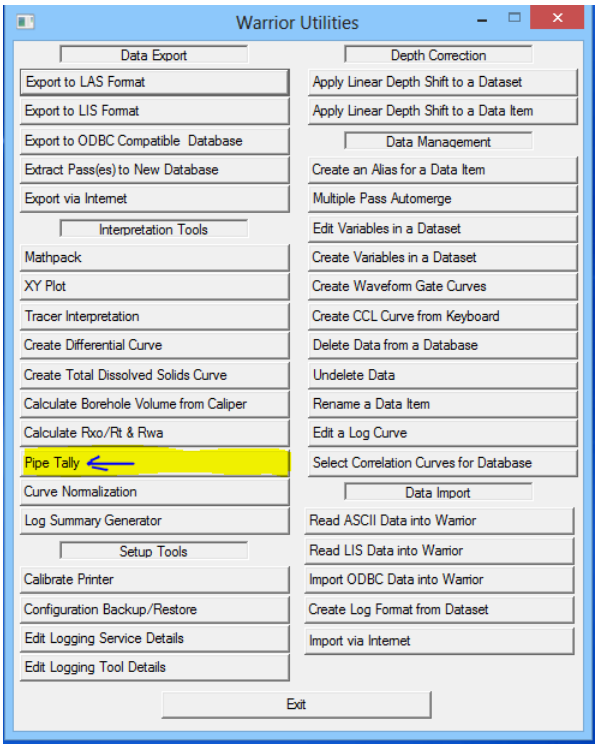
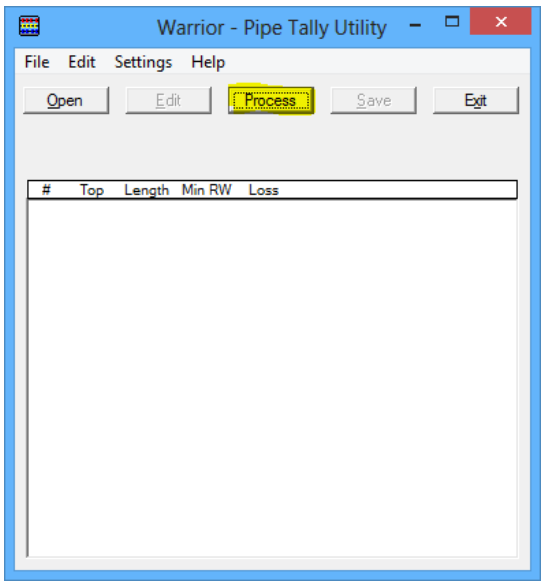


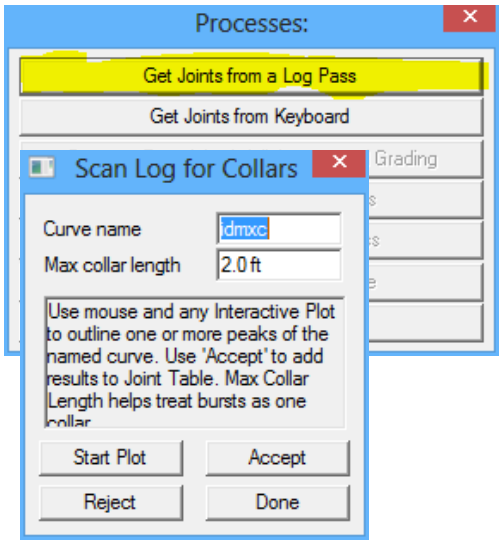
Fig. 26.4 Warrior Database Utilities – Pipe Tally

26.1.1 Get Pipe Tally Data – Scan for Collars

When the Pipe Tally Utility is opened, there is no information present. The first step is to get the casing joints. If you click on the [Process] button, you will get the choice of getting the joints from a log pass or entering them from the keyboard. By clicking on [Get Joints from a Log Pass], multiple collars can be selected at one time with the mouse and the software will enter them into the table. If [Get Joints from Keyboard] is selected, the user must type in each collar position that he wants to use

Fig. 26.5 Pipe Tally Utility – Process





When getting joints from a log pass, any curve that indicates collars may be used, not just CCL. In the following example, since there is no CCL in the string, I will use the IDMXC curve. The maximum collar length would be set to the minimum length of a casing joint or longer than any hardware that might be in the well, normally 2 to 4 feet. When the [Start Plot] button is clicked, Interactive Plot will start. You will need to select the pass that you wish to process and to do a screen plot to see the pass. It is often advantageous to compress the scale of the plot to enable the user to select more collars at one time. To do this, click the Options choice from the Interactive Plot menu.

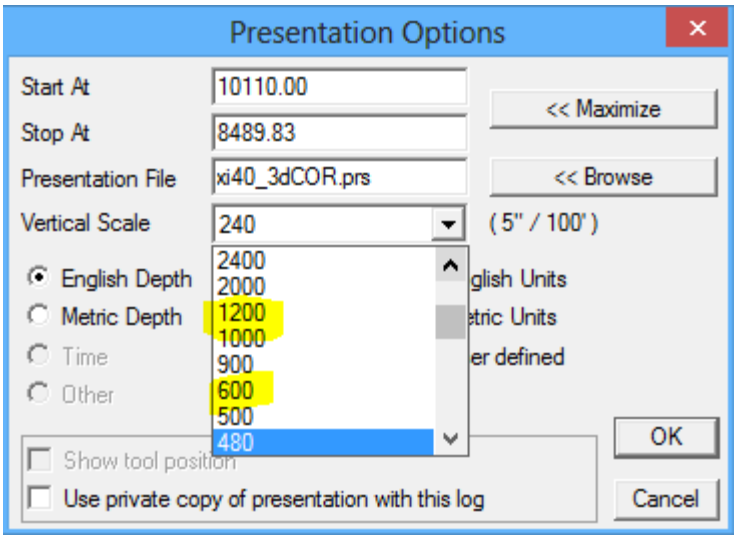
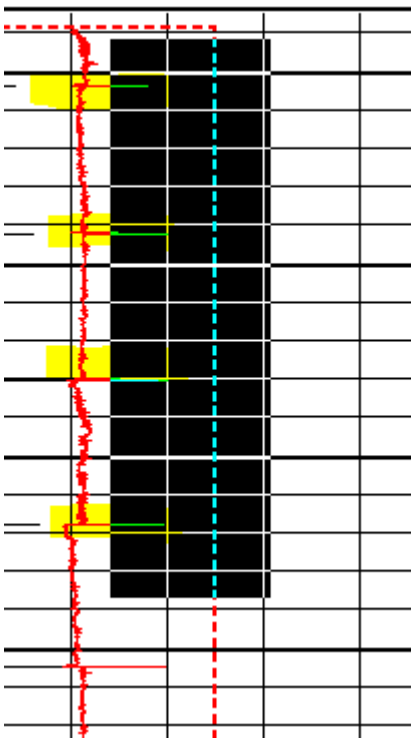


Fig. 26.6 Setting Vertical Scale to compress the viewed log pass

Click the Vertical Scale drop down and select a larger number to compress the scale. 600 or 1200 are good options. Using the mouse, draw a rectangle that catches the peaks of the curve that you are using as a CCL indicator.



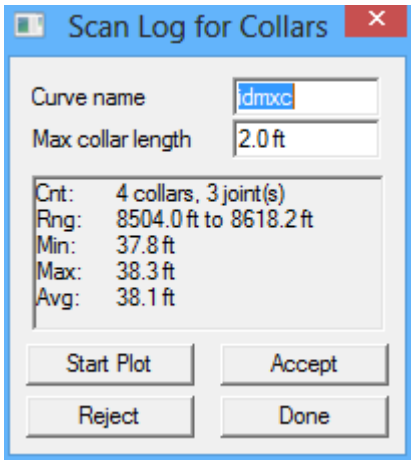


Fig. 26.7 Capturing CCL indications in a log pass

The Scan Log for Collars window will show a summary of what you have just scanned. In this case, it shows 4 collars in the range of 8504.0 feet to 8618.2 feet and gives the minimum, maximum, and average lengths of the joints in that interval. If you click the [Reject] button, the summary is cleared and you may reselect the collars from the log pass. If you click the [Accept] button, the collars that have been selected will be entered automatically into the pipe tally table. You should continue down the log pass, selecting collars until the whole pass has been collars picked. When you are finished, click the [Done] button to close the Scan Log for Collars window.
At this point, it is a good idea to take a close look at the Pipe Tally table and look for problems with the collars that have been selected. Things that should be looked for are extra-long and extra-short joints.

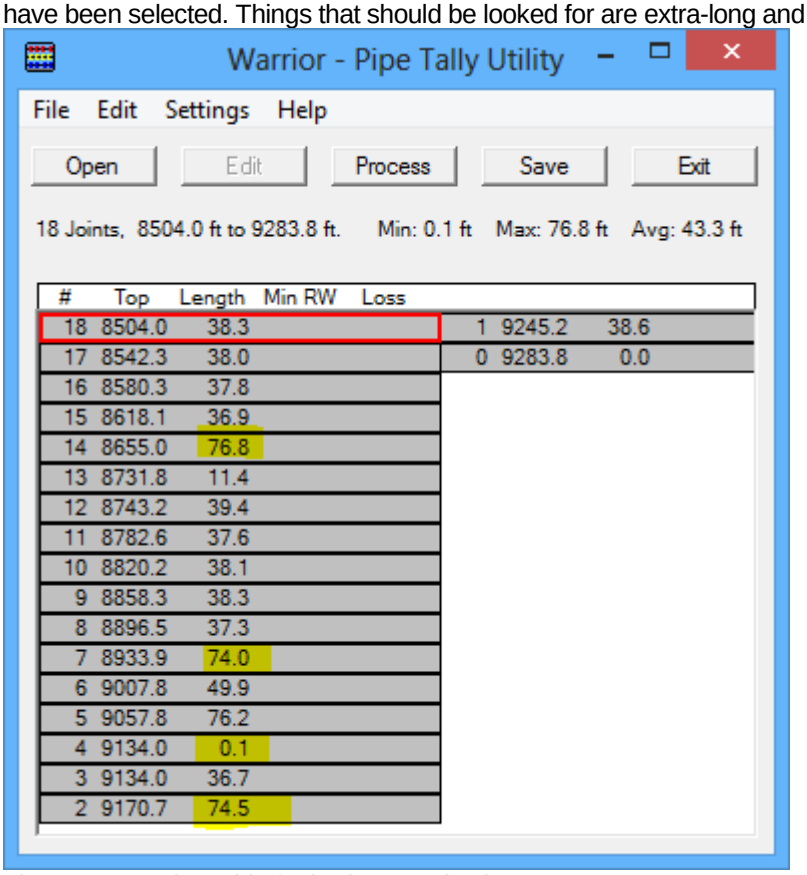


Fig. 26.8 Examine table for bad CCL selections

In the table shown in Fig. 2.5, there are long joints at joints 14, 7, and 2 and a .1 foot joint at joint 4. The long joints are probably caused by not having enough of an indication in the signal to pick the collar and the short joint is caused by selecting the same collar twice. The collars that have been selected twice can be eliminated by clicking on that collar in the table and then click on Edit -> Delete Selected Entries.

