Applied Petroleum Geology

GEOL 598

Sooner Field

Introduction to Petra

Steve Sonnenberg

Modified from Jewel Wellborn (2007)

Outline of Course

Chapter 1 – The Petra Project

Creating New Projects
Database Directories

Chapter 2 – The Main Module

Importing Well Data
Building Well Labels
Setting the Map Projection
Loading Formation Tops
Alias and Reordering
Creating Zones
Computing an Isopach
Importing LAS Data
Importing Monthly Production Data
The “Other” Tab
The Scout Ticket Tab
The View Tab

SOONER PETRA PROJECT

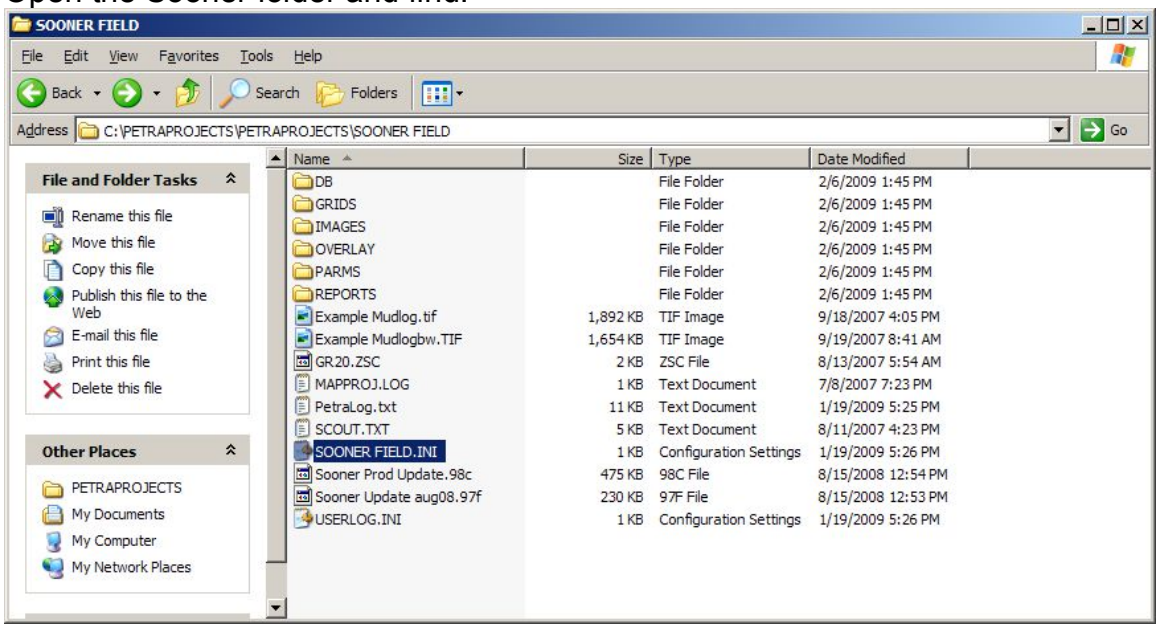
We want to connect to:

Y\GE\Common\Courses\ssonnenb

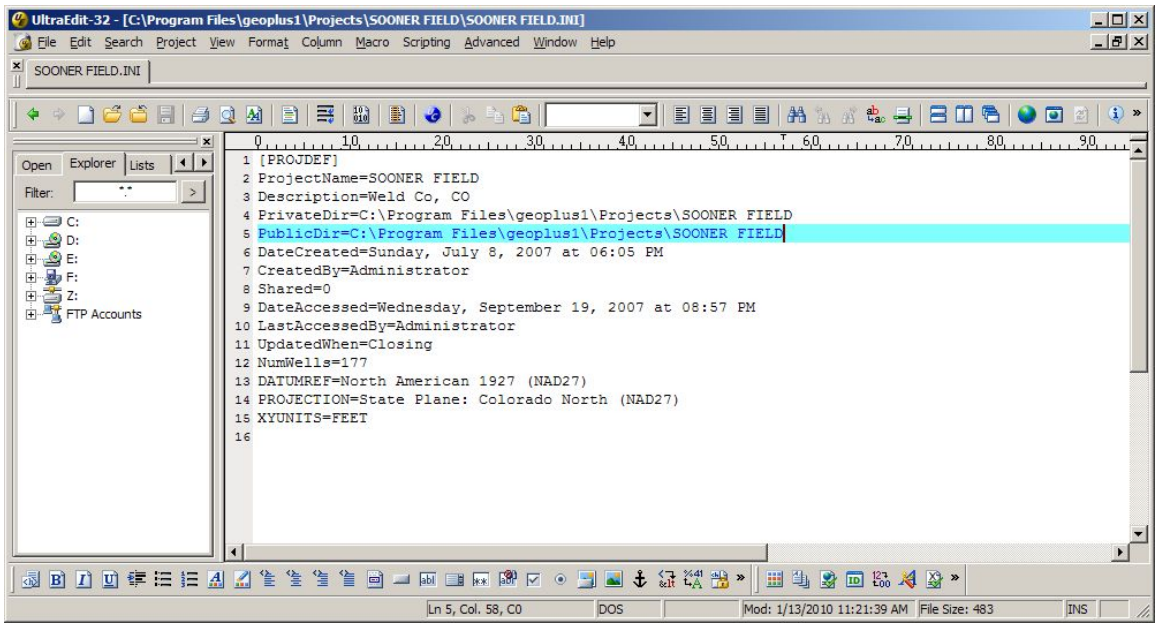
And copy the **SOONER FIELD folder** onto your C drive:

C:\SCRATCH\551\SOONER (make a folder under scratch called: 551\SOONER

Open the Sooner folder and find:

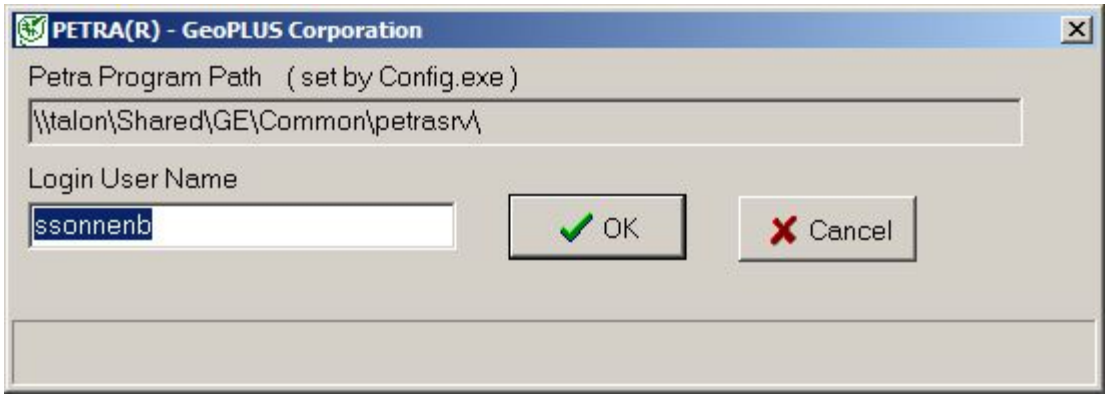


The “ini” file must look like this:

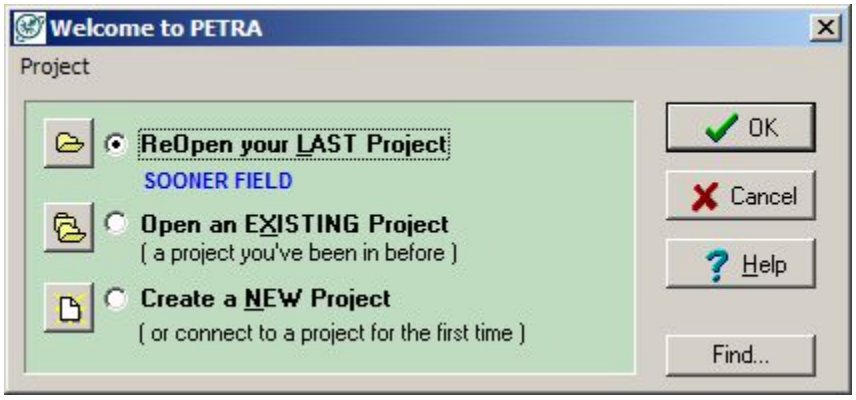


Copy the **Sooner Folder** to this location:
C:\Program Files\geoplus1\Projects\

Open Petra:



