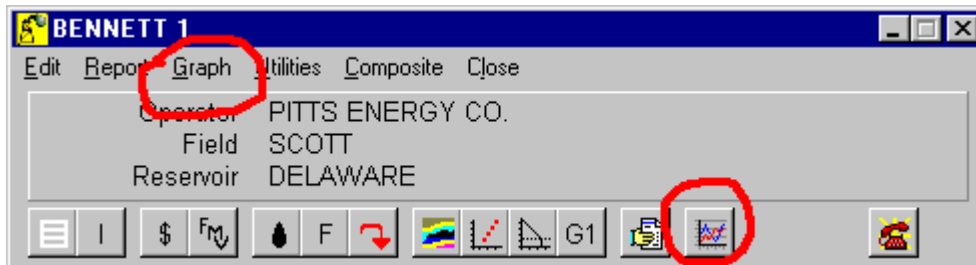


# How To Graphically Analyze Production History Data

March 25, 2004

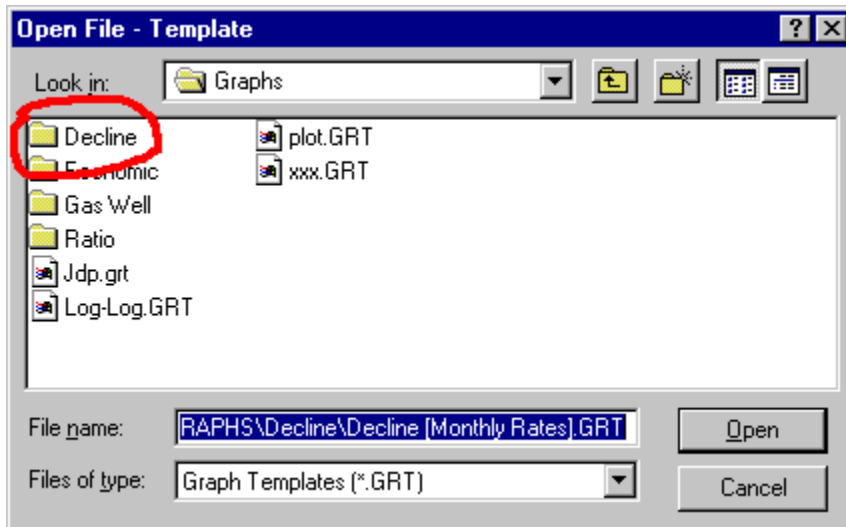
MICA can plot production history on a semi-log graph, analyze any section of the production history with a least squares regression and use the trend found in the regression to project the future production of oil, gas, water, and two additional revenue producing streams. This paper describes how to do this.

**Step 1 – Select and display a semi-log graph on your computer screen.** From the well form select the “Graph” menu item or click the graph speed button.

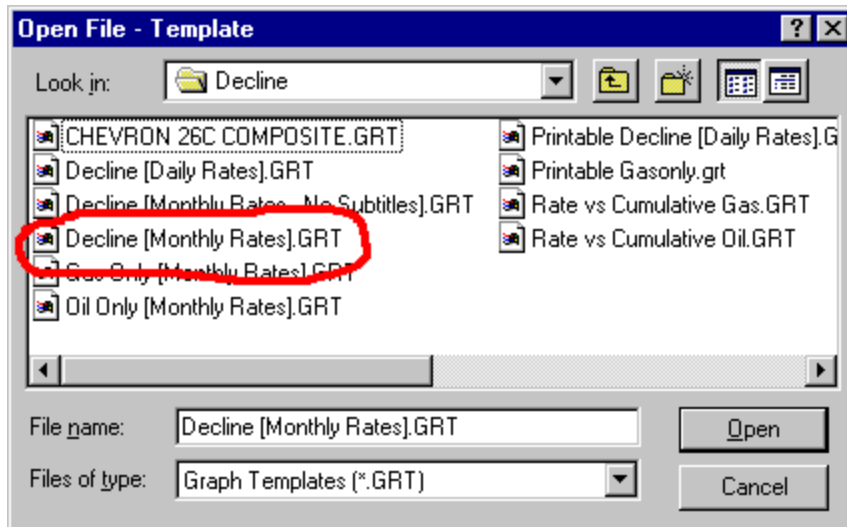


**Note:** The graph speed button has a memory. That is, it will remember the last graph template you have opened for this well and display that graph template again. If you have not yet displayed a graph for this well, then it will simply display the graph template selection.