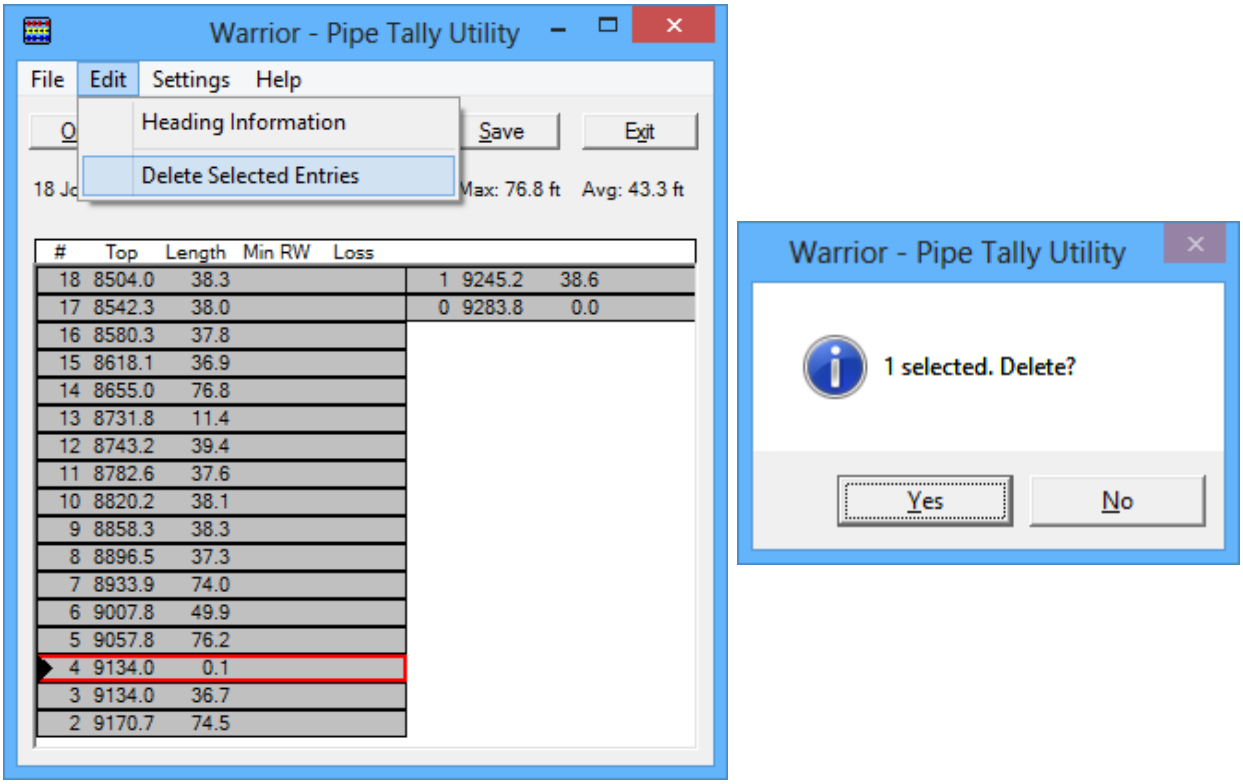
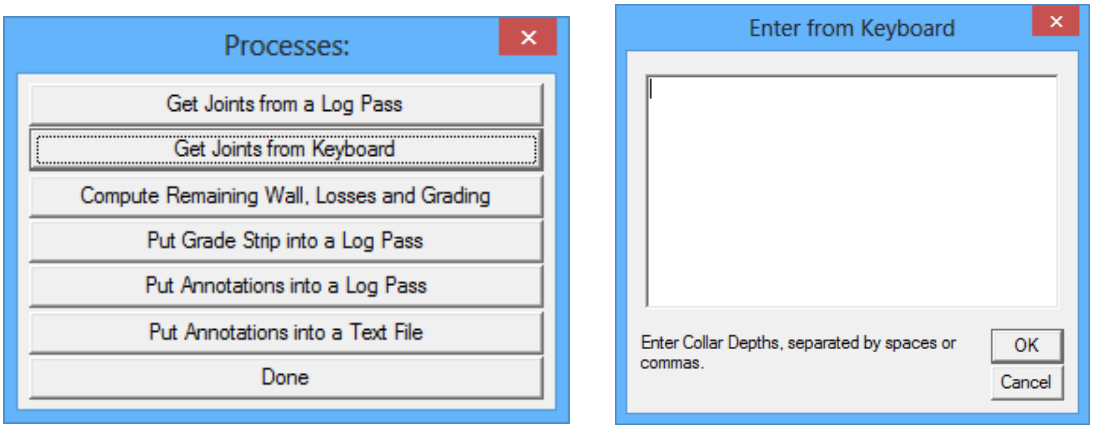


Fig. 26.9 Deleting erroneous entries from table

To correct the long joints, you would need to Process and Get Joints from a Log Pass again or in this case I will Get Joints from Keyboard.

Fig. 26.10 Get Joints from Keyboard



After closely examining the log, I missed collars at 8695.3, 8966.1, and 9209.4. These depths will be entered into the window separated by spaces or commas as shown in Fig. 2.8.

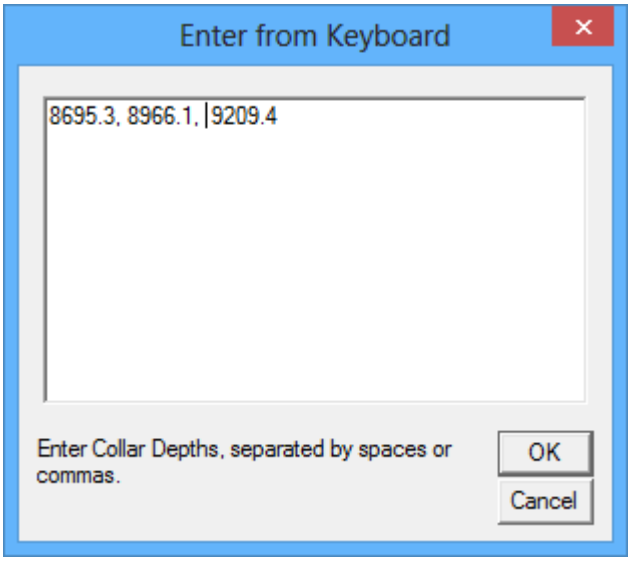
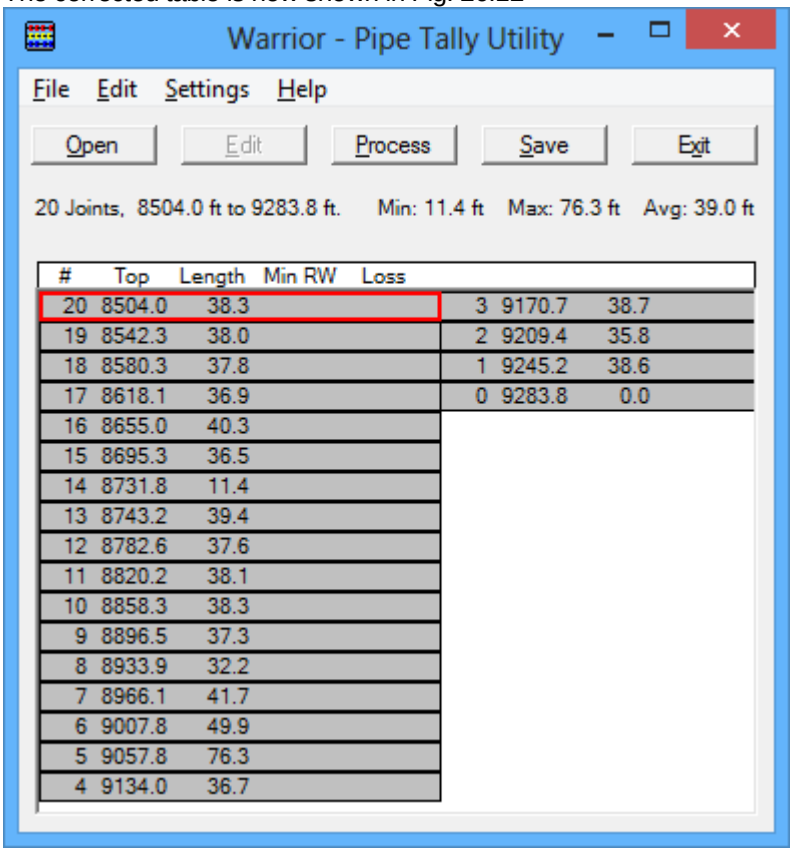


Fig. 26.11 Process – Get Joints from Keyboard

The corrected table is now shown in Fig. 26.12



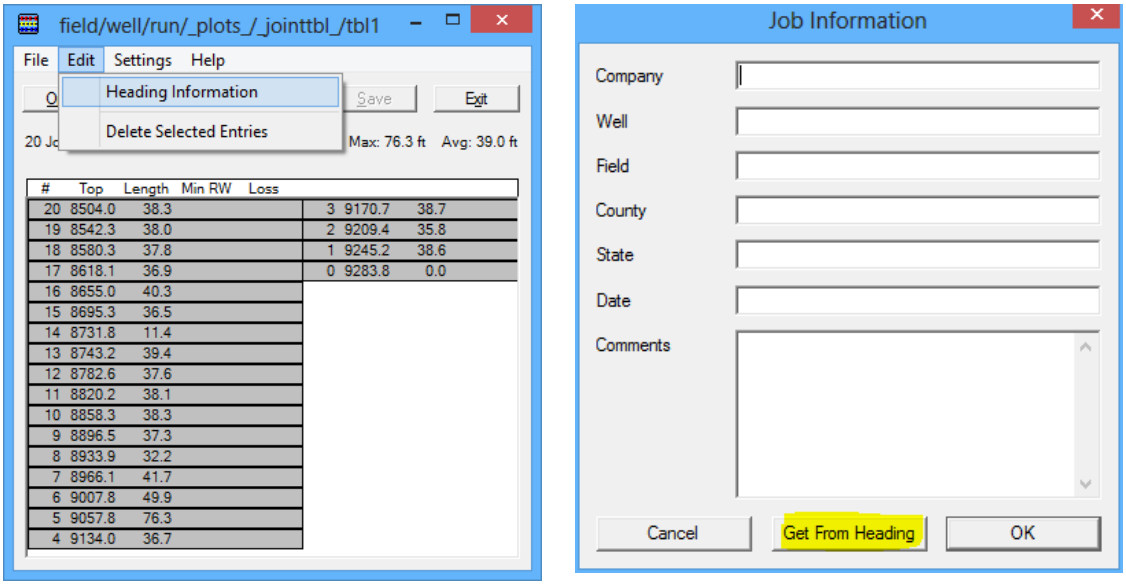
#	Top	Length	Min RW	Loss				
20	8504.0	38.3			3	9170.7	38.7	
19	8542.3	38.0			2	9209.4	35.8	
18	8580.3	37.8			1	9245.2	38.6	
17	8618.1	36.9			0	9283.8	0.0	
16	8655.0	40.3						
15	8695.3	36.5						
14	8731.8	11.4						
13	8743.2	39.4						
12	8782.6	37.6						
11	8820.2	38.1						
10	8858.3	38.3						
9	8896.5	37.3						
8	8933.9	32.2						
7	8966.1	41.7						
6	9007.8	49.9						
5	9057.8	76.3						
4	9134.0	36.7						

Fig 26.12 Corrected Pipe Tally Table

26.1.2 Edit Pipe Tally Settings

There are several things that should be done before continuing. The first is editing the table header information.

Fig. 26.13 Edit Heading Information



If the Warrior Heading has already been completed and saved, that information can be brought into the Pipe Tally Header by clicking the [Get from Heading] button at the bottom of the Job Information window. If that heading information is not available, then the User should enter the data in the fields provided. The heading information is saved into the table by clicking the [OK] button.

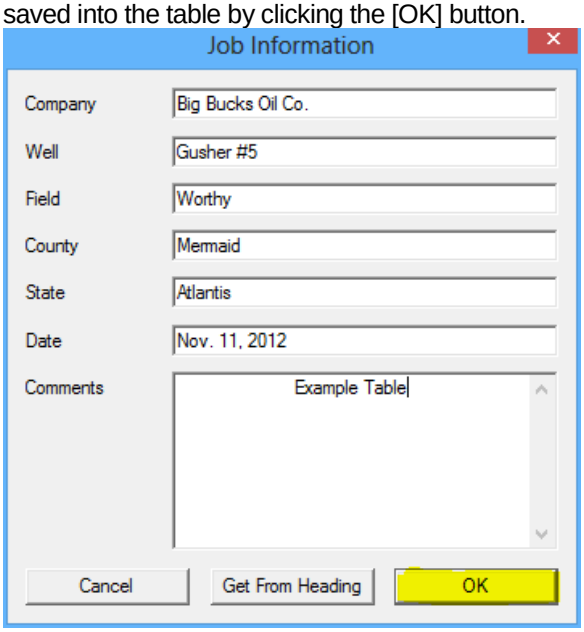
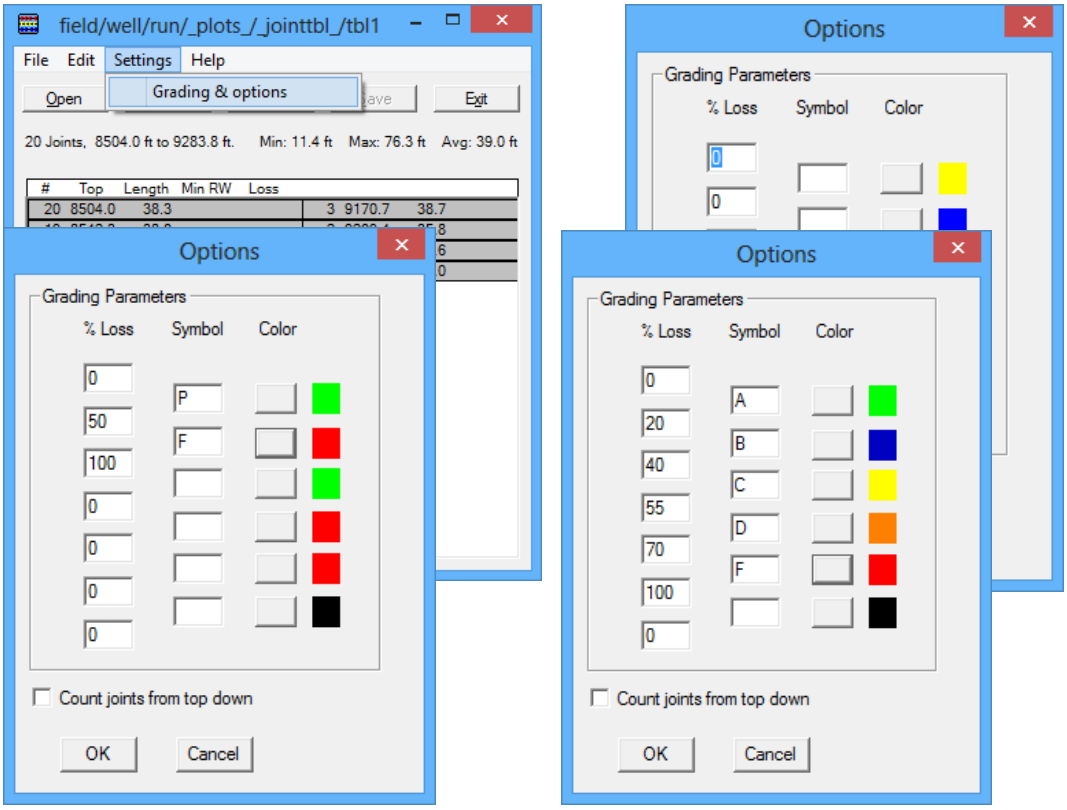