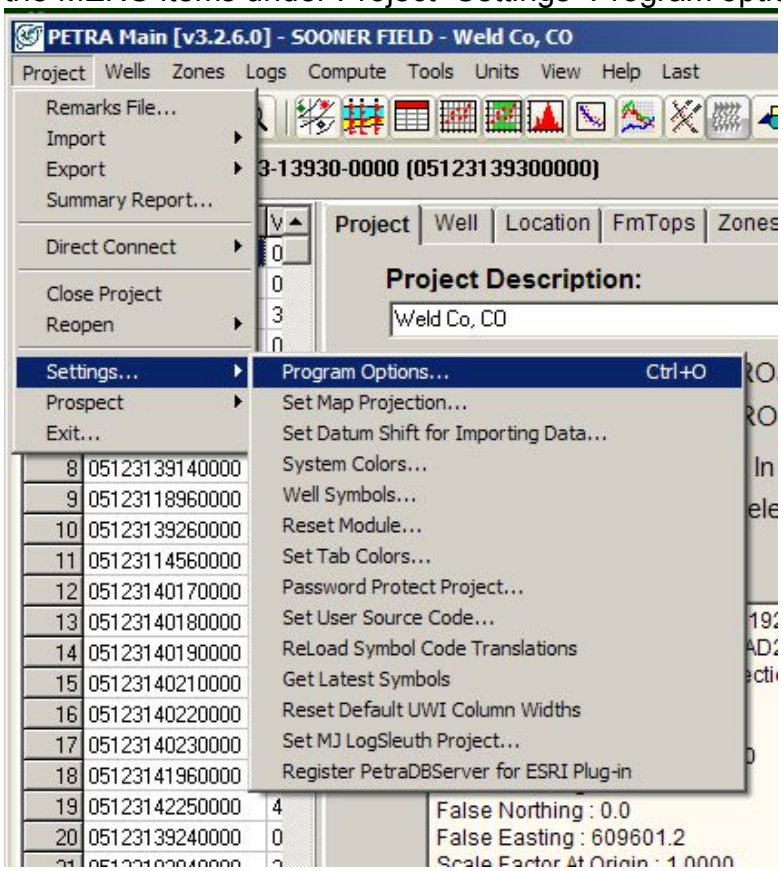
You can either create a new project and create a brand new project or connect to an existing project.



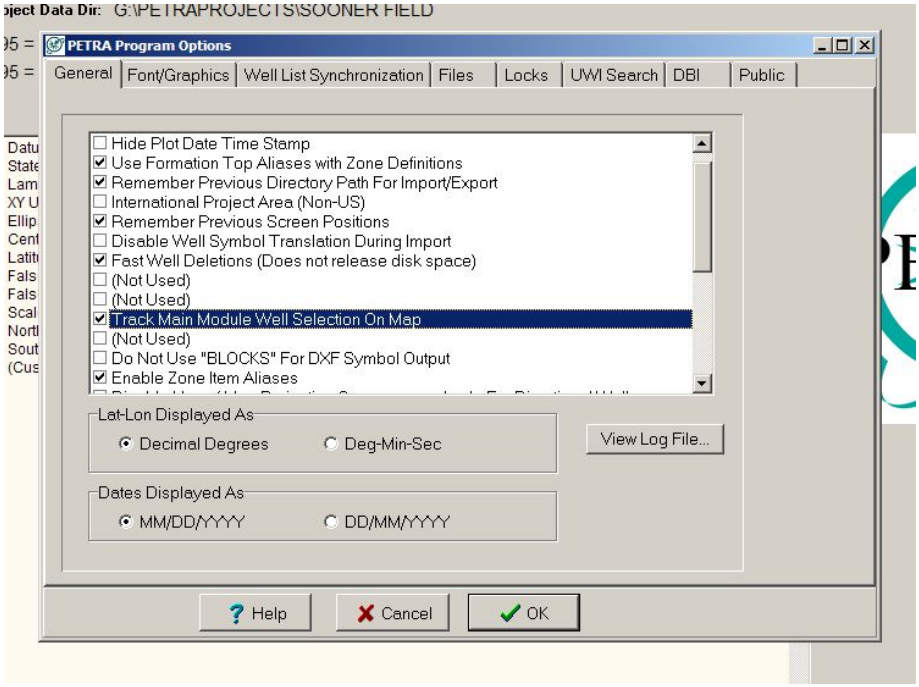
Chapter 2. The Main Module

Project Options

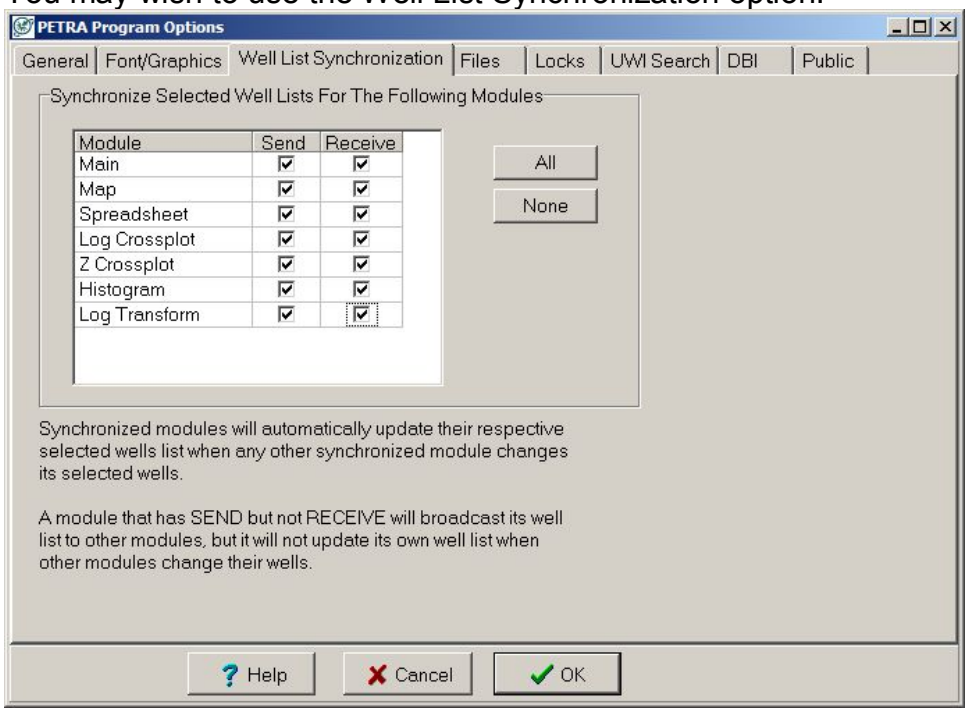
Select some program options to assist you in the operation of the Project. From the MENU items under Project>Settings>Program options:



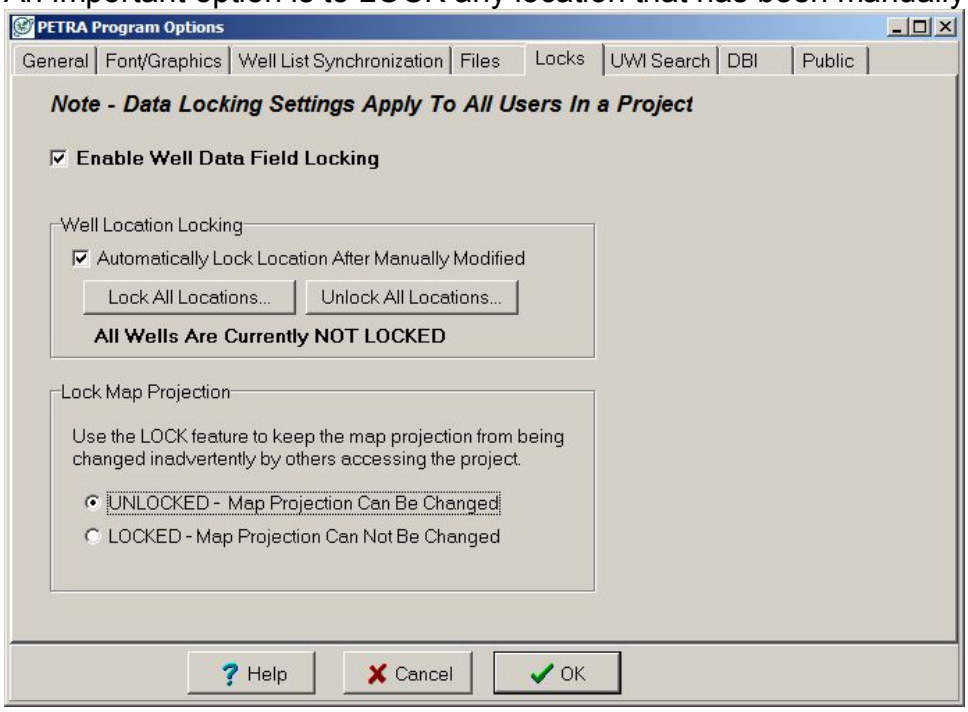
On the General tab you may wish to include the following options as well as the defaults:



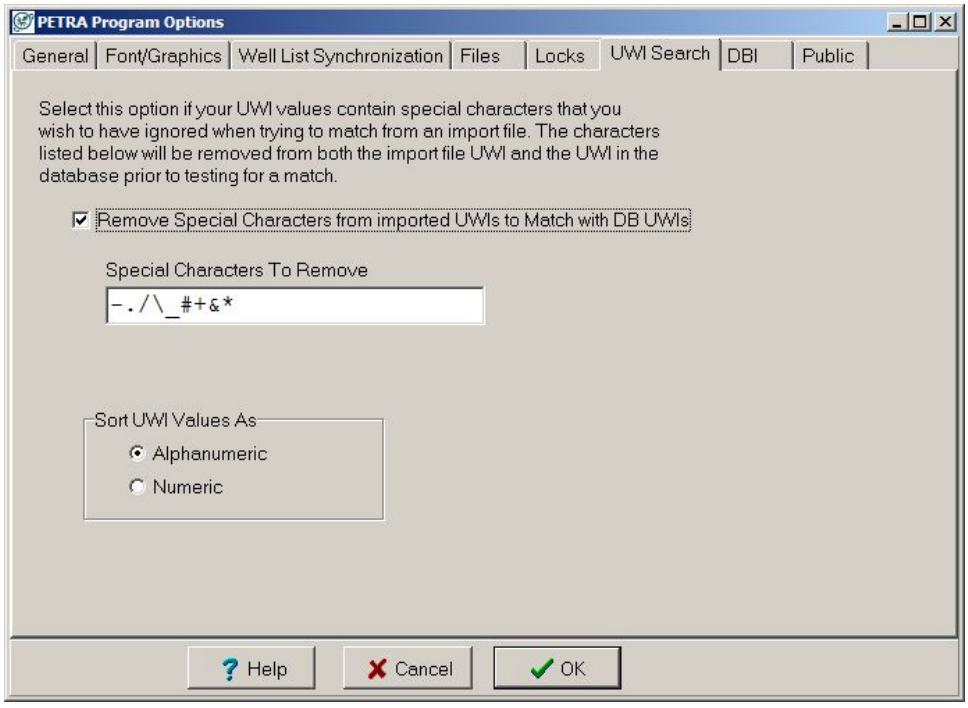
You may wish to use the Well List Synchronization option:



An important option is to LOCK any location that has been manually modified:



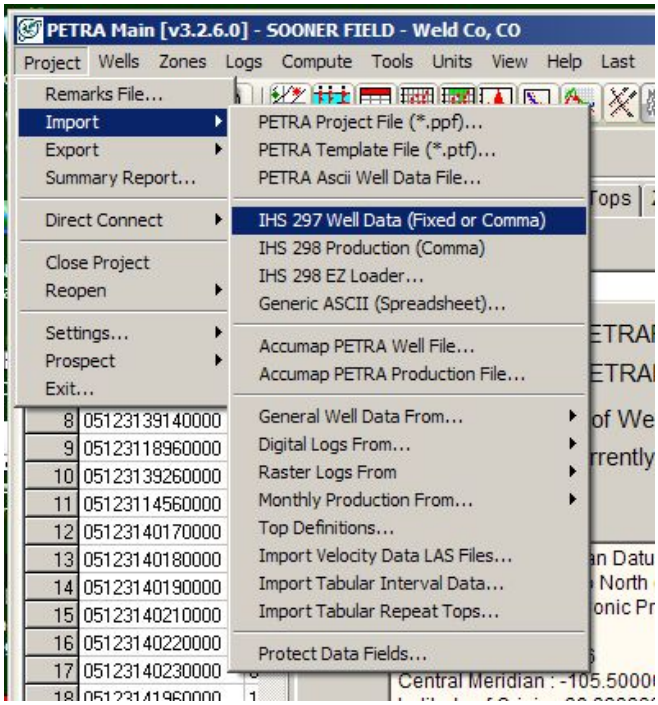
You may wish to remove the “special characters” which sometimes find their way into the API or UWI of the well data:



You may wish to review other additional options that will provide the user with personal preferences regarding fonts, graphics, line widths, and file locations.

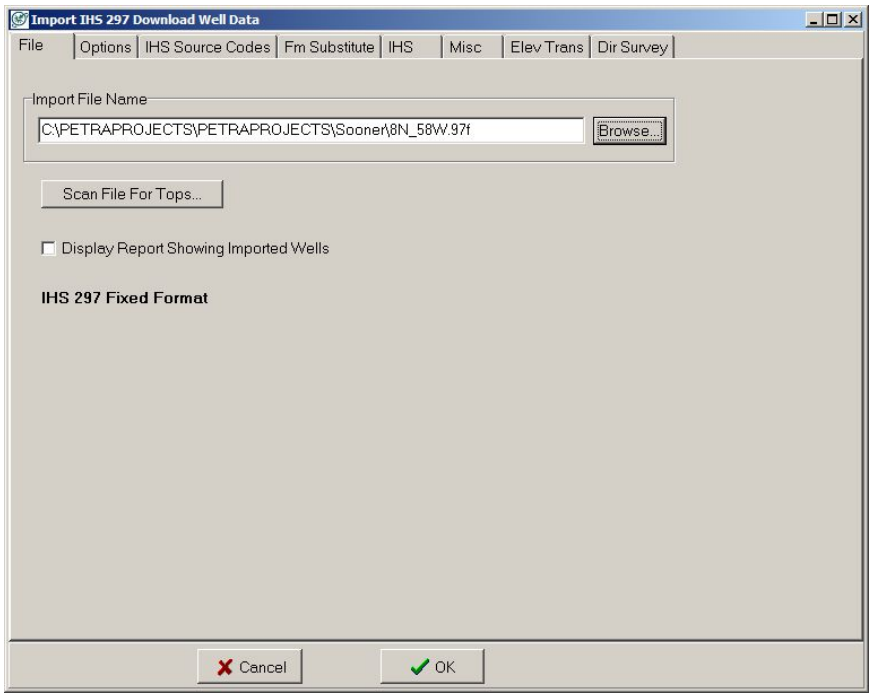
IMPORTING WELL DATA

We will be loading well data from an IHS “297 fixed format” file. Click on “Import>General Well Data From.…>



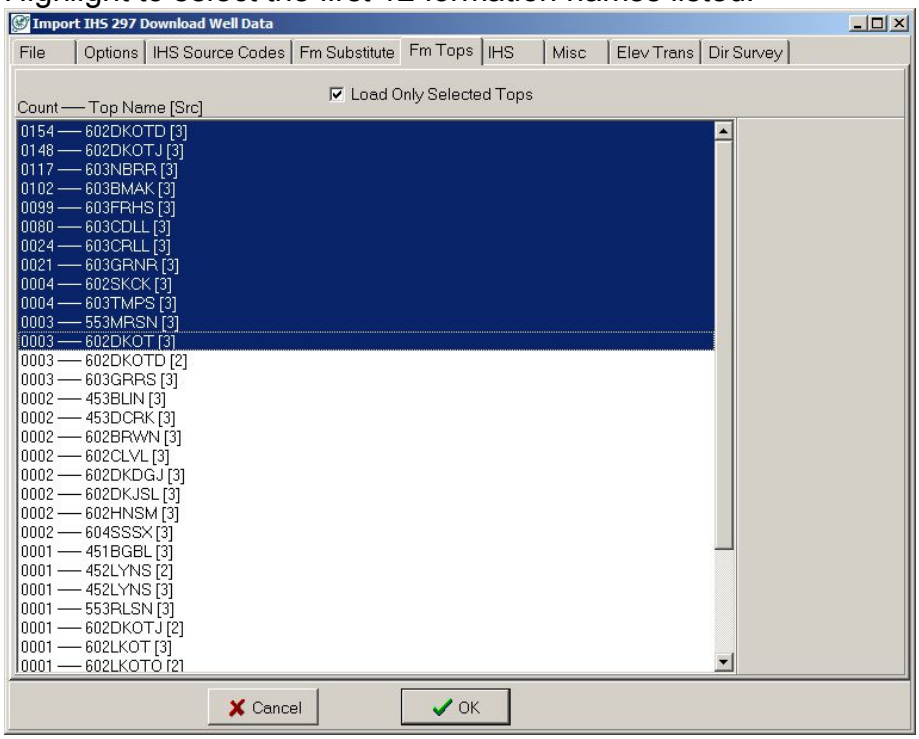
The data file that will be loaded is located in the folder called, C:\Program Files\geoplus1\Projects\Sooner
The file is called “8N_58W_2010.97f”.

The “297” format contains additional perf and “remarks” data. Select the 8N_58W_2010.97f fixed format file and click the “open” button.

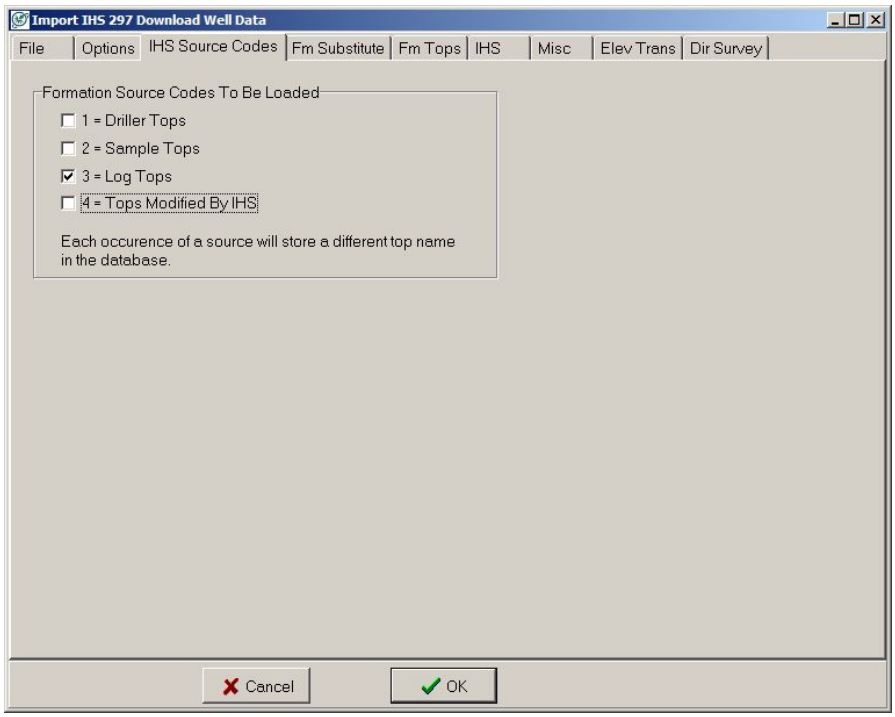


From the “File” tab, click the “Scan File For Tops” to see which formation tops are available for loading.