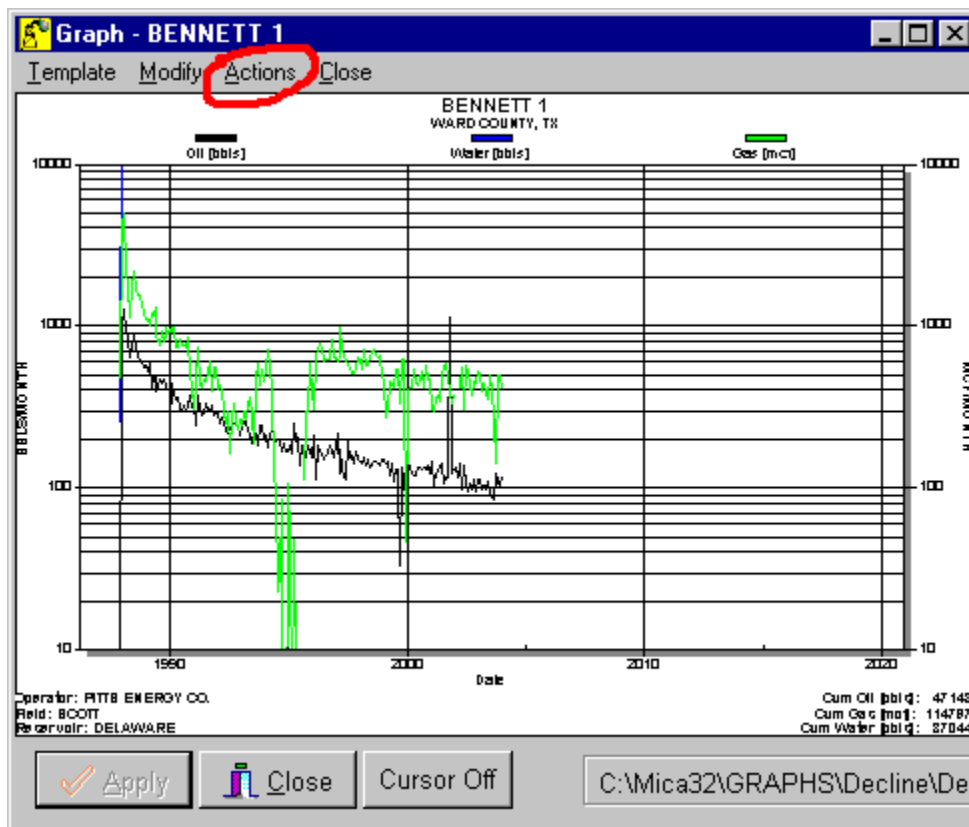
When you select the “Graph” menu item the graph template selection list will appear as shown below:



Generally the graph templates are stored in folders that logically classify the graphs displayed. But as you add graph templates, they may appear anywhere and additional folders may have been created. Double click the “Decline” folder to display graphs used for decline curve analysis. It will display a form similar to the one shown below:

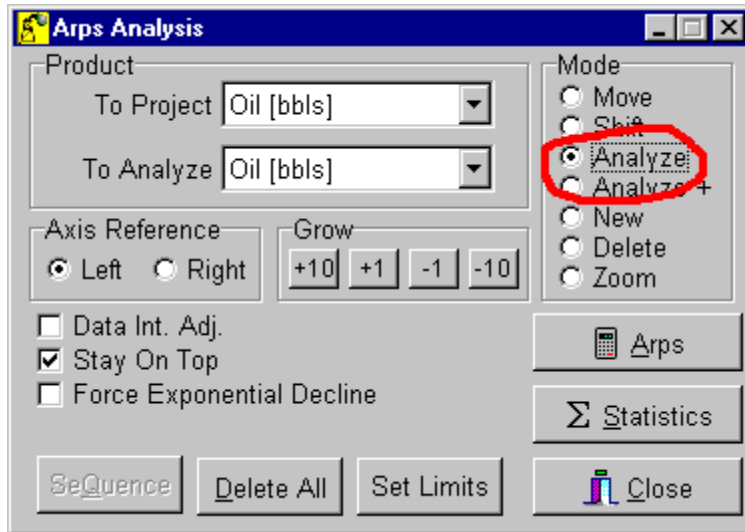


Select the “Decline [Monthly Rates].GRT template and click “Open”. This will display a semi-log graph of the production history similar to the one shown below:



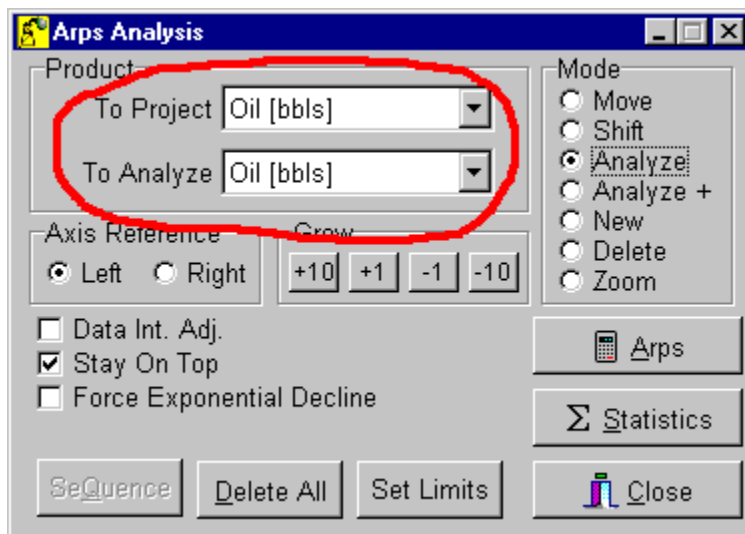
**Note:** You should generally use a monthly semi-log graph to analyze production data.