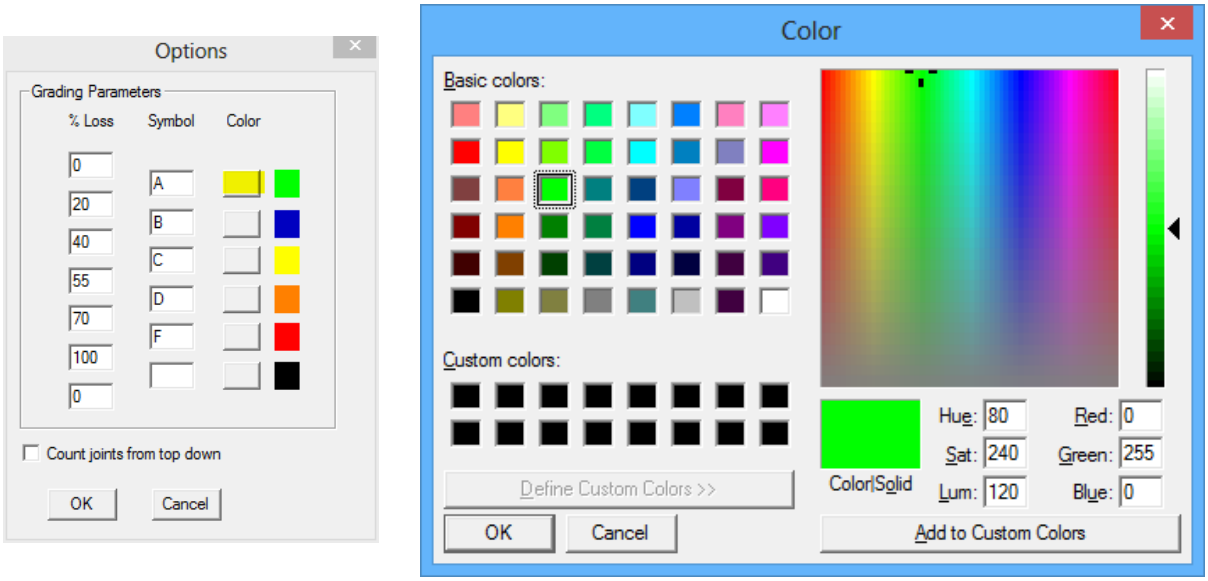
Fig. 26.14 Completed Job Heading Information

If grading to going to be applied to the log data, the grading options need to be set up before the casing thickness is scanned. Click on Settings -> Grading and options to bring up the options window.
Fig. 26.15 Options and Grading



The grading is based on a percentage of loss. The User would normally setup between 2 and 6 grade levels. This may be as simple as 0% - 50% Passing (Green) and 50% - 100% Failing (Red). It could be something more complex, such as a letter grading A=0% -20% (Green), B=20%-40% (Blue), C=40%-55% (Yellow), D=55%-70% (Orange), and F=70%-100% (Red)
Fig. 26.16 Example Grading Scales

The colors assigned to the grading are used as a quick indication of the grading and can be shown both in some of the pipe tally tables and as a pattern strip in the log. The color for a given grade may be edited by clicking on the box located between the grade symbol and the grade color, defining the color and then clicking the [OK] button.
Fig. 26.16 Selecting Grading Colors



26.1.3 Remaining Wall Loss and Grading
Now that grading options have been set up, the next step is to have the software scan the log, computing the wall loss percentage and grading the casing joints. Click on [Process] to open the Process window. Click on the [Compute Remaining Wall, Losses and Grading] option.

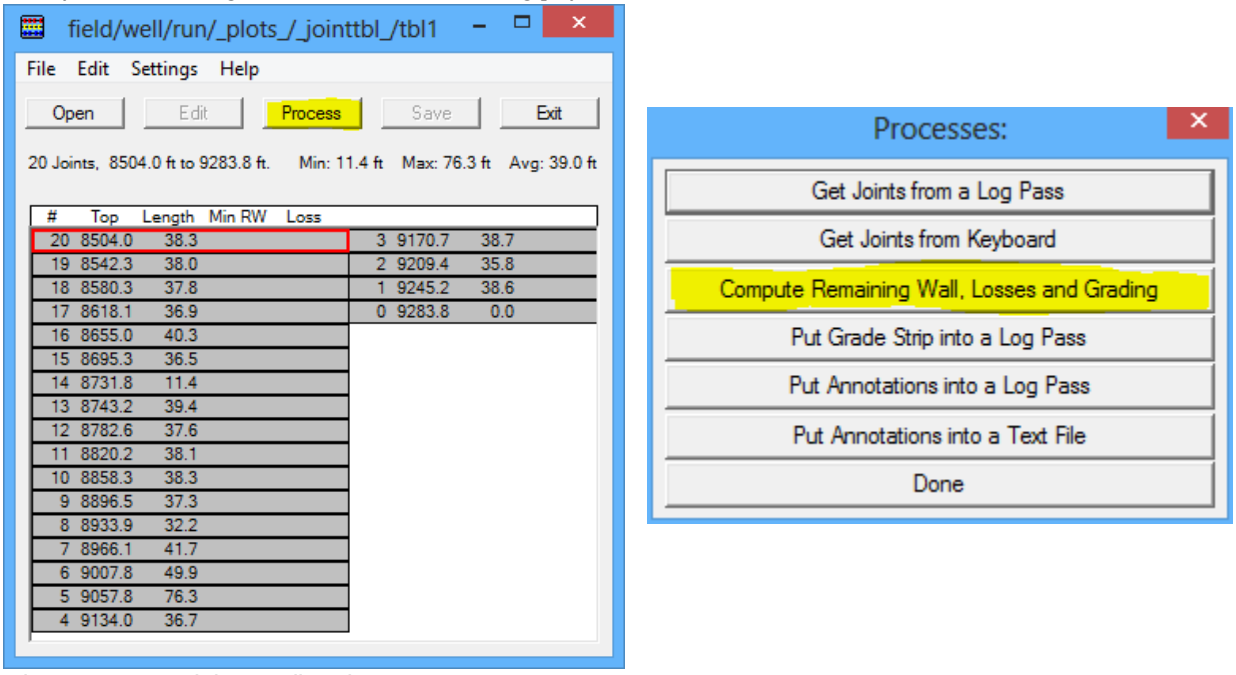


Fig. 26.17 Remaining Wall and Losses

There are two ways to process the remaining wall and losses. If the Warrior Caliper Processing software has been used, remaining wall has already been computed and that curve (MINRC – Minimum Remaining Corrected) can be used. The second method is to use the maximum diameter (which, depending upon the caliper eccentric could be appreciably off) and the casing OD and ID set up in Variables.
From the Compute Loss and Grading window, the User will first need to select which method that he wishes to use. And then, using the [<<Browse] button select the data item that he wished to use to process the log for losses.

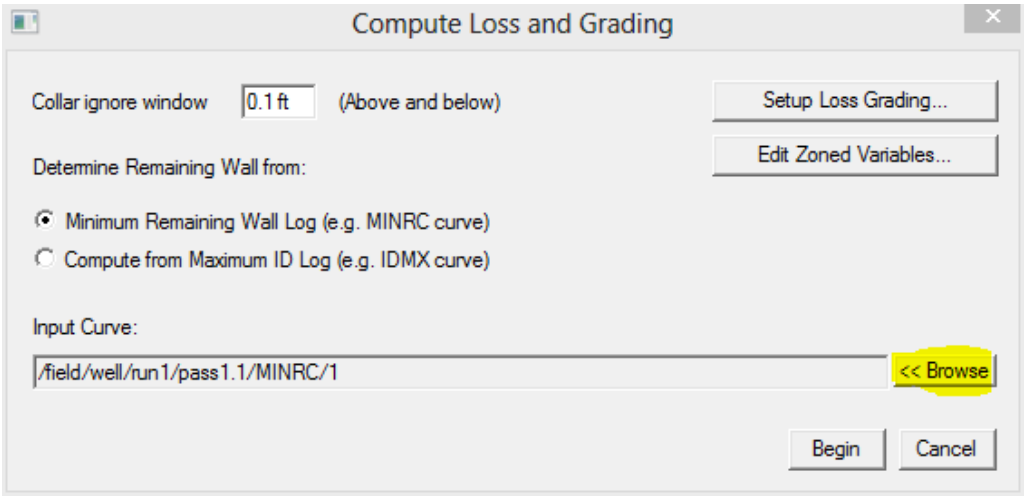


Fig. 26.18 Compute loss and Grading

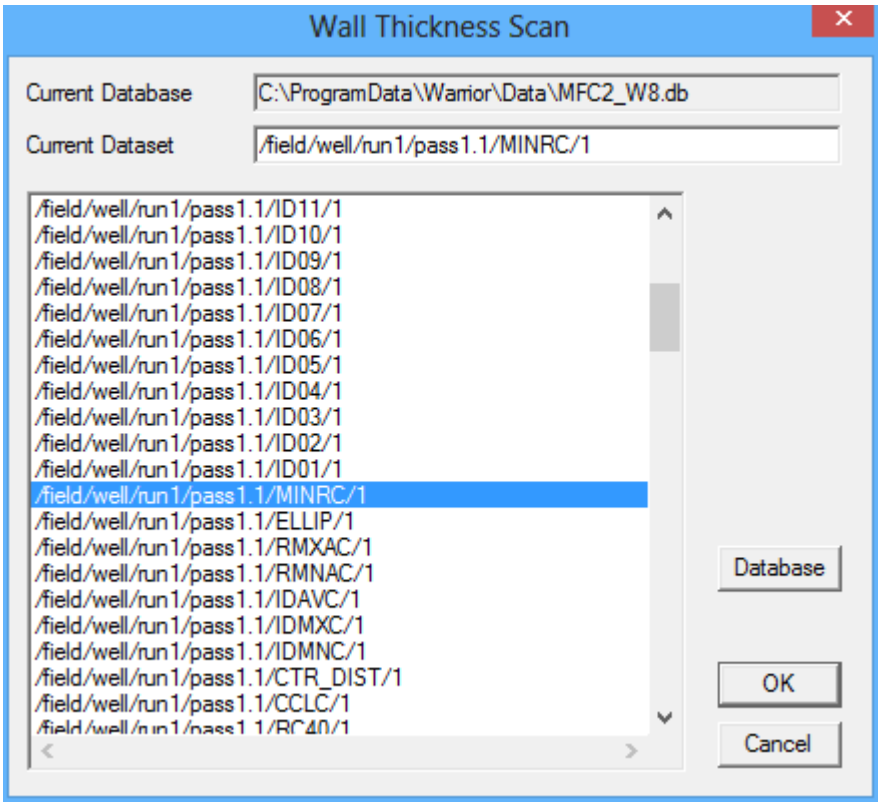


Fig. 26.19 Selecting Data to Process for Losses

The Pipe Tally table will now be completed, showing the number of joints, the collar depth of each collar, the length of each joint, the minimum remaining wall in each joint, and the grade that has been given to each joint.