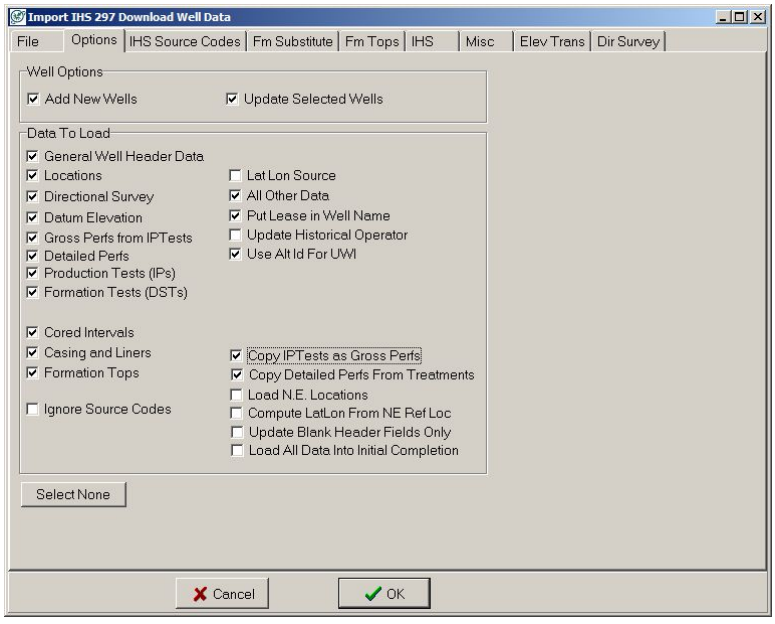
Highlight to select the first 12 formation names listed:



On the “IHS Source Codes” tab, select only item “3””Log Tops”

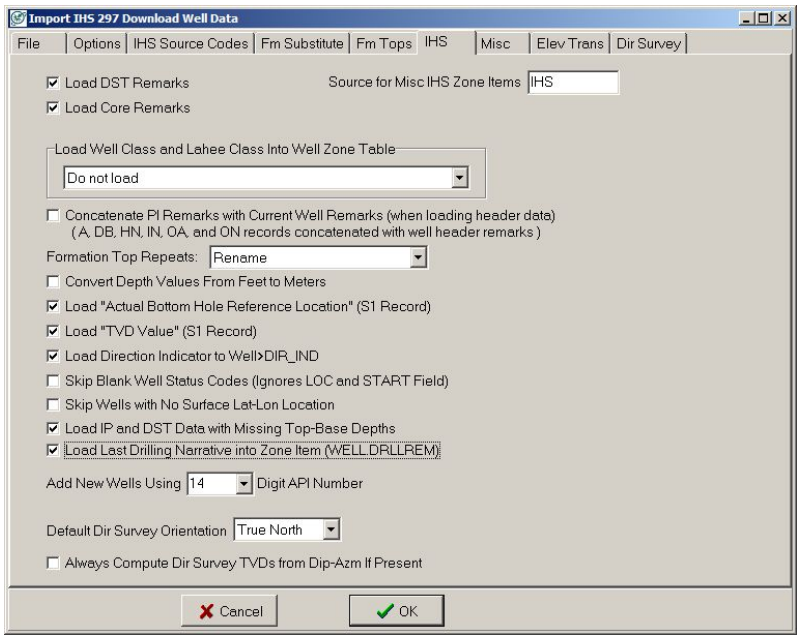


Next return to the “Options” tab to see the various types of data you can load from this file. Notice that Formation Tops is checked. We have selected 12 tops to be loaded. You may wish to load only certain tops, or the entire set available. Most of the wells in active areas have sufficient log (3) tops, however, there are basins which are “old enough” that electric log tops were not available.

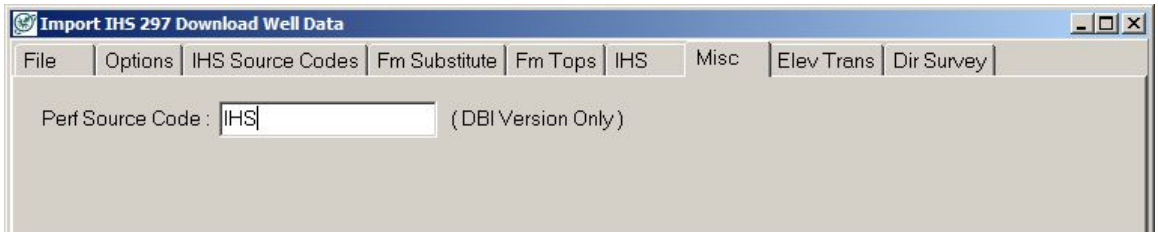


You may wish to include the DETAILED perforation records and those from the production tests and treatments.

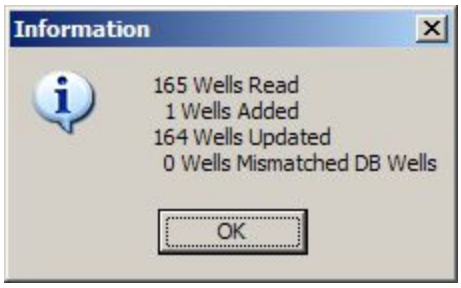
Select the IHS Tab and select the following options:



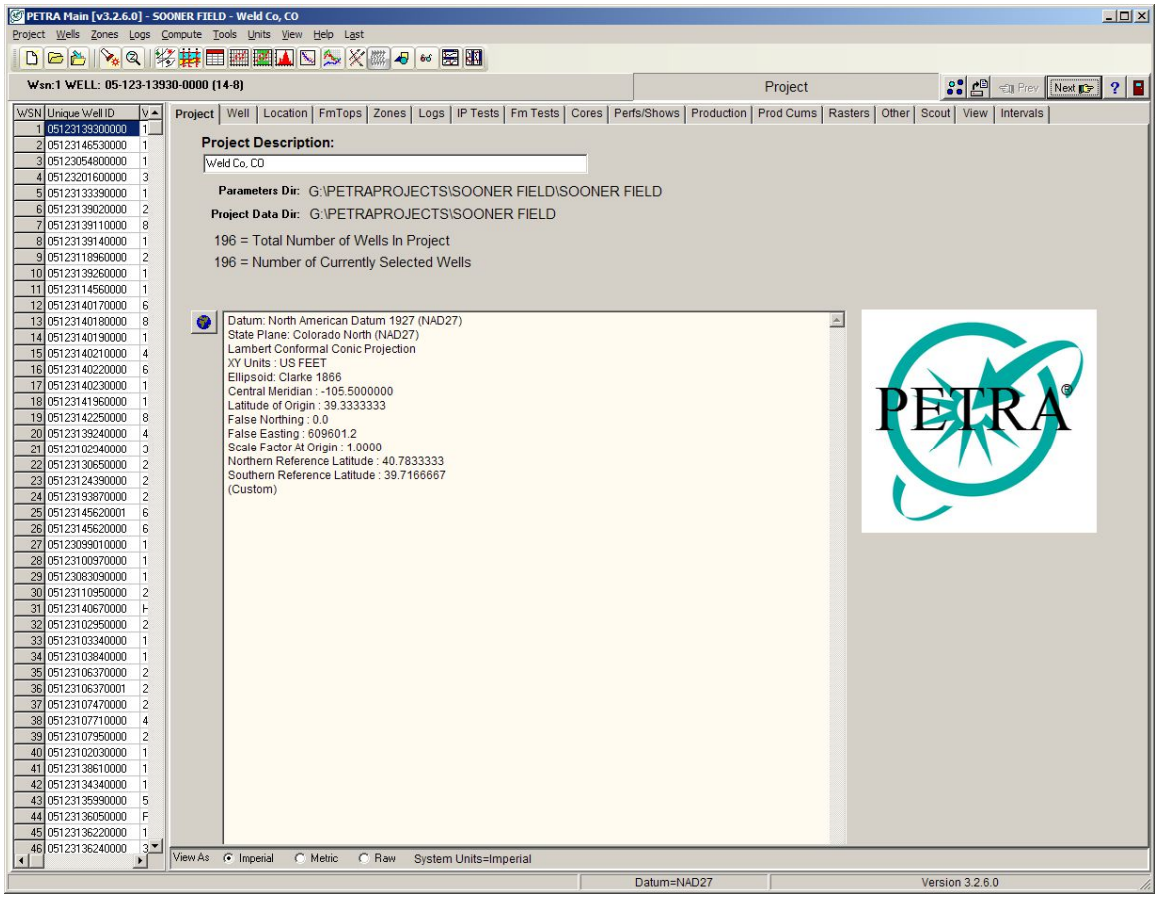
Another suggested option is from the MISC Tab, give the IHS Source to the perf records:



Click the OK button to begin loading the well data:



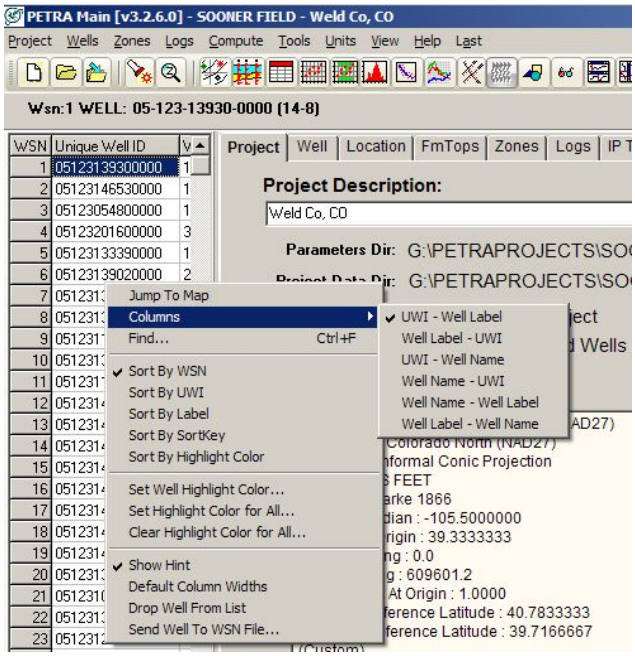
A successful load will show the number of wells read, added, updated, or mismatched with wells already in the database.



Return to PETRA's "Main" module after loading the well data from IHS "97f" file, i.e., the 297 fixed format file.

Note the list of well API numbers on the left side of the screen. You may navigate from one well to another by clicking on this well list. The data for the highlighted well is displayed on the right. Each data "tab" contains information about the highlighted well. You will also see that the "Project" Tab shows the total number of wells in the project is 196 wells.

Three columns are available for your use: WSN, Unique Well ID (usually the API), and a Well Label (this can be built as a user defined option for the Project). A right mouse button will allow you to select the columns to show and column choice for sorting:



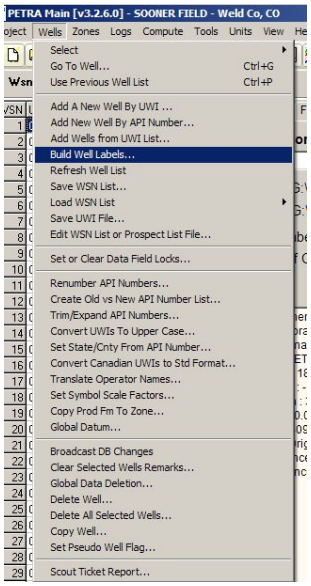
Definition:
WSN – A sequential number assigned by the database to each well as it is loaded. WSN values are unique, cannot be modified, and are not reused if the well is deleted. WSN lists are used throughout PETRA as a means to retain well selection or search results and can be used to limit a variety of mapping display functions.

BUILDING WELL LABELS

After you have your wells loaded into the project, you may want to build well labels instead of using the default well label that is automatically generated when the project was created.

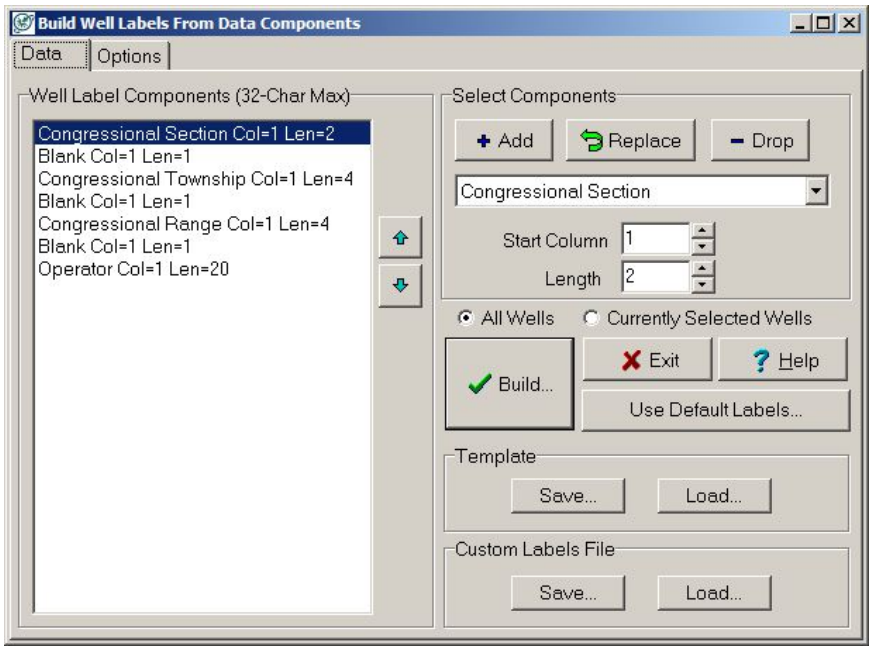
The Build Labels function can build a well label field using parts from other well header fields. This can be very useful in project areas such as the Mid-Continent where many wells have the same well name or number in different locations. Building a well label using section-township-range fields makes well identification much easier. Some geologists like to use the Operator, Well Number and Lease Name to build the well label.

Well labels may contain up to 32 characters. This option in invoked from the main menu under “Wells>Build Well Labels”:



The objective in building the well labels is to define each of the Well Label Components. Each component is selected from the Select Component section along with its length and starting position. Well labels will be built for either "All Wells" or only the "Currently Selected Wells" depending on the option selected.

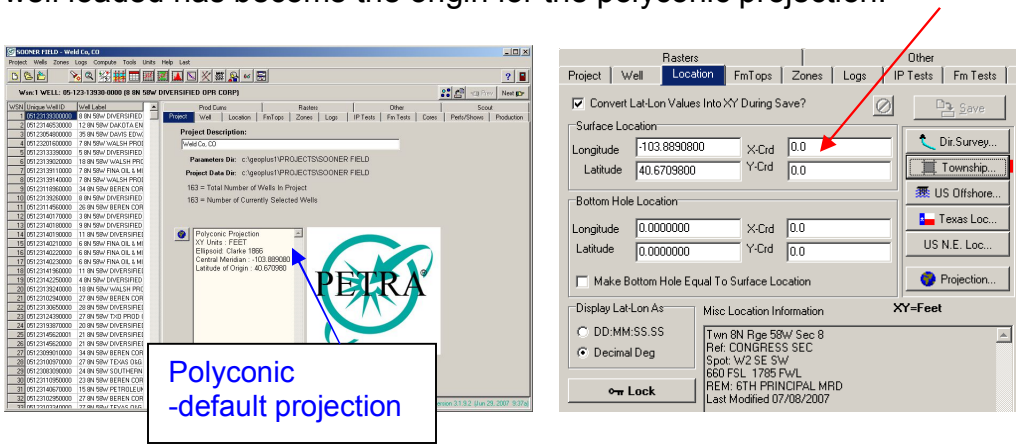
Use the "Add" button to add a selected component to the Well Label Components list. The "Replace" or "Drop" buttons are used to modify or remove an existing component. The Start Column parameter defines the starting position in the component field. For example, if you wanted the API series number, set the start column to 6 and the length field to 5. The Length parameter defines the number of characters extracted from the component field:



After defining all components, click the OK button to build the well labels for all wells.

SETTING THE MAP PROJECTIONS

Petra uses a Map Projection to convert Latitude-Longitude coordinates into mappable XY Cartesian coordinates. All mapping is done through the XY positions. Map projections are specific to the data area ad the same. We have not set a particular map projection for our project, so we are using PETRA's default projection, which is a Polyconic projection. Looking at the "Location" Tab you will notice that the X-Y location of the first well is 0,0. This is because the first well loaded has become the origin for the polyconic projection:



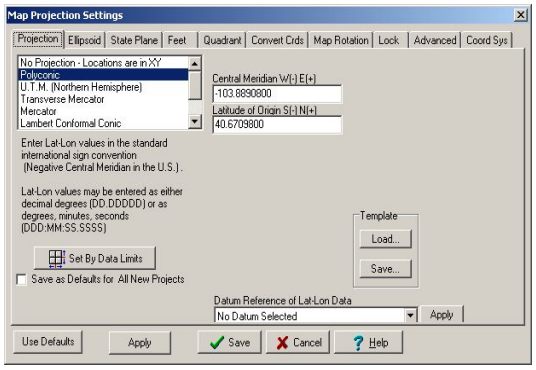
We need to change the map projection to one that is more <u>universally accepted.</u> We need to have our coordinates and maps in standard projections to match those of other systems. A good choice for this project area is a Colorado North NAD27 State Plane coordinate system. Click the "Projection" button located on the "Location" or "Project" Tab.