**Step 2 – Open the Arps Analysis form and select the product to analyze.** To open the Arps Analysis form select the “Actions/Arps Analysis” menu item from the graph form as shown above. The Arps Analysis form will appear as shown below:

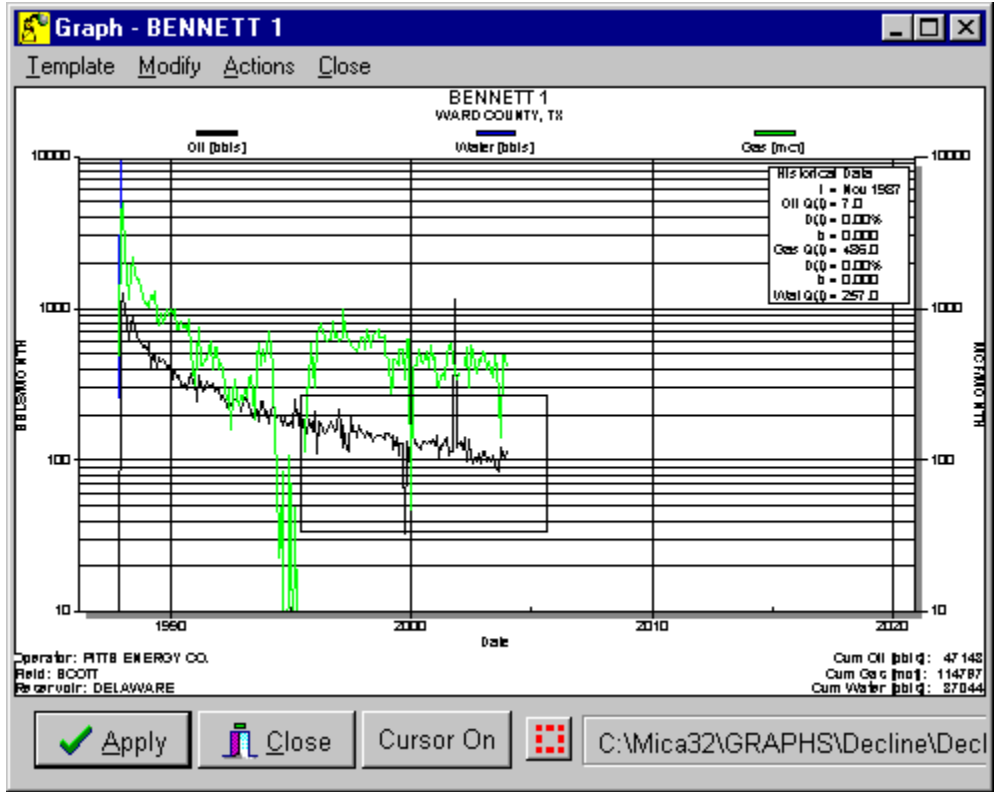


You will want to move the Arps Analysis form on your screen so that you can see both it and the graph form at the same time. To move it click and drag the title bar.

In the “Mode” panel on the upper right corner of the Arps Analysis form select the “Analyze” option. When in the Analyze Mode, you must tell MICA which product you wish to analyze and which product you wish to project using the trend found from the regression. This is done with the “Product” panel to the left of the Mode panel on the Arps Analysis form. In this example we will first analyze the oil production. Set the “Product To Analyze” and “Product To Project” both to “Oil” as shown below:

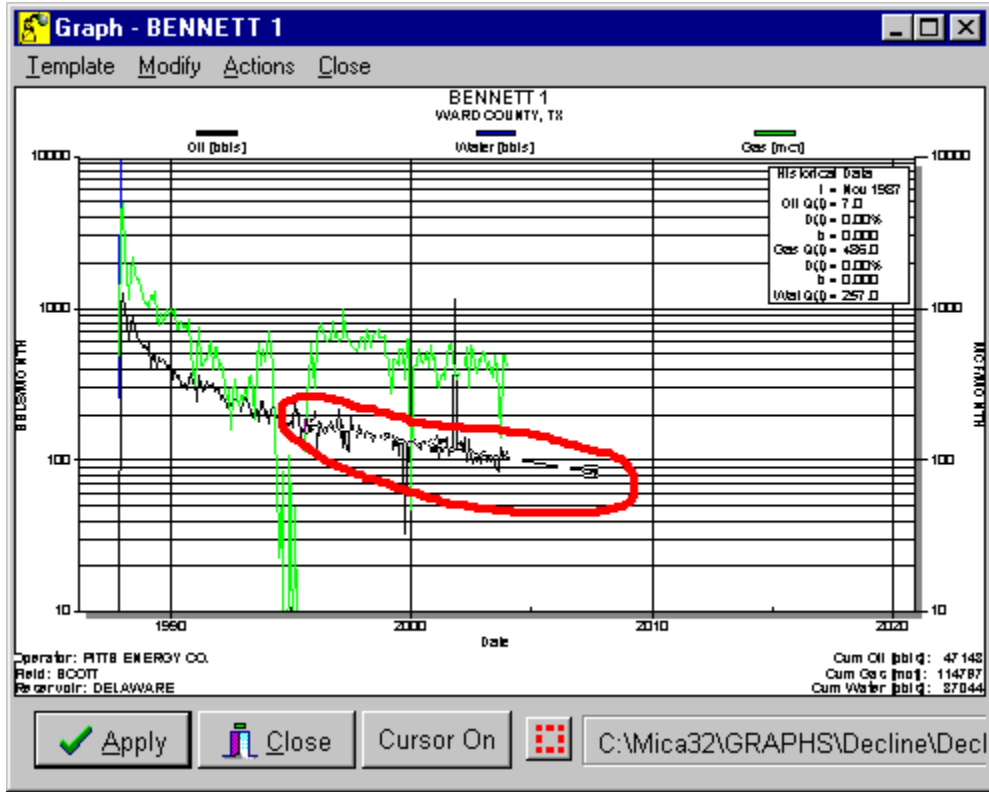


**Step 3 – Draw a box around the production data on the graph.** On the graph you should select a range of data that best represents the trend of the oil production and draw a box around it. To draw a box around the data move your mouse cursor to the upper left hand corner of the box, then click and drag the mouse cursor to the bottom right hand corner. As you do this, you should see a black box appear on the graph. All data within the box will be used in the regression and all data outside of the box will be ignored.

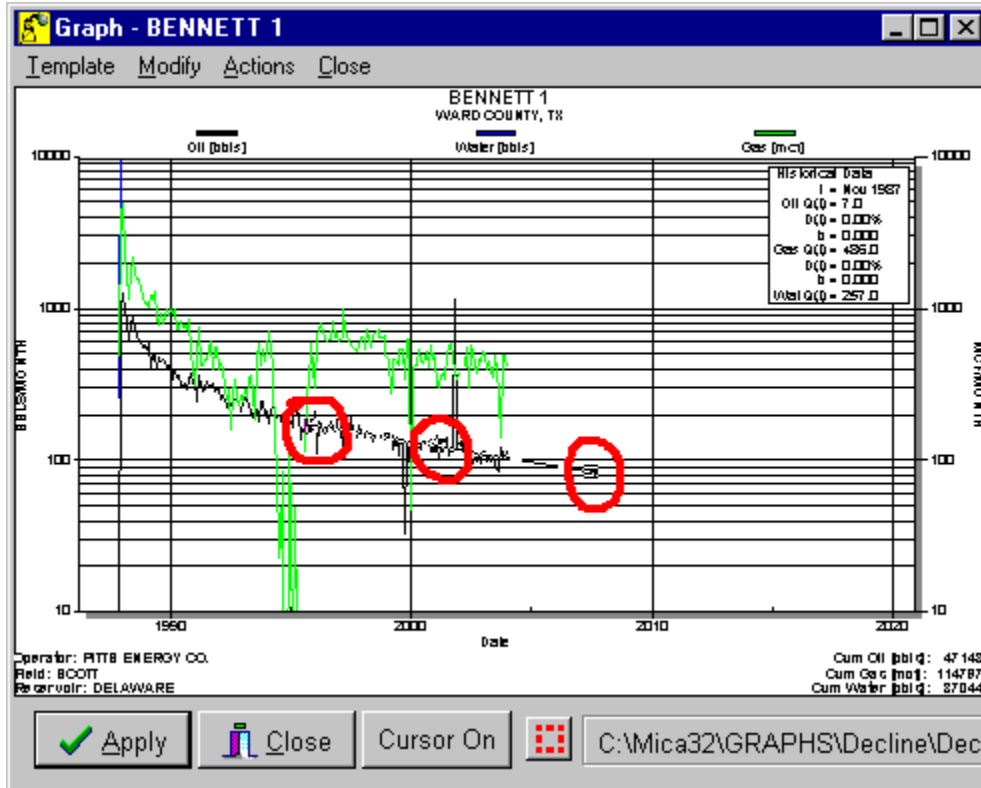


We have drawn the box as shown above.

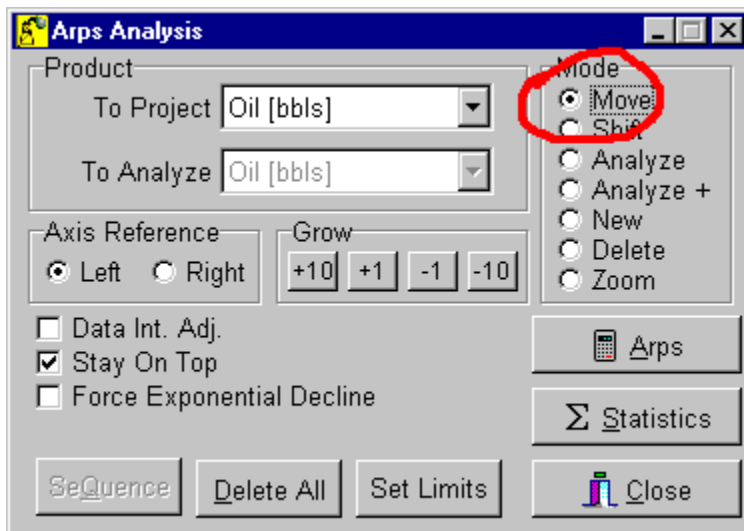
After you release the mouse button the regression analysis will be performed on the data within the box and a decline segment will appear on the graph that represents the best fit line through the data as shown below:



The decline segment will have three small black boxes on it. One at the beginning, one in the middle and a third at the end of the segment. Depending upon the history data the decline segment itself and the boxes may be difficult to see as shown on above. The black boxes are called anchor points and are shown below:



**Step 4 – Adjust the decline segment if necessary.** You can now use the anchor points to move the decline segment. To do so set the “Mode” on the Arps Analysis form to the “Move” option as shown below:



When you do this, you can now grab and drag one of the anchor points. When you move your mouse cursor over an anchor point it will change from an arrow to a cross hair cursor. To drag an anchor point simply click and move your mouse holding down the mouse button.

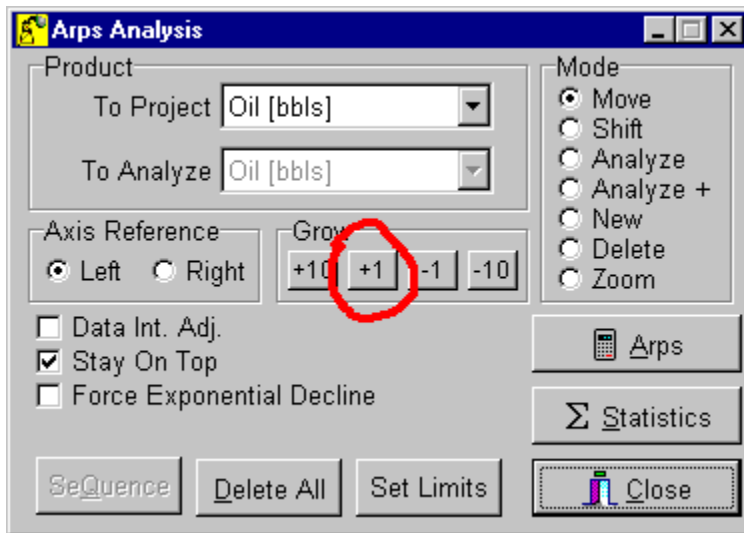
Dragging the first anchor point will move the beginning of the decline segment up, down, left, or right. Dragging the middle anchor point up and down will add and remove curvature to the decline segment affecting the hyperbolic exponent. And dragging the last anchor point will move the end of the decline segment up, down, left, or right.

Setting the “Mode” panel to the “Shift” option will allow you to shift the entire decline segment to any location on the graph while maintaining the slope of the segment.

**Note:** You can also select the Mode option by right clicking on the graph. This will display a pop-up menu and you can select the Mode options from that menu.

**Step 5 – Grow the decline segment.** After you have positioned the decline segment on the graph where you want it, you should grow it. Growing it simply extends the end point of the decline segment. Whenever MICA generates a production forecast it will generate a forecast only as long as the decline segment dictates. That is, if the decline segment begins in March of 1997 and ends in July of 2005, then the production forecast generated by MICA will start and end on those dates. Of course, if your production forecast ends on July of 2005, then your revenue will stop on that date also.

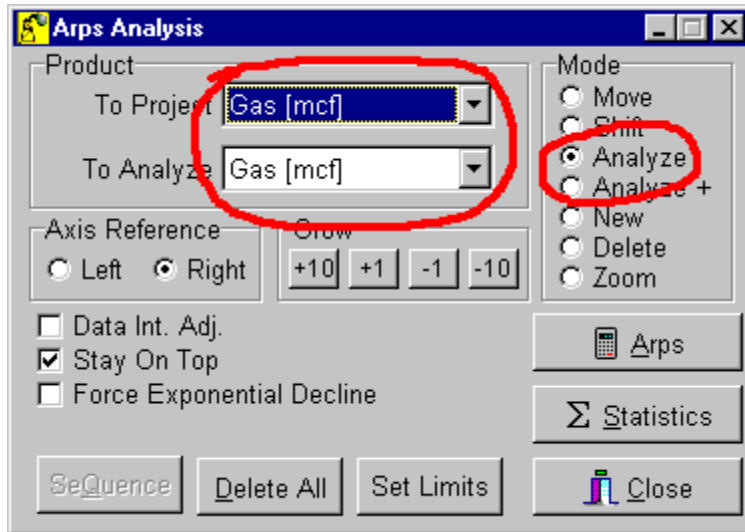
To grow the decline segment click on the “+1” button on the “Grow” panel of the Arps Analysis form as shown below:



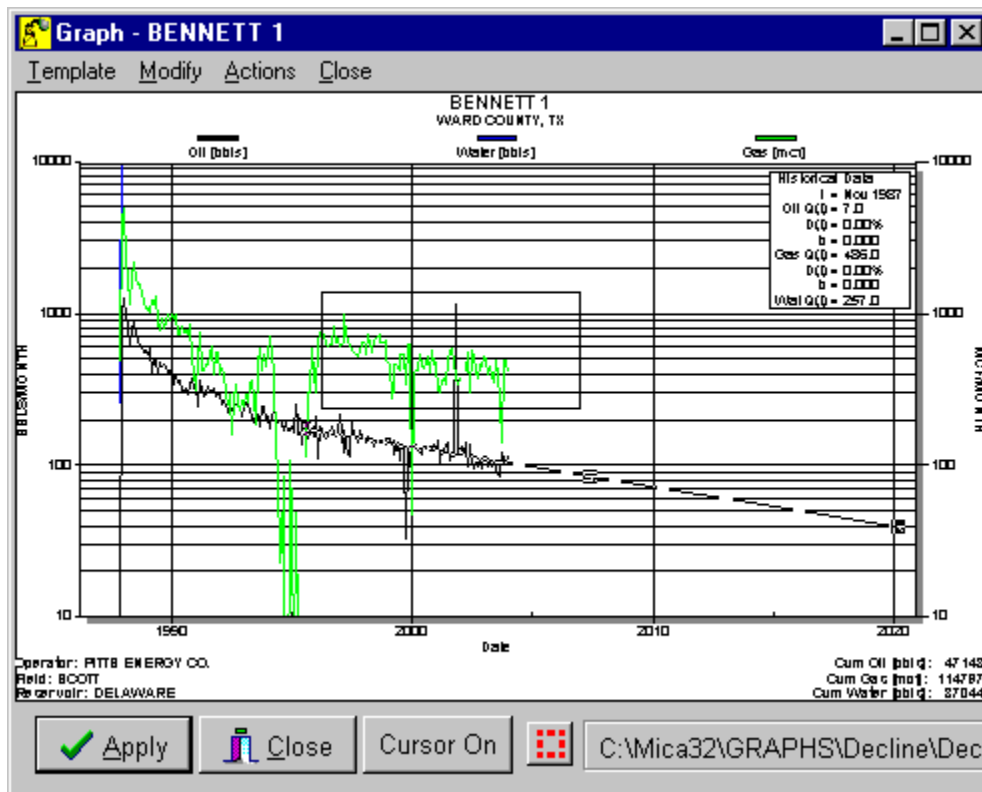
Each click of the “+1” button will grow the decline segment by one year. The “+10” button will grow the decline segment by ten years. You will see the decline segment grow as you click the button.

**Note:** It is probably best to grow the decline segment until the end point is obviously uneconomic, say down to one bbl/month, and then let the economics stop the production at a point before the end point when the well become uneconomic.

**Step 6 – Analyze other products as necessary.** If the well produces a secondary stream, then you should analyze it also. Set the Arps Analysis form to the “Analyze” mode and set the “Product To Analyze” and the “Product To Project” to “Gas” as shown below:

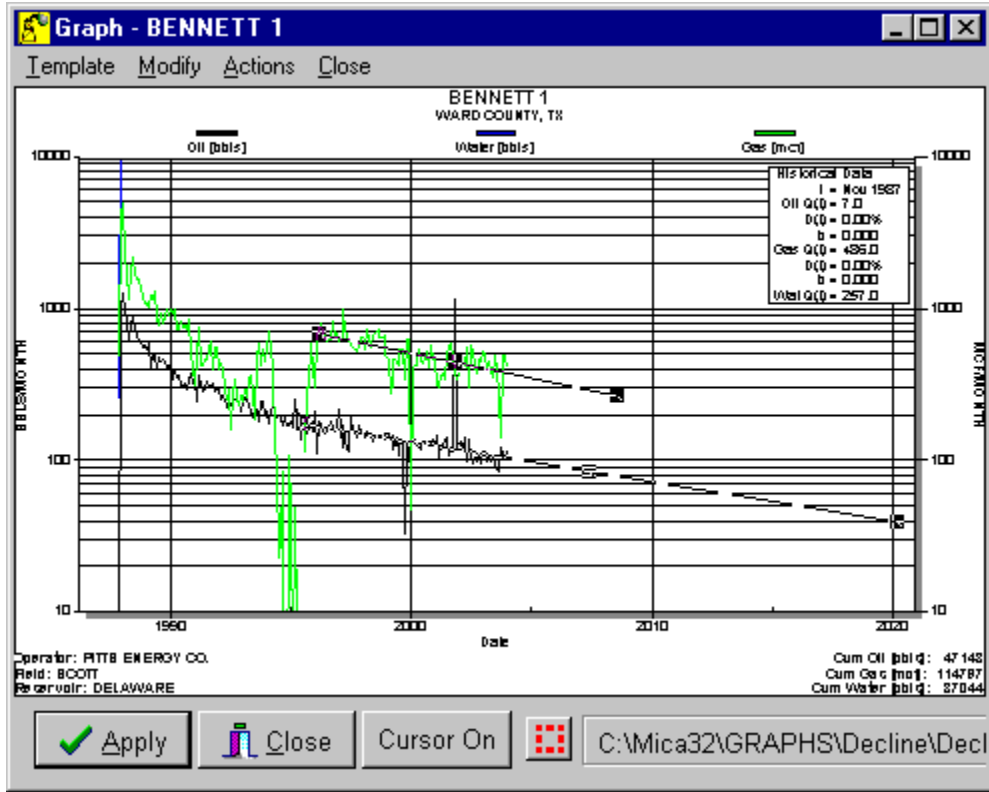


Now draw a box around a section of the gas production history as shown below:

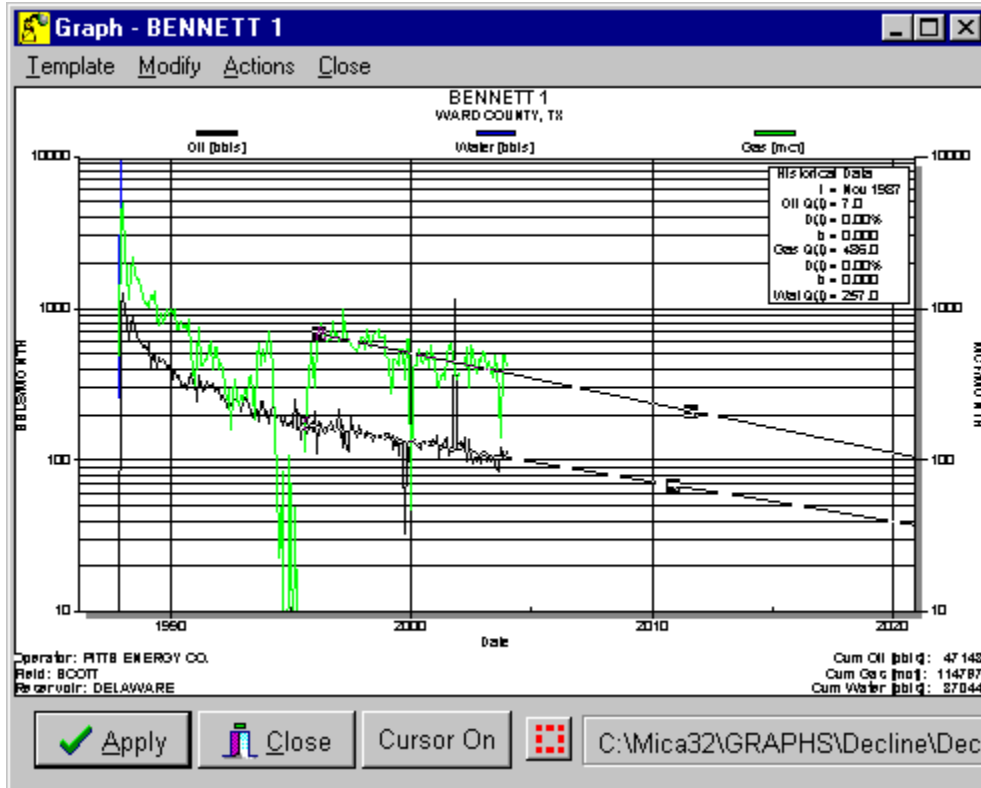


This will create a gas decline segment as shown below:



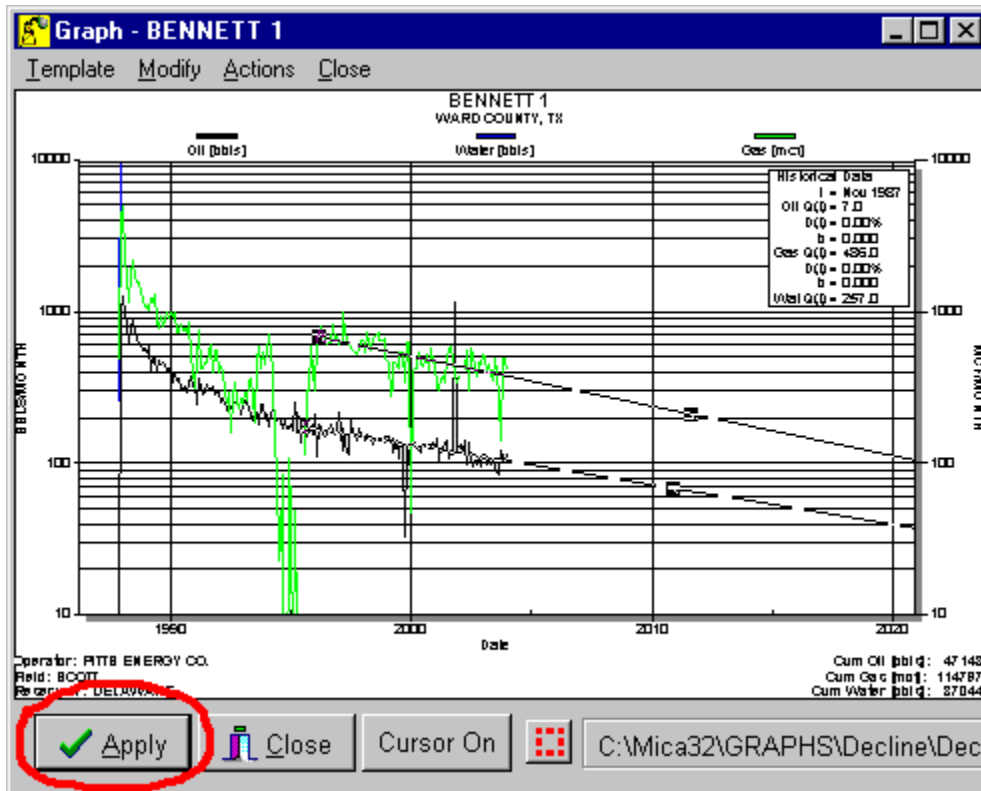


Now grow the gas decline segment by clicking the “+1” or “+10” buttons on the Arps Analysis forms just as you did for the oil decline segment above. Again remember to grow the decline segment until the end point is obviously un-economic. When you have grown the gas decline segment your graph should look similar to the one shown below:



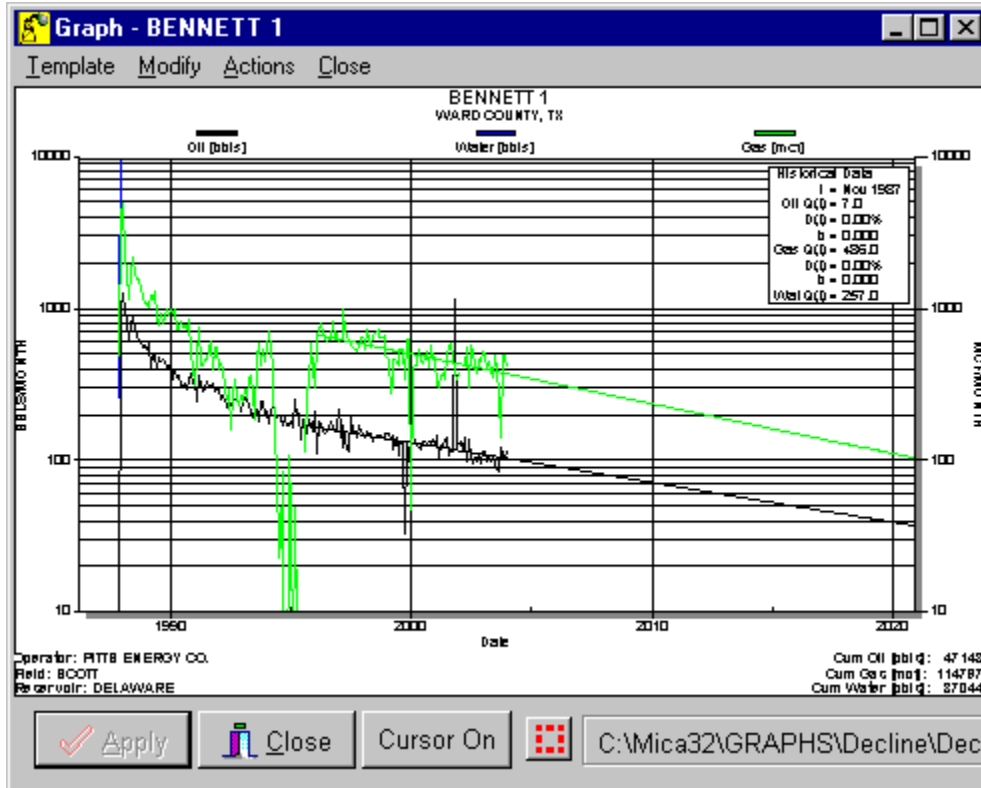
**Note:** You can shift between the oil decline segment and gas decline segment by simply clicking on an appropriate anchor point. You **MUST BE** in the “Move” mode or “Shift” mode in order to do this. When you do so, the “Product To Project” and “Product To Analyze” will display the appropriate data.

**Step 7 – Once all decline segments are positions correctly click “Apply”.** Once all decline segments on the graph are positioned appropriately click the “Apply” button on the graph.



This will save the decline segments and generate a monthly production forecast that was represented by the decline segments. In addition, if you have already set up economic parameters it will run the economics.

The monthly production forecasts will be drawn on the graph, but they appear “under” the decline segments. When you close the Arps Analysis form, the decline segments will disappear, but the monthly production forecast will still be displayed as shown below:



If you open the Arps Analysis form again, the decline segments will be displayed over the production forecast.

Step Review:

- Step 1 – Select and display a semi-log graph on your computer screen.**
- Step 2 – Open the Arps Analysis form and select the product to analyze.**
- Step 3 – Draw a box around the production data on the graph.**
- Step 4 – Adjust the decline segment if necessary.**
- Step 5 – Grow the decline segment.**
- Step 6 – Analyze other products as necessary.**
- Step 7 – Once all decline segments are positions correctly click “Apply”.**