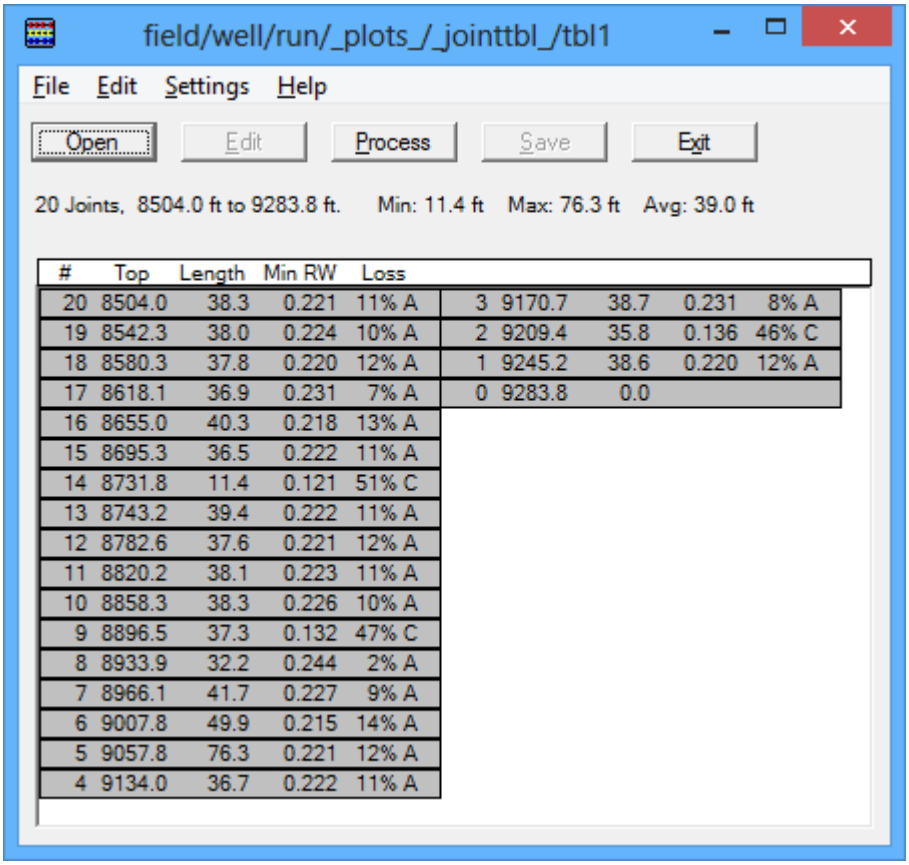


Fig. 26.20 Completed Pipe Tally Table

26.2 Multi-Finger Caliper Presentations

If the Warrior Caliper Processing software is being used, there are several additional curves or outputs that are created in addition to the standard logging outputs. These include, but are not restricted to IMGMAPC (corrected image map), IDMXC (corrected maximum diameter), IDMNC (corrected minimum diameter), IDAVC (corrected average diameter), MINRC (minimum remaining wall), and CTR_DIST (distance from center of tool to center of hole). These outputs can be added to presentations in the normal manner.

26.2.1 Pipe Tally Annotations and Grading

During the processing of the Pipe Tally table, there are two processes that will add data to the database. These are “Put Grade Strip into a Log Pass” and “Put Annotations into a Log Pass”. While the information is added to the database, it is not plotted until it is added to a presentation format.

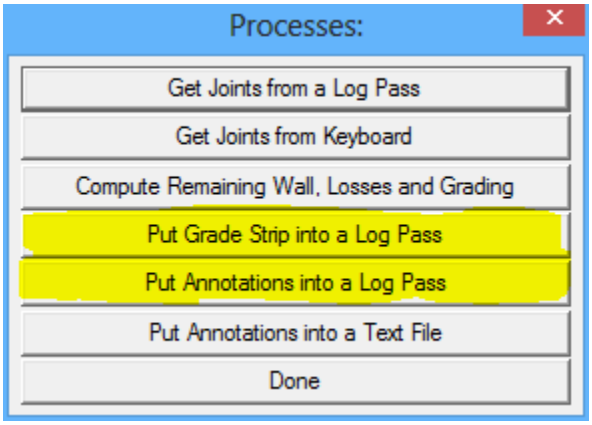


Fig. 26.21 Additional Pipe Tally Processes

From Interactive Plot, with a log pass pulled up, edit the log format. Click on the [Add] button to add a new database item to the presentation.

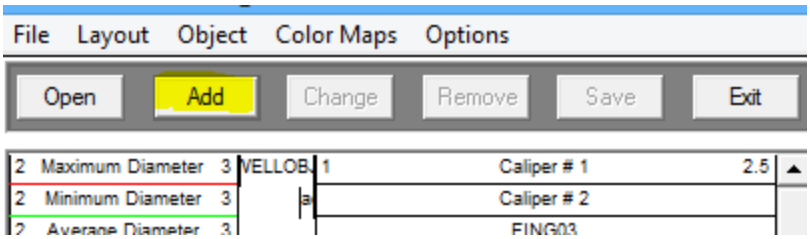


Fig. 26.22 Add a New Item to Presentation

To add the Pipe Tally Annotations to the presentation, the DB Item needs to be PTANN. This can be typed in or chosen from the [Current Pass] drop down list. The annotations can be placed in any track that is available, and the scales have no relevance in this case. The Presentation Type must be tabular and the Style needs to be Tabular by delta.

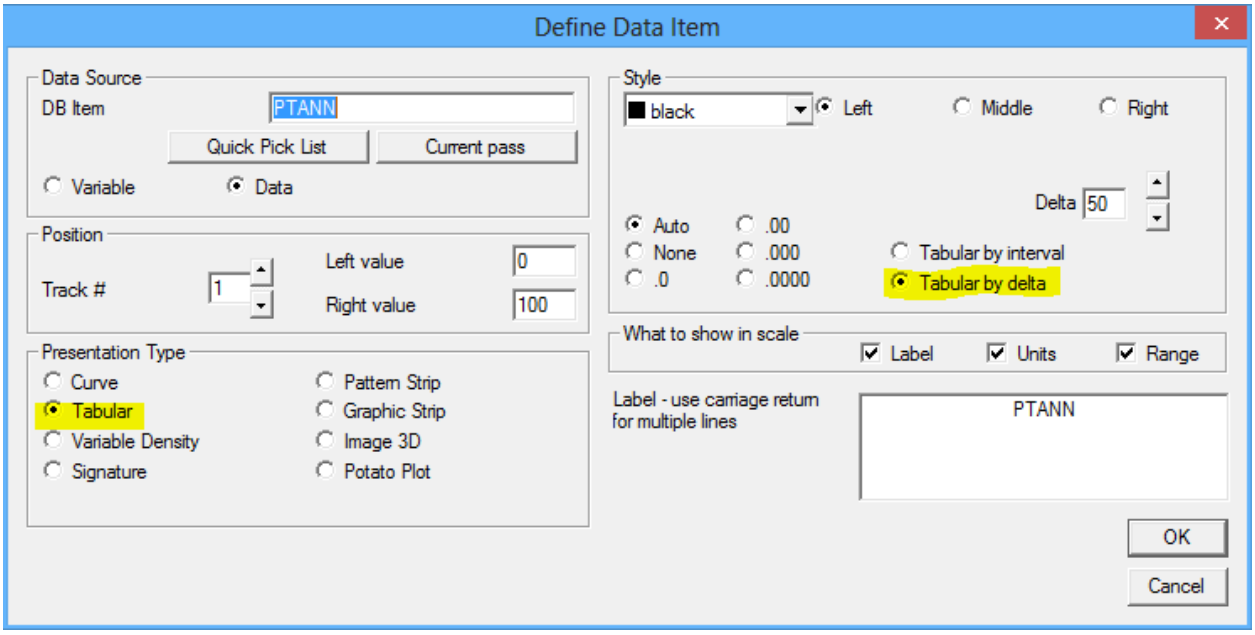


Fig. 26.23 Adding Pipe Tally Annotations

To add the grading strip, the DB item needs to be Grade. The presentation type needs to be a Pattern Strip. The color map needs to be Pipe Grade. This is a special color map that can only be edited from the pipe tally grading and options settings. It cannot be edited through the normal color map editing. The scales should be set from 1 to the number of grades that were set up in the Pipe Tally Options.

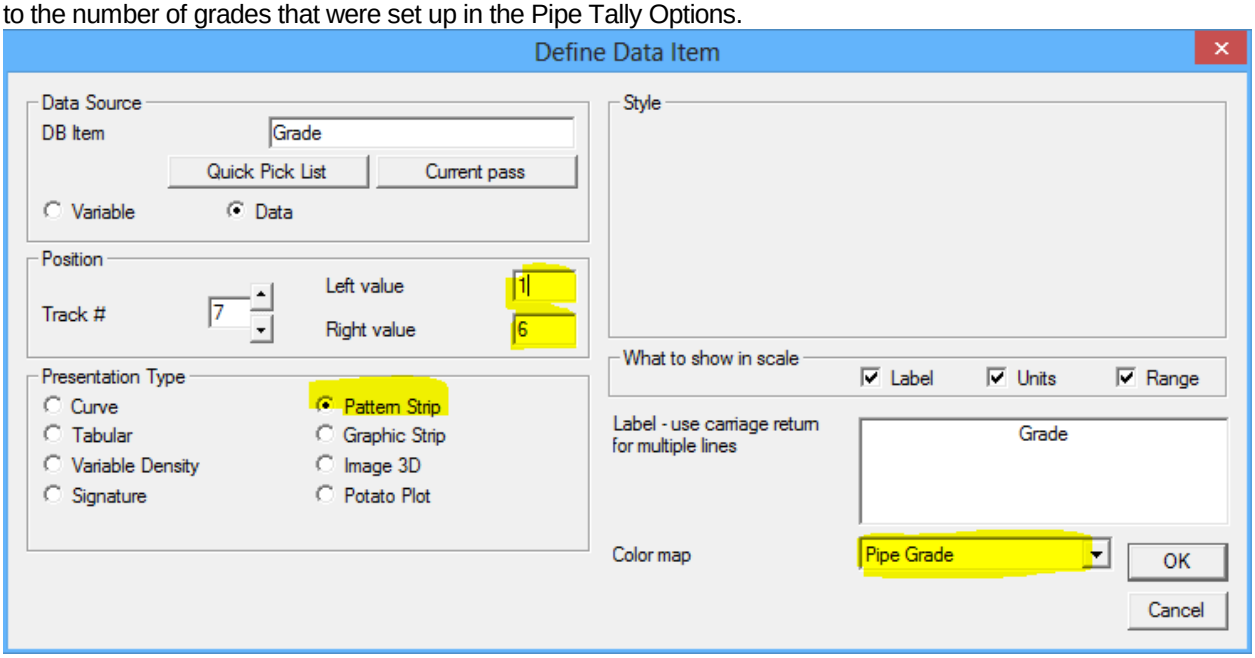
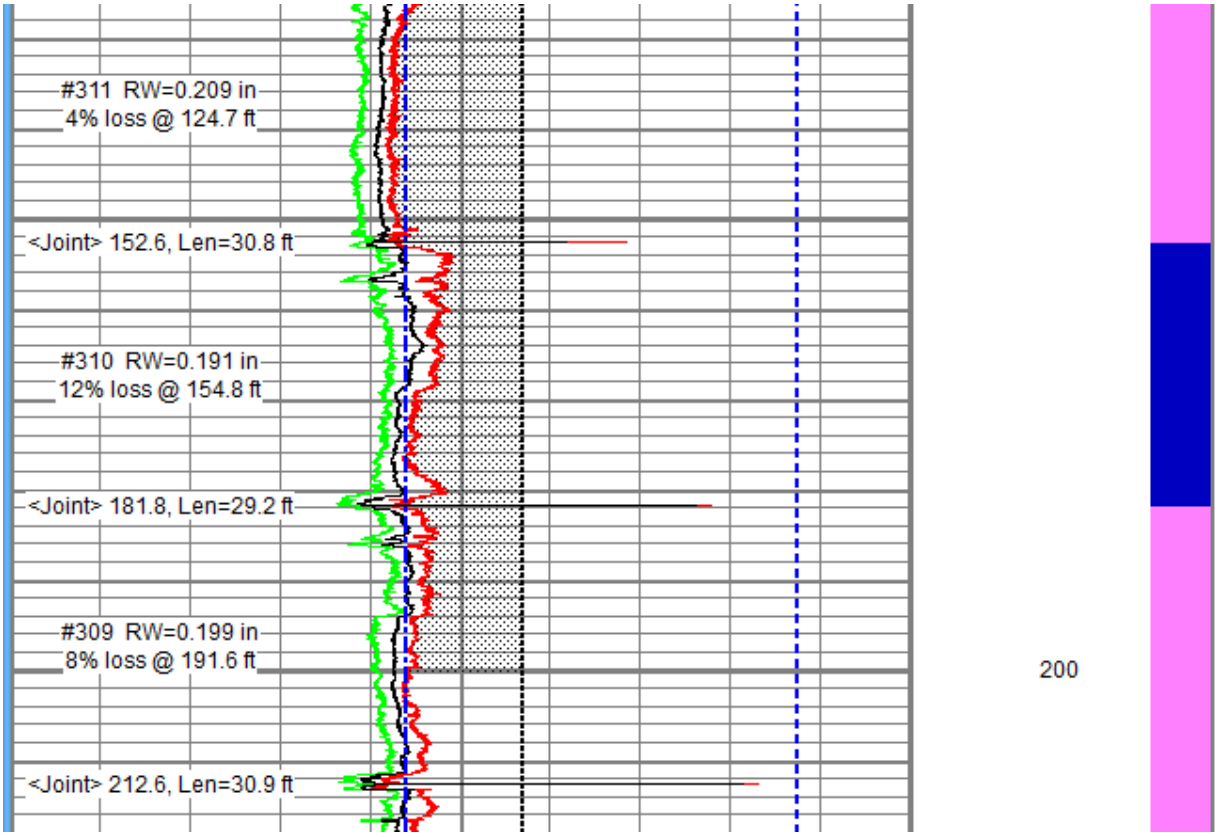


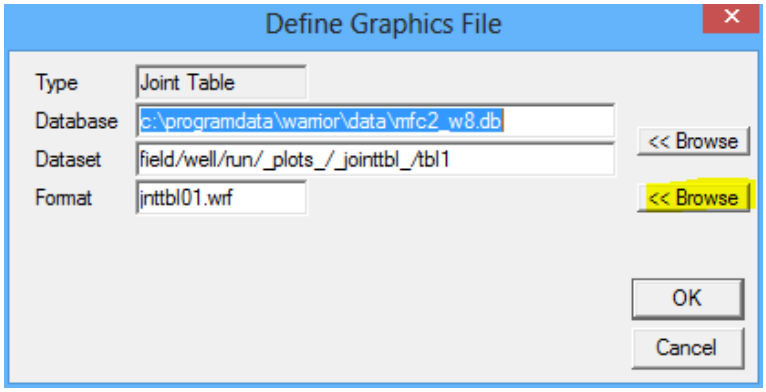
Fig. 26.24 Adding Pipe Grade Strip

Fig. 26.25 shows an example with annotations and grading strip in a presentation.