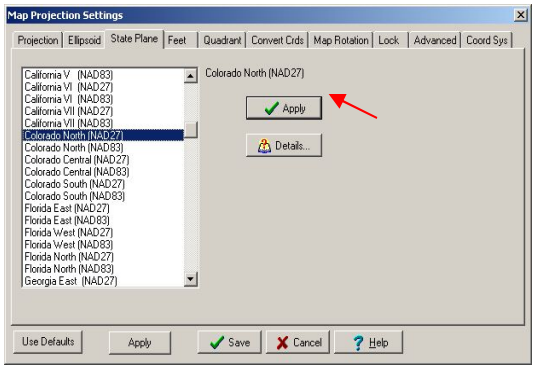
Definitions:

<u>Datum:</u> – A "DATUM" is defined by a spheroid which approximates the shape of the earth, and the spheroid's position to the center of the earth. Unless specifically ordered for another datum, most data purchased for the United States is in the NAD 1927 datum. The **North American Datum of 1927 (NAD27)** is defined as the horizontal datum designed for the United States based on the Clarke Spheroid of 1866, whose origin was defined as Meades Ranch, Kansas. The "origin", located at Meades Ranch, is a fixed coordinate, and all other points have been calculated from this point. Generally speaking, the NAD27 datum was designed for LOCAL surveying purposes, where all coordinates were measured from a specific point located on a local spheroid. In 1990, the NAD 83 datum was officially adopted as the legal horizontal datum for the United States by the Federal Government (Federal Registry Vol. 55, No.155, dated August 10, 1990). You may wish to discuss the options of datum use with your team and your company's geodesy experts.

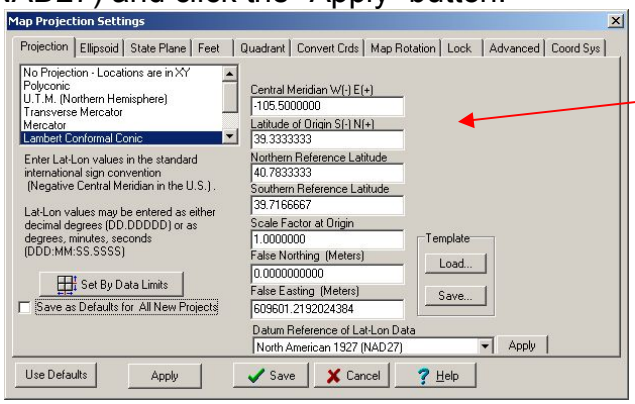
Latitudes and Longitudes within these different Datum are vastly different, and may be a source of difficulty in accuracy, units of measurements, and "rounding" errors in your well locations.

Projection: - Generally a UTM, or Universal Transverse Mercatur projection will work the best in the continental United States. You will also have the option for State Plane projections. The projection is a mathematically calculated way to plot XY's to "flatten the earth".





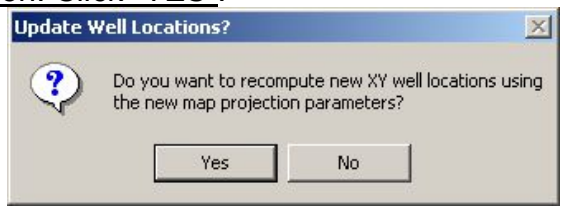
Click on the "State Plane" Tab, scroll down and highlight the Colorado North (NAD27) and click the "Apply" button.



The ORIGIN point of the state plane for Colorado North NAD27 is shown in the detailed information on the

Click on the "Projection" tab. You will see that you are now using a "Lambert Conformal Conic" projection and the associated parameters for the Colorado North (NAD27) State Plane coordinate system.

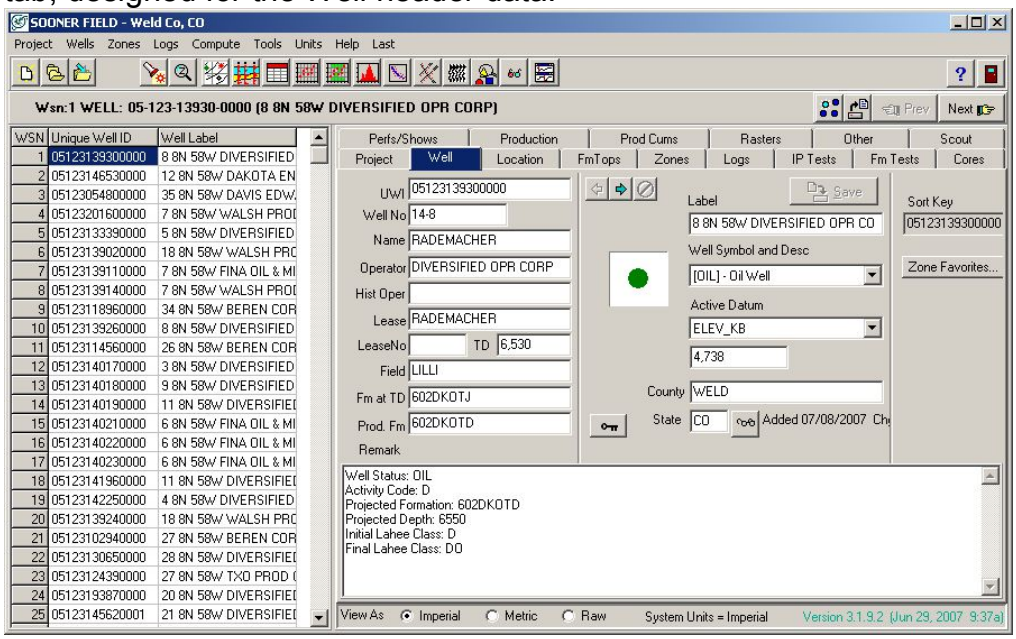
Finally, click the "Save" button at the bottom of the screen which contains the green checkbox. <u>You will be prompted to update your well locations (X,Y's) using the new map projection. Click "YES"</u>.



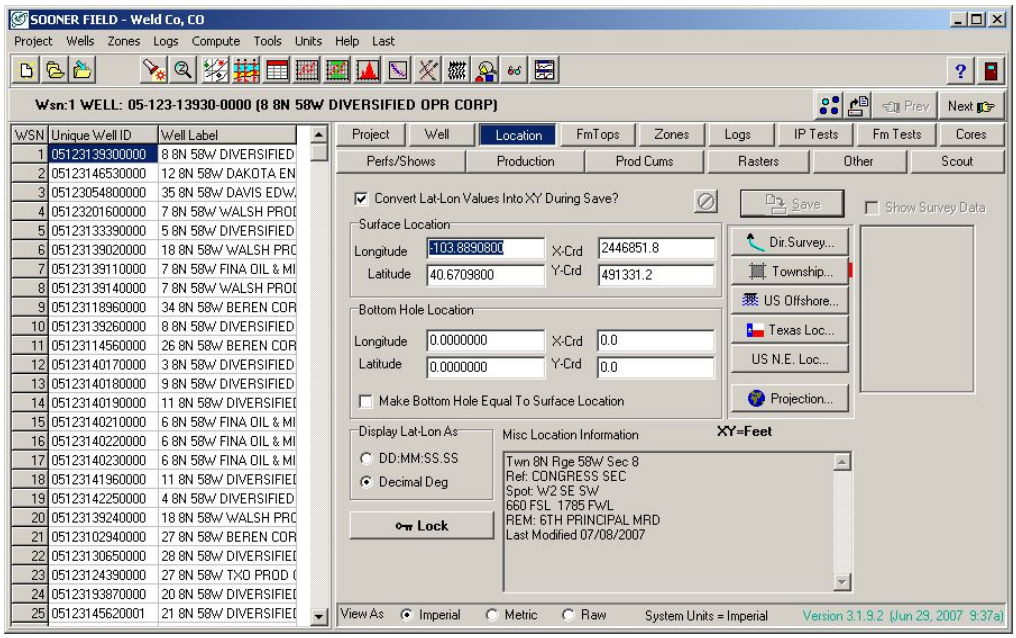
The “Location” Tab now shows the newly computed XY coordinates for the first well. The Latitude-Longitude values are not modified.