26.2.2 Pipe Tally Tables in Plot Job

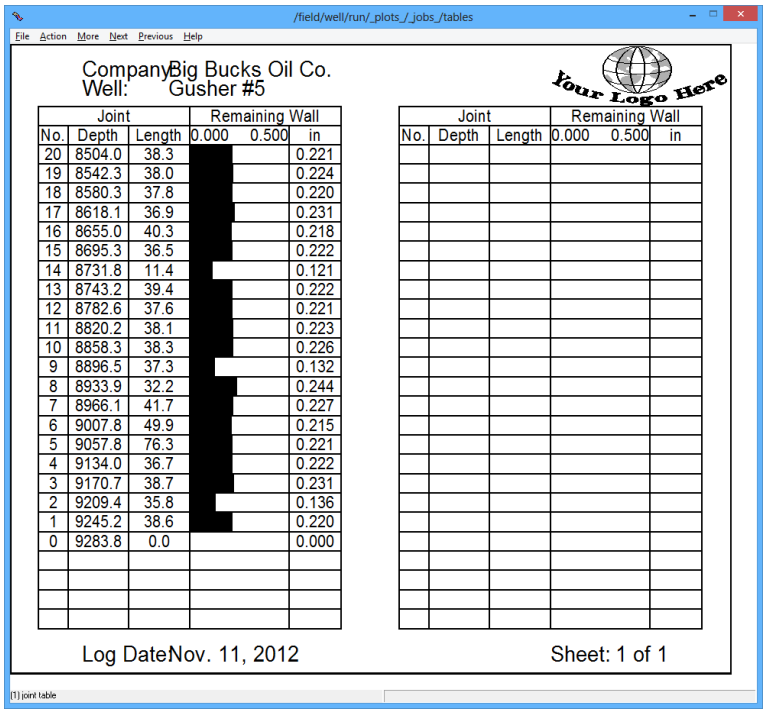
-
- When adding a pipe tally table to a plot job, there are several formats that the table may be printed under. These are *.WRF in the Warrior\Format folder. When adding the table to a Plot Job, the format that is to be used for printing the pipe tally table can be selected. Examples are shown below.