MAIN MODULE TABS

The Main Module holds the database for the project. The first tab is the WELL tab, designed for the Well header data:

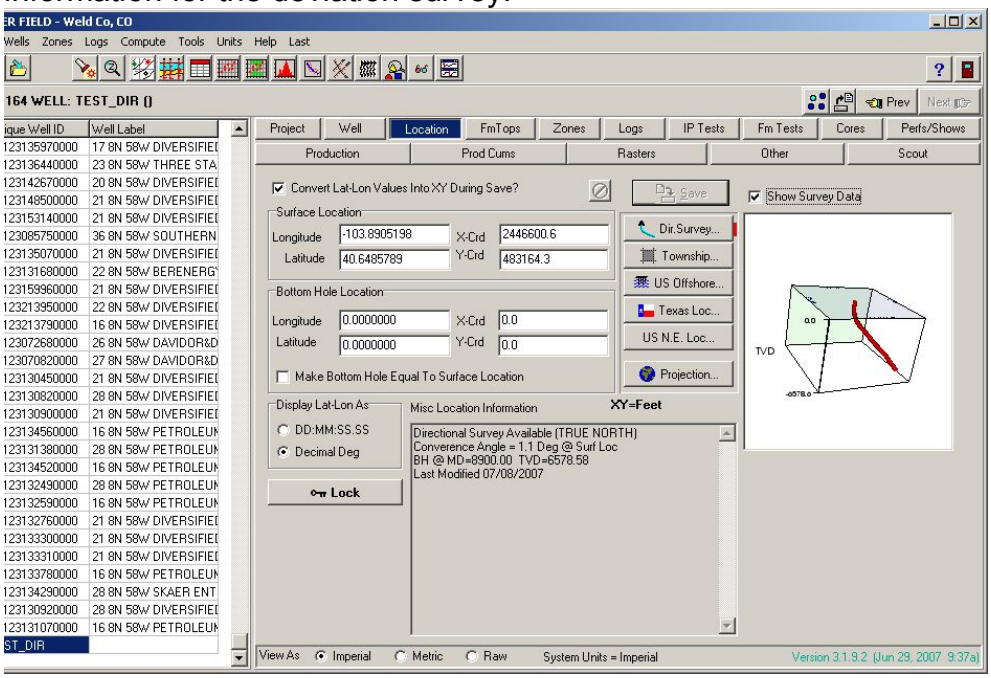


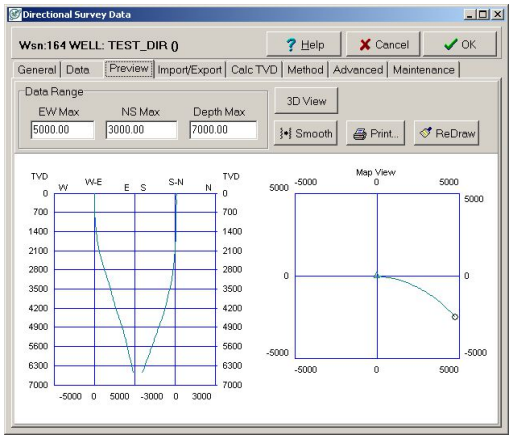
The Location Tab shows the Lat-Long and XY coordinates for the individual wells. The Township-Range-Section, Abstract-Survey (Texas Loc), or Offshore Locations are also available and can be used as additional well location information.

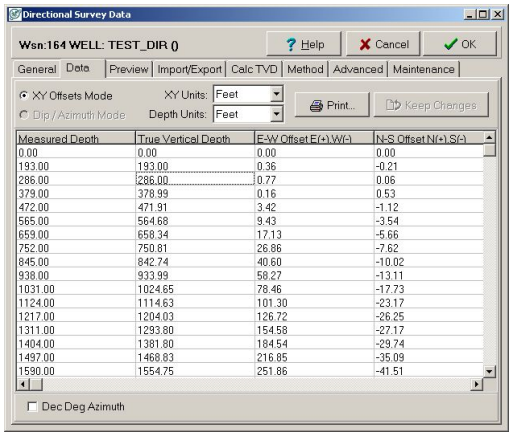


DIRECTIONAL SURVEYS

If the well has a directional survey, you may show the survey data, and detailed information for the deviation survey:





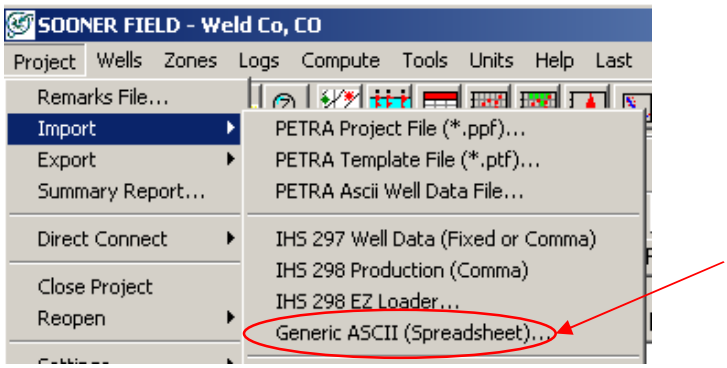


The directional data can be loaded by either XY offset or Dip/Azimuth mode, and a variety of import/export functions are provided.

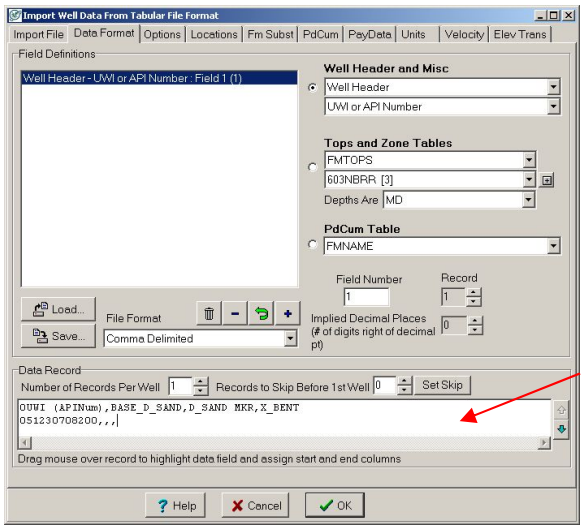
Petra uses directional survey data to compute down hole vertical depths and XY locations, and to augment well displays and calculations. Survey data consists of measured depth (MD), true vertical depth (TVD), offset (EWE) and offset (INS). Alternately, measured depth, borehole dip and azimuth can be specified from which TVD, EWE and INS will be computed using the radius of curvature method.

LOADING FORMATION TOPS (Spread Sheet Data)

Many times you will have well data that can be loaded from an Excel spreadsheet file. PETRA will read a space delimited file (extension of .PRN) or a comma delimited file (extension of .CSV) which can be saved out of Excel. PETRA does not read the .XLS file directly. We will load formation tops from a "csv" file. To load this type of data, select the "Project >Import> Generic ASCII File" menu located in the "Main" module:



Click the "Open File" button and choose the file called, SOONERTOPS.CSV located in the *c:\geoPlus1\Data\Sooner* folder:

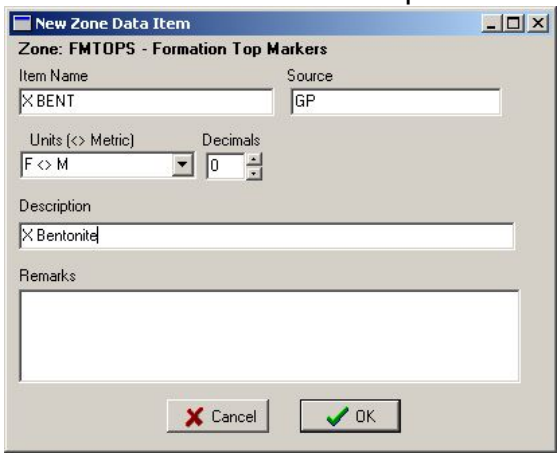


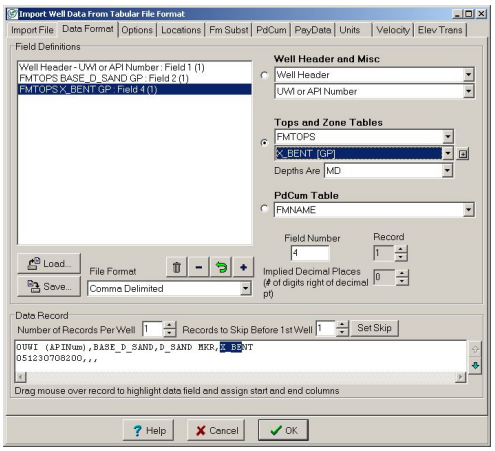
The "Data Format" Tab shows the first two records of the file at the bottom. Click the light blue down arrow once to scroll to the next record. You should now see the last header record and the first data record containing the API number and several commas.

We need to **skip the 1st header record** at the top of the file. Click the "Set Skip" button and a value of 1 will be put in the "Records to skip before 1st well" option. You can also enter a value of 2 manually. Skipping the records removes the "header" rows of the spreadsheet from being entered into the database.

We will next “connect” each field in the file that we wish to import to a database item. To start with, the API number must be present in the file to match a file record to a well in the database. Highlight the API number in the “Data Record” section using the mouse as shown in the figure above. Note that the “Field Number” value is set to 1. Click the “blue plus” button located in the center portion of the screen. The API number (UWI) will be added to the “Format Definition” list. The other fields that we need to load are formation tops for the Base D Sand and XBENT.