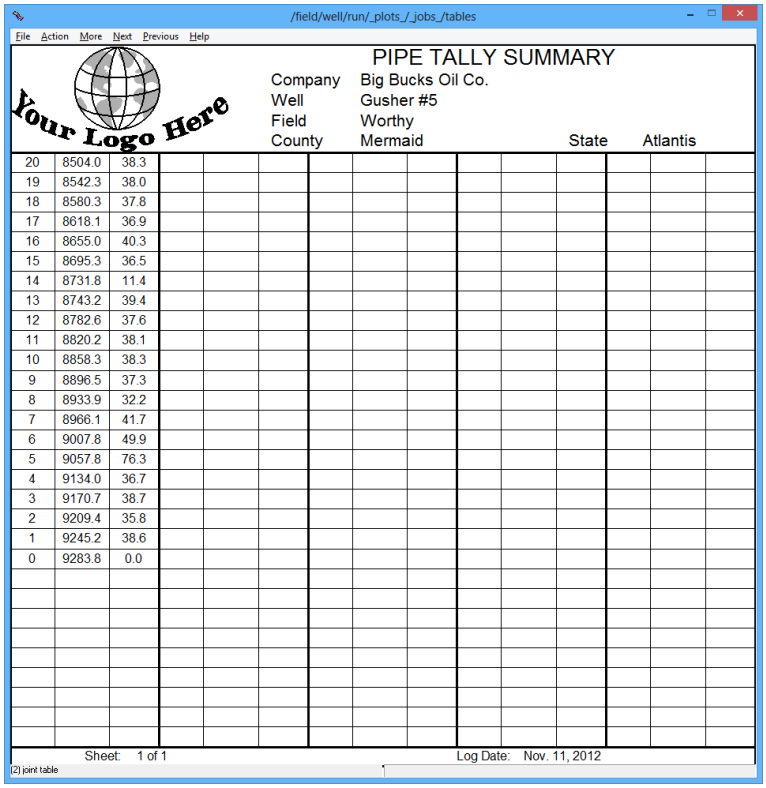
-

Fig. 26.26 Selecting Pipe Tally Report format

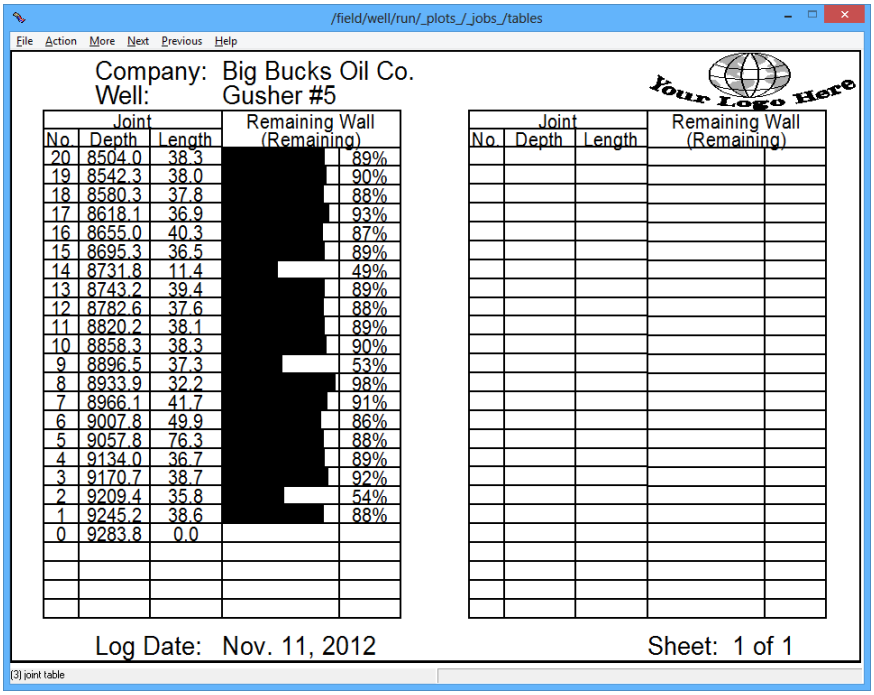
-



- JNTTBL01.wrf

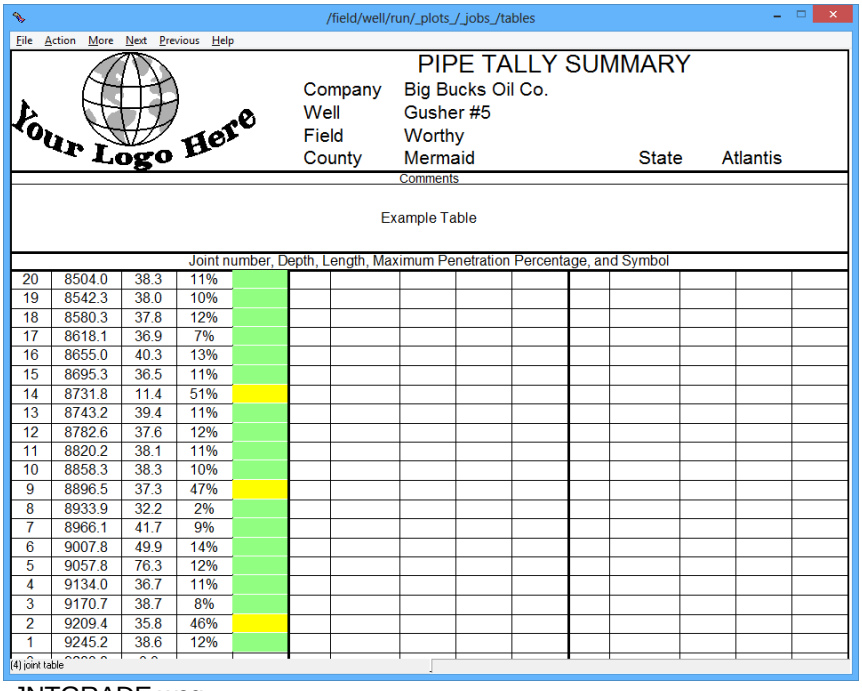


- CCL.wrf
-
-



- JNTBARPCT.wrf

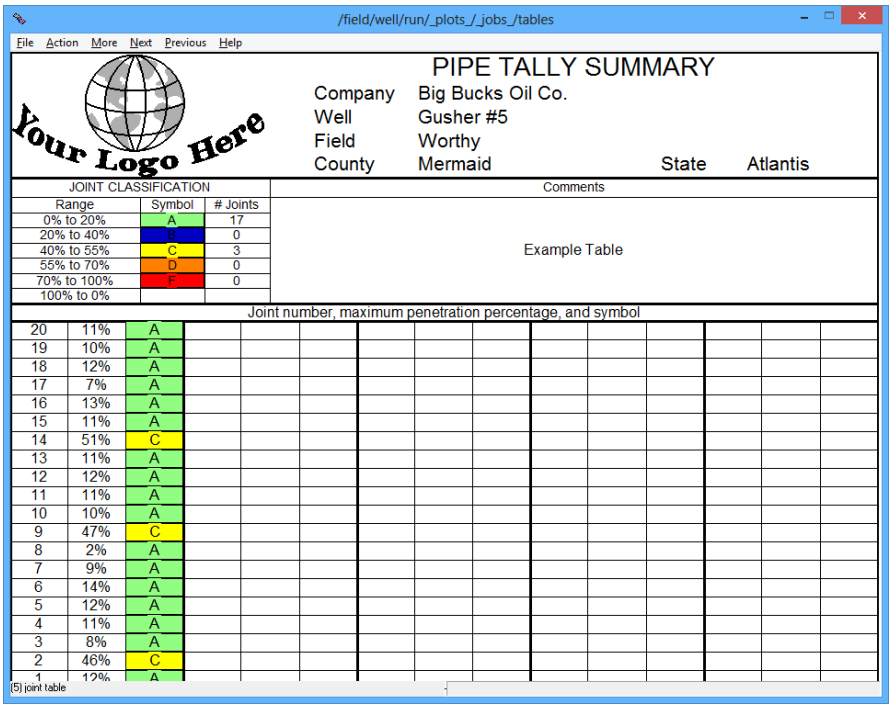
-
-



- JNTGRADE.wcg

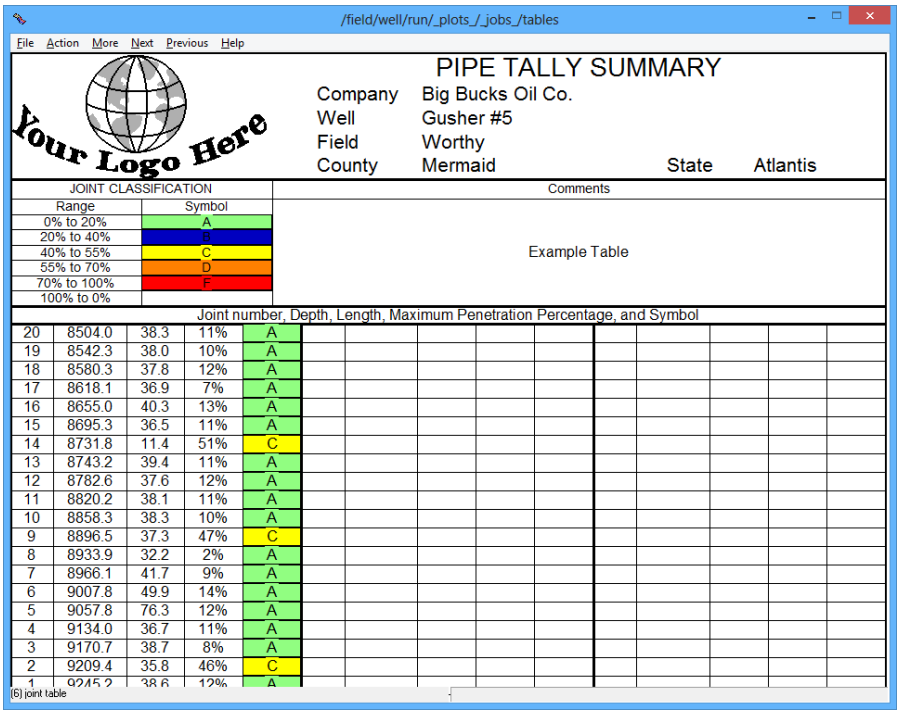
-

-



-

- MAC.wrf



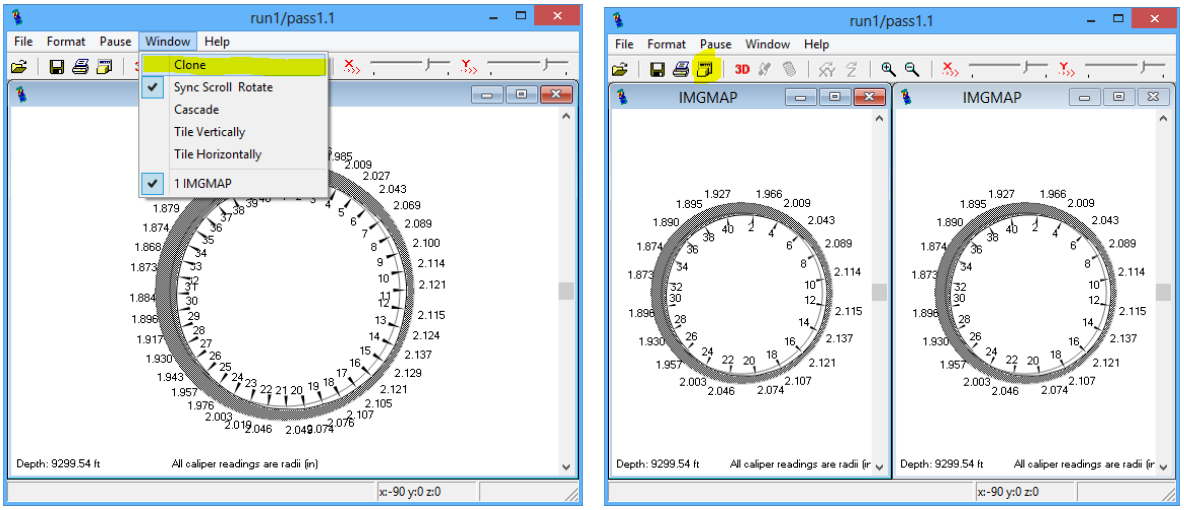
- MAC2.wrf

Fig. 26.27 grading examples

26.2.3 Borehole Presentations

The Borehole Presentation Window, available in some presentations, has been enhanced with the ability to show two image map presentations. To show the second image map, click on the “Window” menu option and then select “Clone”.

Fig. 26.28 Setting Borehole Image Presentation for two Images



Once the two images are cloned they will be the same image. By clicking one of the images and then clicking on the “Options” icon, as shown in fig. 3.1, the second image can be set to be a corrected caliper array image IMGMAPC. Either image can be set to either a 2-dimensional or 3-dimensional presentation.

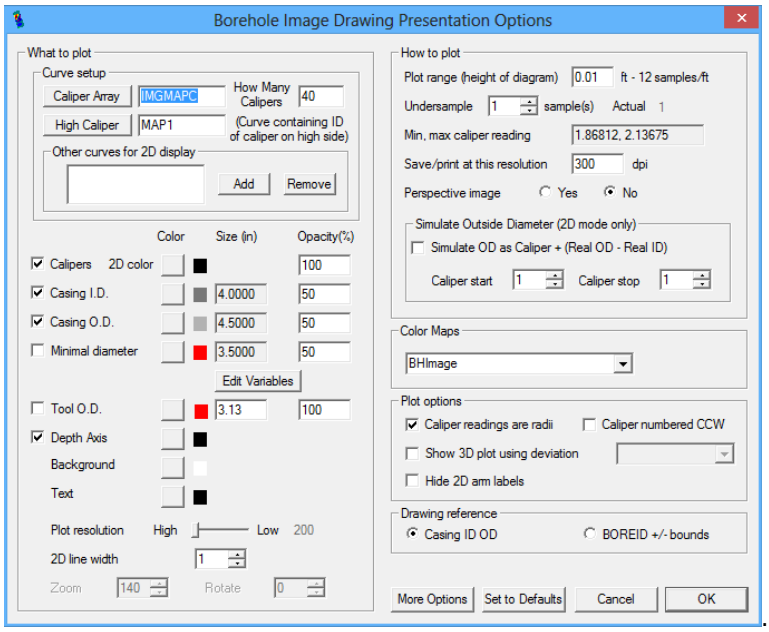
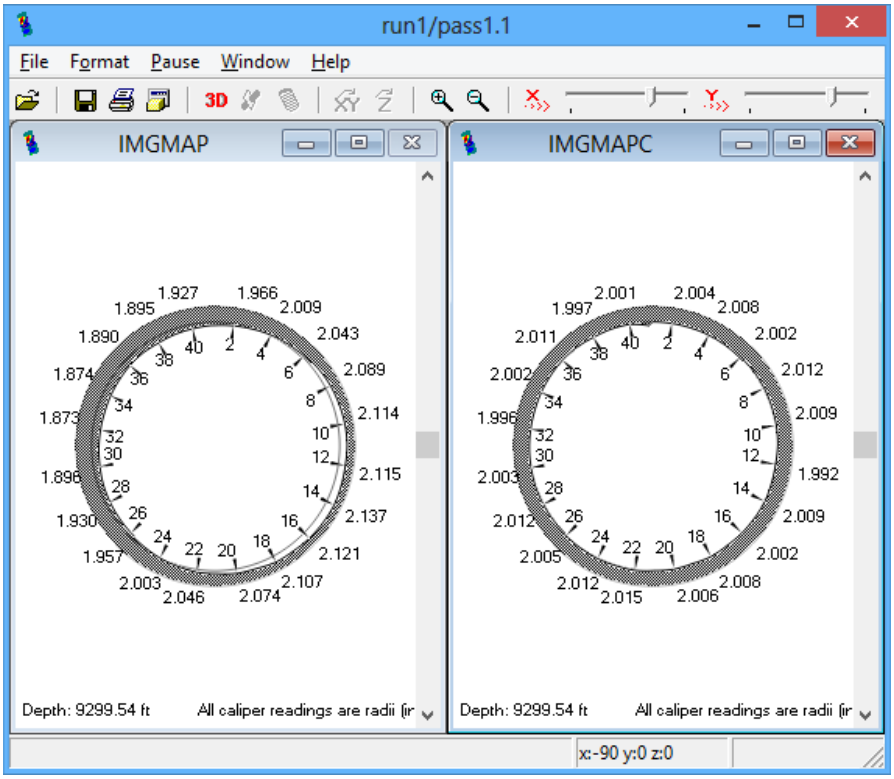


Fig. 26.29 Setting Corrected Image for Second Borehole Presentation



clicking on the “Options” icon, as shown in fig. 3.1, the second image can be set to be a corrected caliper array image IMGMAPC. Either image can be set to either a 2-dimensional or 3-dimensional presentation.

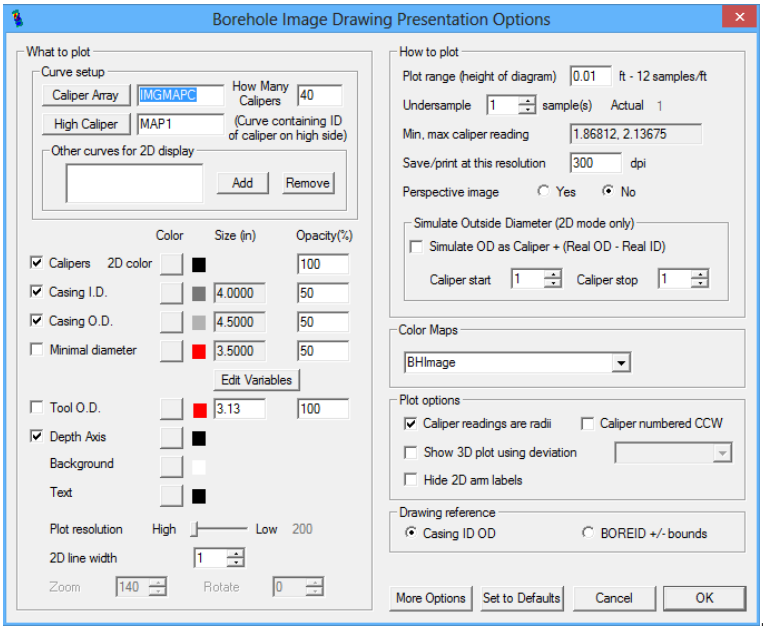


Fig. 26.30 Setting Corrected Image for Second Borehole Presentation

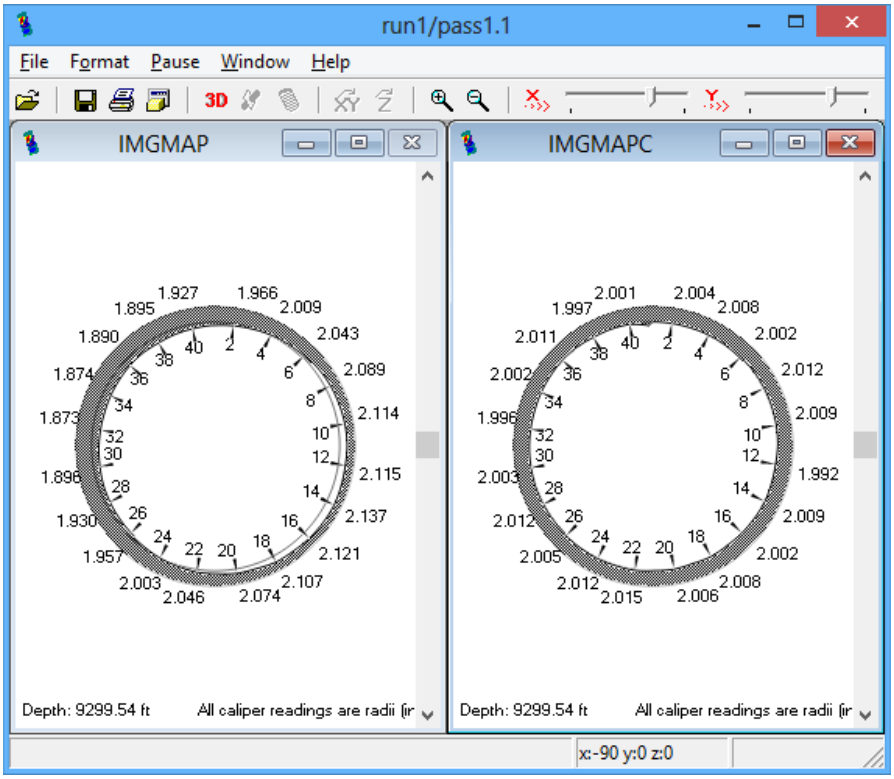


Fig. 26.31 Showing Caliper Array Image and Corrected Image

26.2.4 Multi-Finger Presentations

In previous versions of Warrior software, an array of curves, such as arm radii, each had to be plotted individually. This meant that if a scale change was required each individual arm had to be rescaled. Warrior 8 allows the User to plot a list of curves as a single DB item. The presentation shown if fig.3.4.1 shows a 40 arm caliper presentation with arm R01 plotted from 2.4375 to 4.9375. Each additional arm is plotted with the scales set to .0625 less so that arm R40 is plotted from 0 to 2.5.

In this example, I will remove every caliper arm curve as shown in Fig. 3.4.2. Next I will click the [ADD] button and select the List type of Data Source for the DB item. Click the [Curve List Properties] button to bring up the Curve List Editor Window as shown in Fig. 3.4.4.

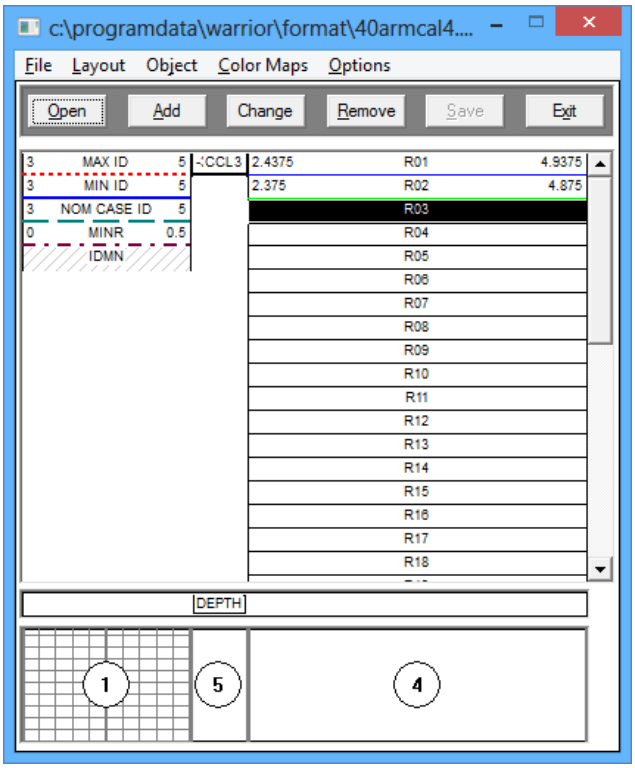


Fig. 26.32 Typical 40 arm caliper presentation

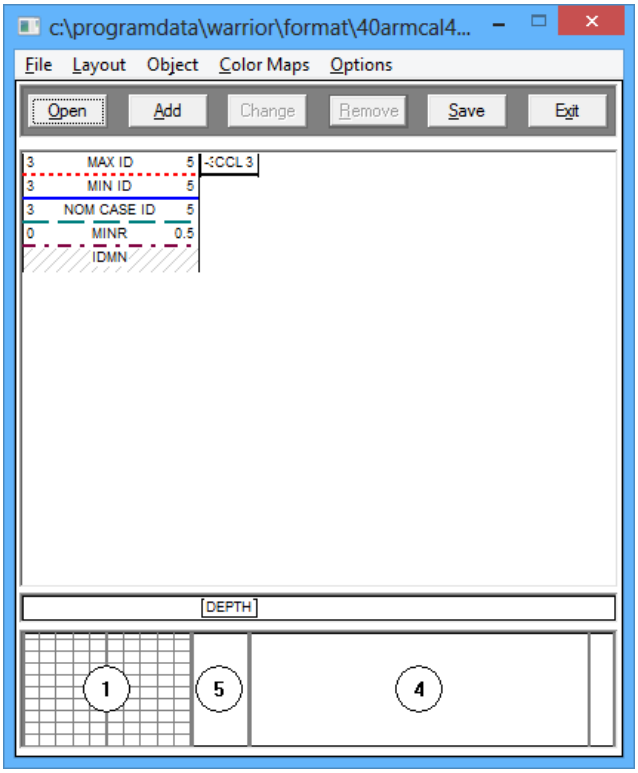


Fig. 26.33 Presentation with all caliper arm curves removed

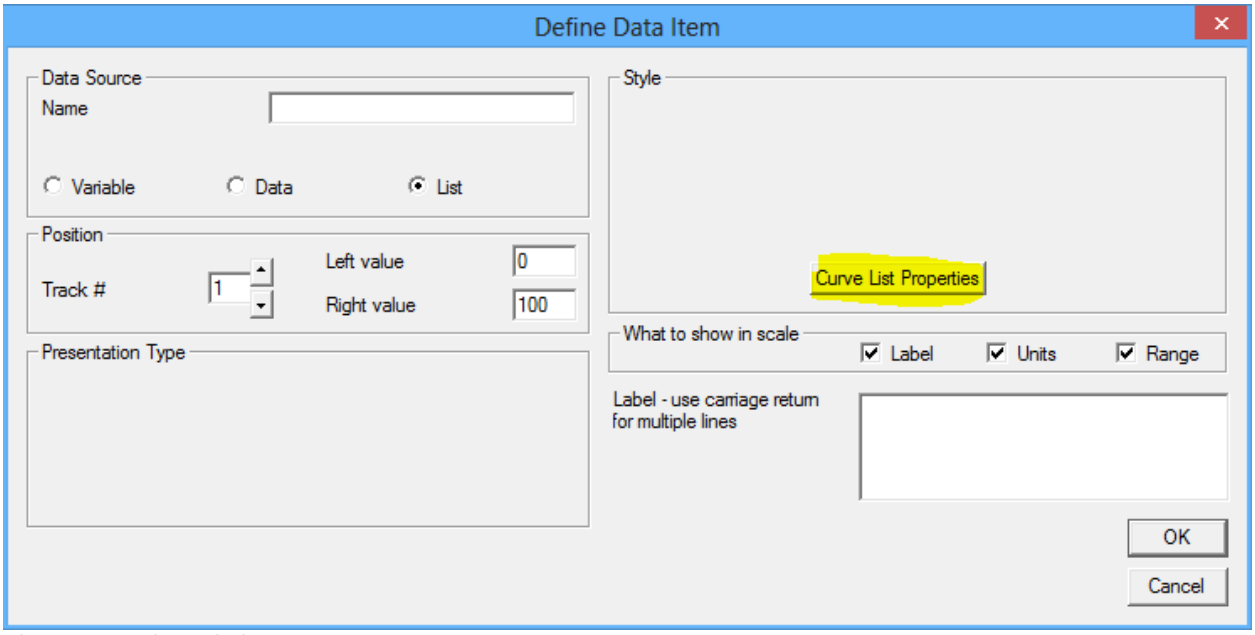


Fig. 26.34 Selected List type Data Source DB Item

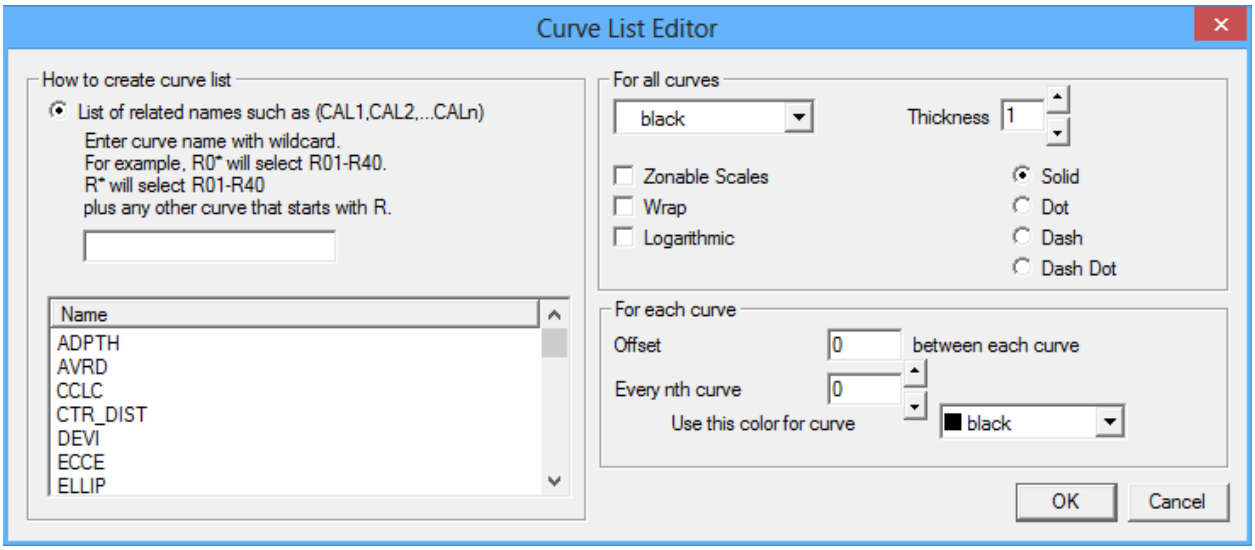


Fig. 26.35 Curve List Editor Window

On the left side of the Curve List Editor Window is a drop down list of all the available outputs. Select the first curve in the list of curves that you would like to plot. There is a brief example that describes how to pick the curve shown in the “How to create curve list” box. When the curve is selected, the “list identifier” will be filled out. The “For all curves” box of the Curve List Editor Window is used the same as the style box of a normal curve.

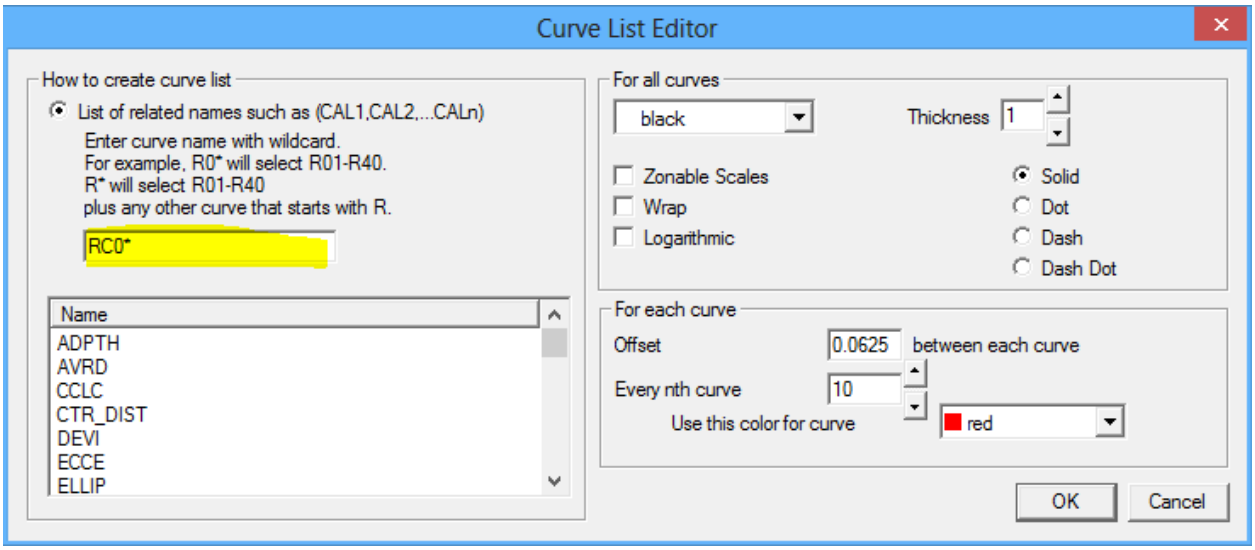


Fig. 26.36 Select List of Curves

The “For each curve” box provides some additional settings. When plotting multiple curves, it is normal to offset each curve by a small amount so that the curves are not stacked on top of each other and are distinguishable. Another method of distinguishing multiple curves is to make one of the curves a different color every so often. This box provides the User those capabilities with the multiple curve lists. When the settings have been selected, click [OK] to close the Curve List Editor window. Note that the scales for the first curve and every nth curve will automatically be shown.

The final settings for defining the list of curves are giving the list a name. This can be anything to identify the list, such as Calipers, R0 thru R40, or whatever the User decides is appropriate. The track and the scales also need to be set. The scales will be the scale for all of the curves, but only the first curve and every nth curve will the scales be shown on the log insert. When complete, click [OK] to save the curve definition. Then click [Save] to save the edited plot.

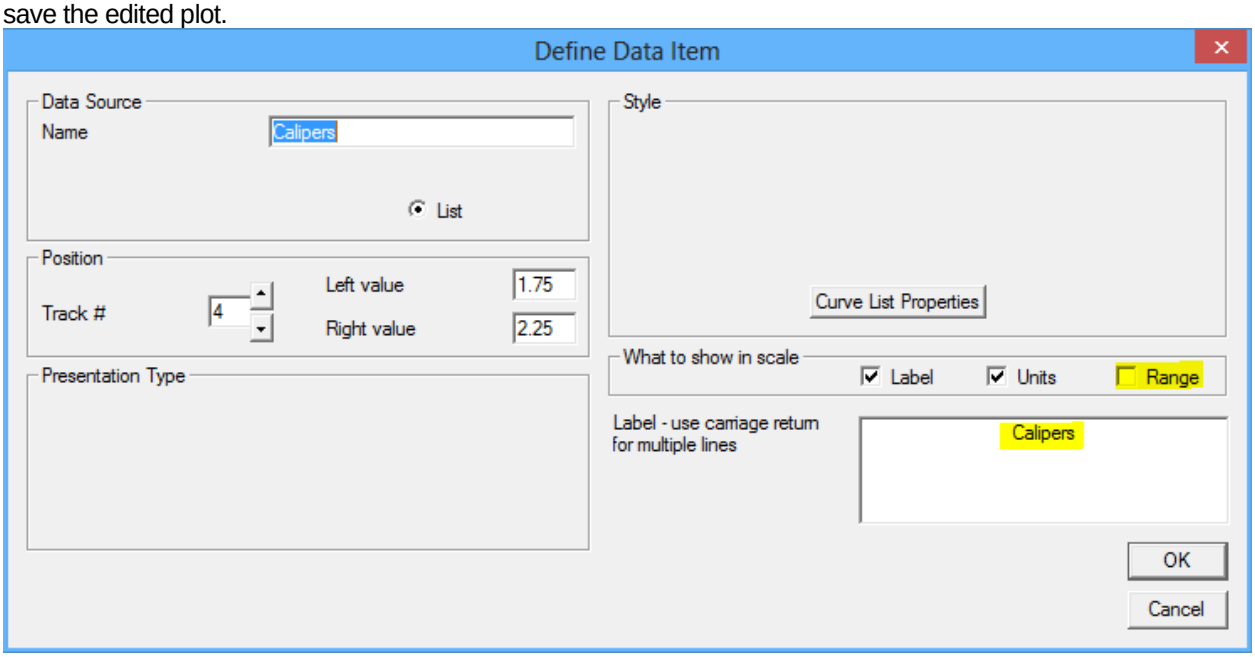


Fig. 26.37 Setting Track and Scales and giving list of curves a name

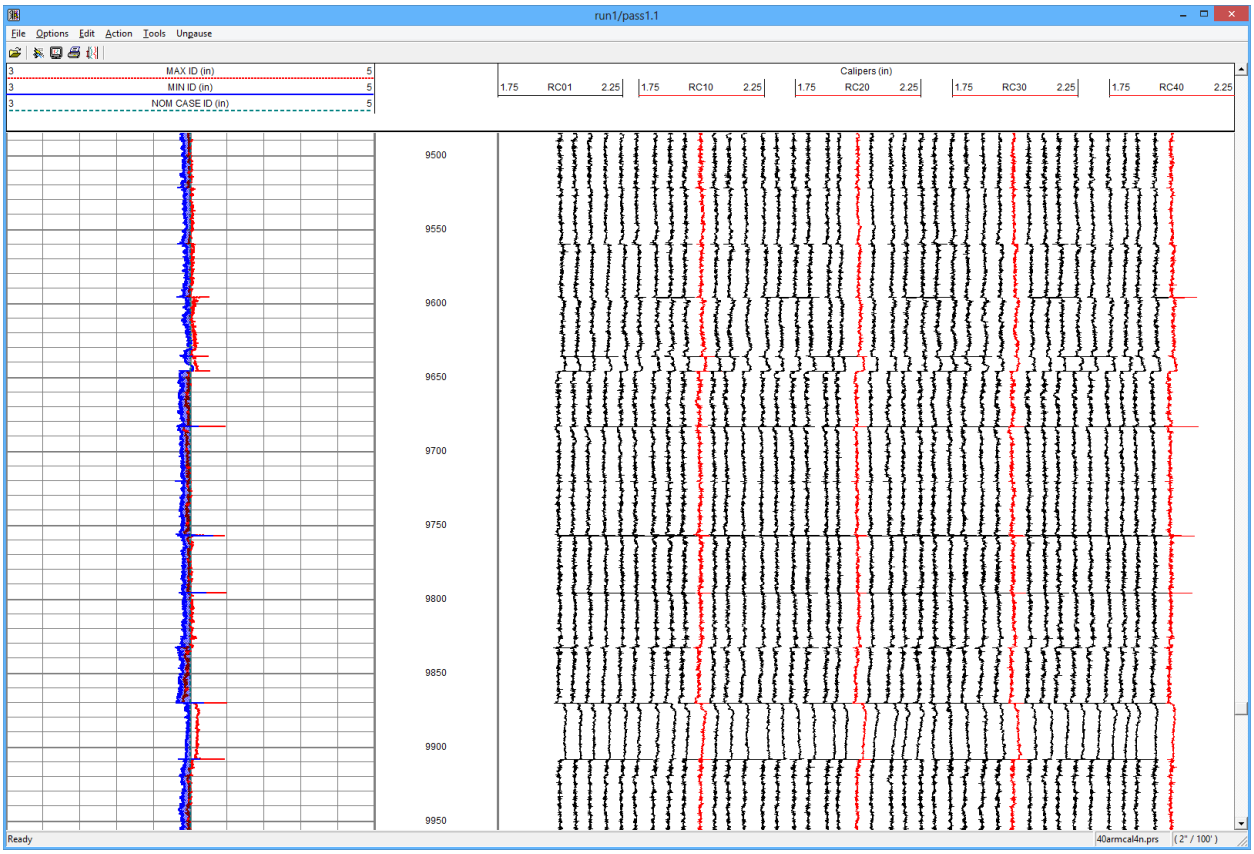


Fig. 26.38 Final presentation for a list of caliper curves

26.3 Multiarm64(32).exe

This program will read in LAS data from a Multi-Arm service and create a single pass in a Warrior database. This pass will not only contain the curves found in the LAS data, but will also create a 180 point VDL curve by interpolating between each of the Multi-Arm caliper readings. This program also contains a viewer that can display a 3 dimensional view of a section of the Multi-Arm data. The program is located at "C:\Program Files\Scientific Data Systems\Bin"

26.3.1 Importing Multi-Arm Data

The first step is to import the Multi-Arm data in to a Warrior database. Use the build button “Import from LAS” to select the LAS file to import.

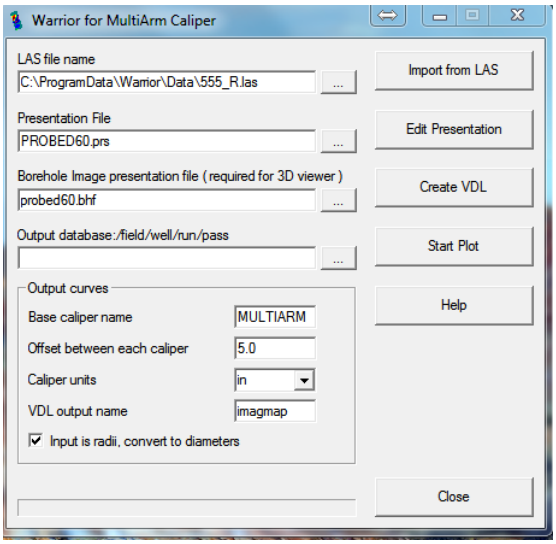


FIG:26.39 LAS Multiarm Caliper

26.3.2 Caliper Presentation

The presentation file will be embedded in the database as the presentation to be used when the data is plotted. This can be edited later.
Select the Las File
Select The Presentation file (Probed60.prs)
Select the output database Select an existing database or type in a new database name. Fill in the field/well/run portion of the dataset. The name of the pass will always be the same as the LAS file name.
Set the offset between calipers to show all the calipers in one track
Type the “Base Caliper Name” (MULTIARM)
Type the VDL output name (imagmap)
If you just have LAS then select **import from LAS**. If you have the database select create **VDL**

26.3.3 Output curves
The program will search through the Multi-Arm LAS data for caliper curves that start with this name – i.e. ARM1, ARM2, etc. It uses these names to create the 180 point interpolation for the 3-D view. The offset between each caliper is automatically applied to the presentation file to display the individual arm data. An offset of 0 would put all of the arm curves on top of each other which may make it difficult to see responses of individual curves. The VDL output name is the name of the curve that will contain the interpolation of the caliper data. This curve will contain 180 data points for each depth sample.

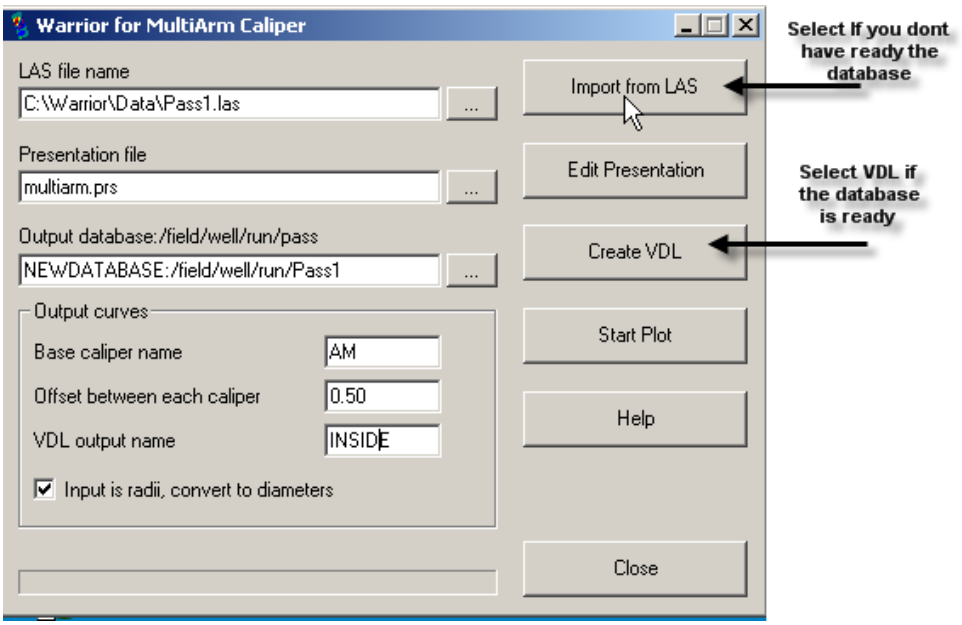


FIG: 26.40 Set up Multi-Arm Caliper

Start the process to convert the LAS to BD It takes long time for example to produce 1Gb .

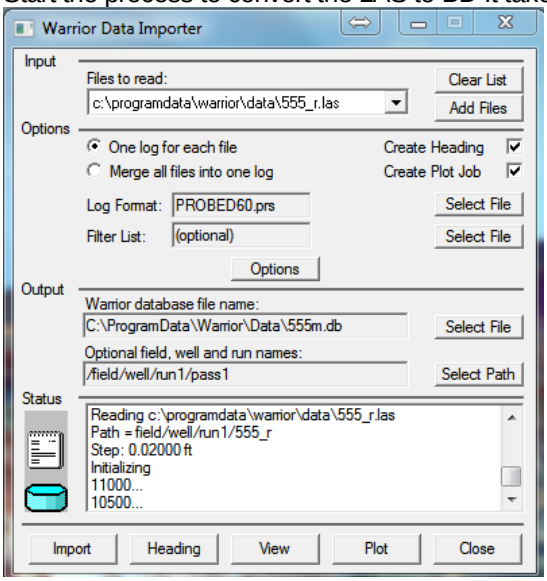


FIG: 26.41 Warrior Data Import

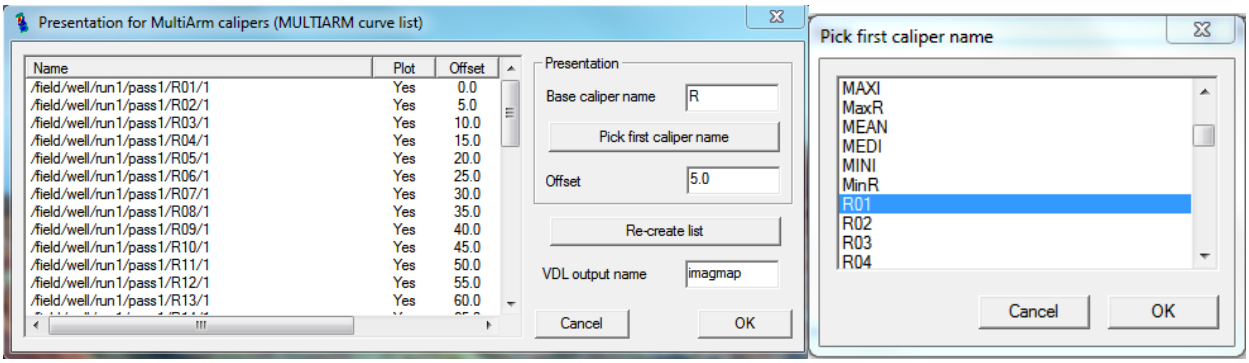


FIG: 26.42 Selecting Caliper Name

Once the system reads through the LAS file it will prompt you to select a caliper name, browse the list until you find the applicable mnemonic.

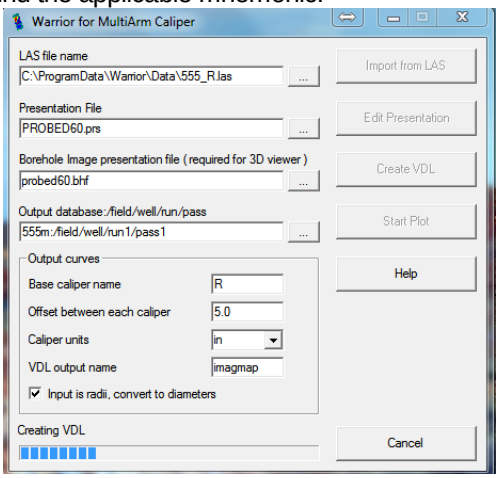


FIG 26.43 Creating VDL

Once it has completed the process the system will open the resulting file with interactive plot using the presentation selected earlier.

26.3.4 Edit Presentation

See section 6