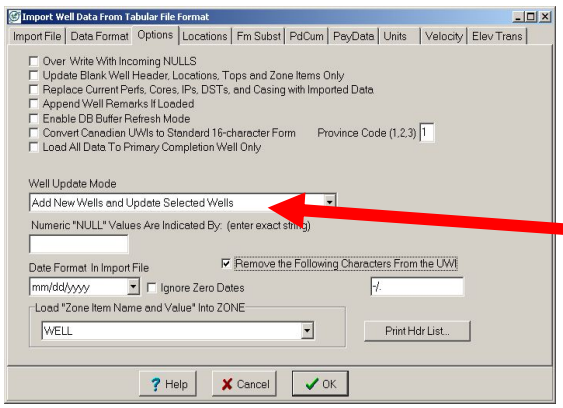
To define the field position of the Base of the D sand, highlight the words “BASE_D_SAND”. This is field number 2 and needs to be assigned or connected to a formation top. We need to add a new top to the FMTOPS table by clicking the small gray plus button beside the tops list. Enter the formation top name of Base D Sand and a description. Again, click the button to add Base D Sand to the formation description list.





Repeat the above process for the formation top XBENT (field #4).

IMPORTANT – Check how wells are to be updated or added. Look at the “Well Update Mode” located on the “Options” Tab. Select “Update Selected Wells Only” to insure we don’t accidentally add any wells to our project.

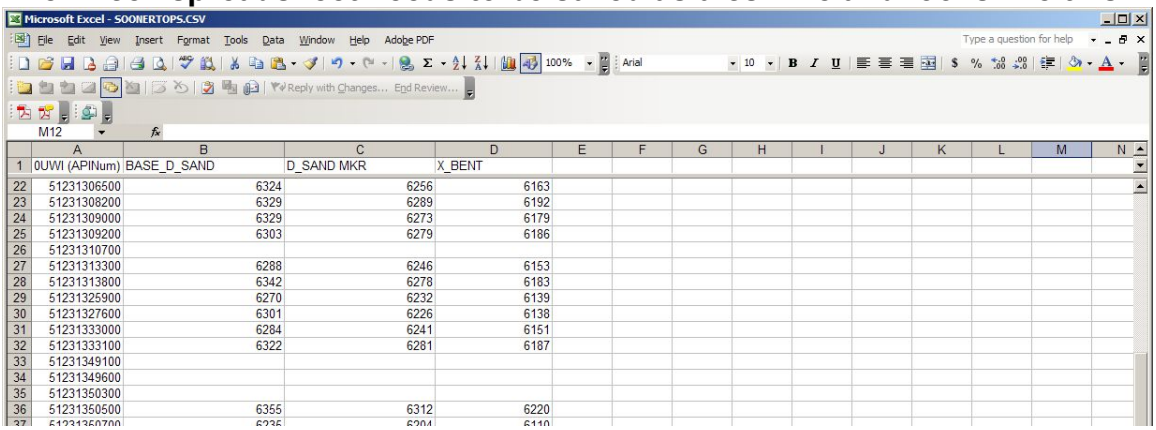


Click the “OK” button to begin loading the file.

Change to: Update Selected wells only

Save the format definition by clicking the “Save” button Save... just in case you need to reload this file. Save the format as **TOPS.FM1.**

The Excell spreadsheet needs to be saved as a csv file and looks like this:



Microsoft Excel - SOONERTOPS.CSV

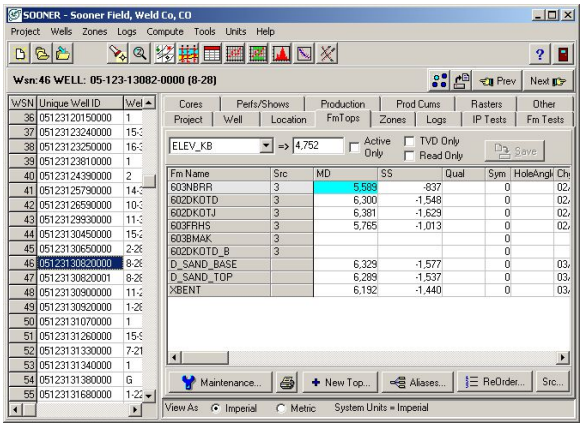
	A	B	C	D
1	0UWI (APINum)	BASE_D_SAND	D_SAND MKR	X_BENT
22	51231306500	6324	6256	6163
23	51231308200	6329	6289	6192
24	51231309000	6329	6273	6179
25	51231309200	6303	6279	6186
26	51231310700			
27	51231313300	6288	6246	6153
28	51231313800	6342	6278	6183
29	51231325900	6270	6232	6139
30	51231327600	6301	6226	6138
31	51231333000	6284	6241	6151
32	51231333100	6322	6281	6187
33	51231349100			
34	51231349600			
35	51231350300			
36	51231350500	6355	6312	6220

FORMATION TOPS DATABASE

On the “Main” module, click on the “FmTops” Tab and <u>locate the well with WSN #22</u>. You should see the two new tops listed at the bottom of the list. The formation top is stored in the database table as measured depth. Subsea or TVD subsea for deviated wells is computed when needed. You can edit either MD or SSTVD values.

The **QUALITY CODE** (QUAL) field is available for you to enter such comments as FO (faulted out), EST (estimated), INL (Interval Not logged), “?” (questionable data), or NDE (not deep enough). The quality code field can be posted and used to query wells, highlight posted data and filter wells used for contouring. Quality codes have a maximum of 8 characters.

You can also enter a **REMARK** for each top value. Simply double-click in the remark field to bring up the edit box. Remarks have a maximum of 4096 characters.

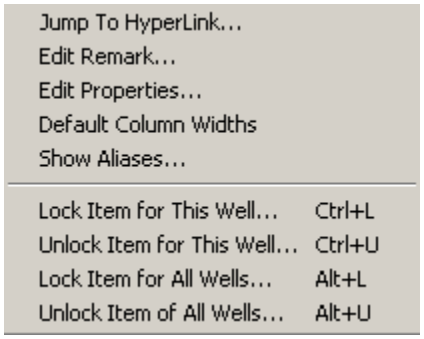


SOONER - Sooner Field, Weld Co, CO

Wsn:46 WELL: 05-123-13082-0000 (8-28)

Fm Name	Src	MD	SS	Qual	Sym	HoleAngl
603NBRR	3	5,589	-837		0	
602DKOTD	3	6,300	-1,548		0	
602DKOTJ	3	6,381	-1,629		0	
603FRHS	3	5,765	-1,013		0	
603BMAK	3				0	
602DKOTD_B	3				0	
D_SAND_BASE		6,329	-1,577		0	
D_SAND_TOP		6,289	-1,537		0	
XBENT		6,192	-1,440		0	

A right mouse selection on any formation top will allow the user to “lock” the top for this well or all wells.



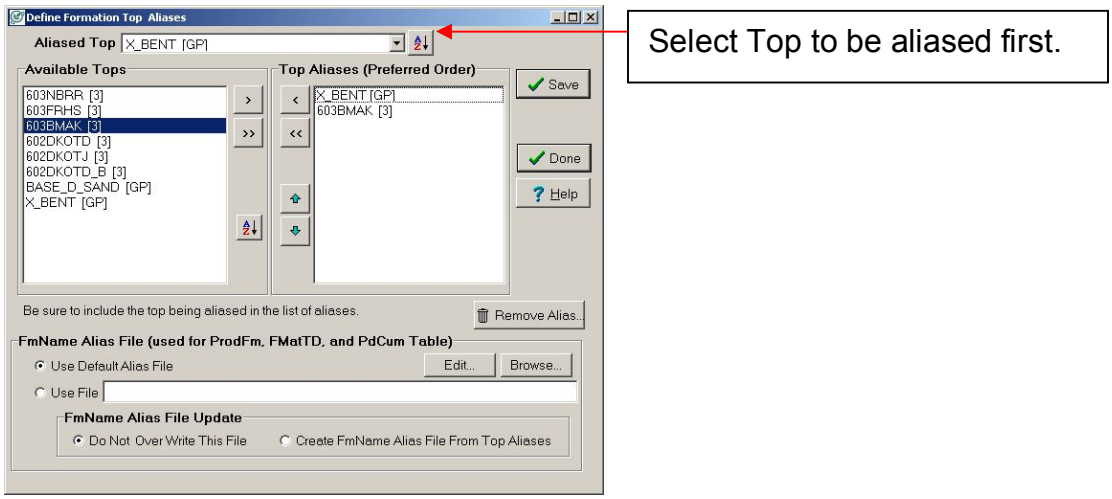
ALIASING and REORDERING FORMATION TOPS

Assigning Formation Tops Aliases

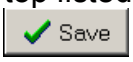
Formation top aliasing allows multiple top names to be searched when referencing a single top name. Top aliasing involves assigning an ordered list of top names to the original, or aliased top. Whenever a well value for the top is retrieved from the database, the alias list is searched from top to bottom order, until a non-null value is found. Aliases should be specified in order of preference, i.e., from highest to lowest priority.

From the “Main” module’s “FmTops” Tab, click the aliases button 

located at the bottom of the screen.



Select Top to be aliased first.

Select the X BENT for the Aliased Top drop-down list at the top of the screen. The XBENTwill automatically be added to the list of Top Aliases. Select the 603BMAK (3) top listed on the left to add it to the aliases list. Finally, click the “Save” button 

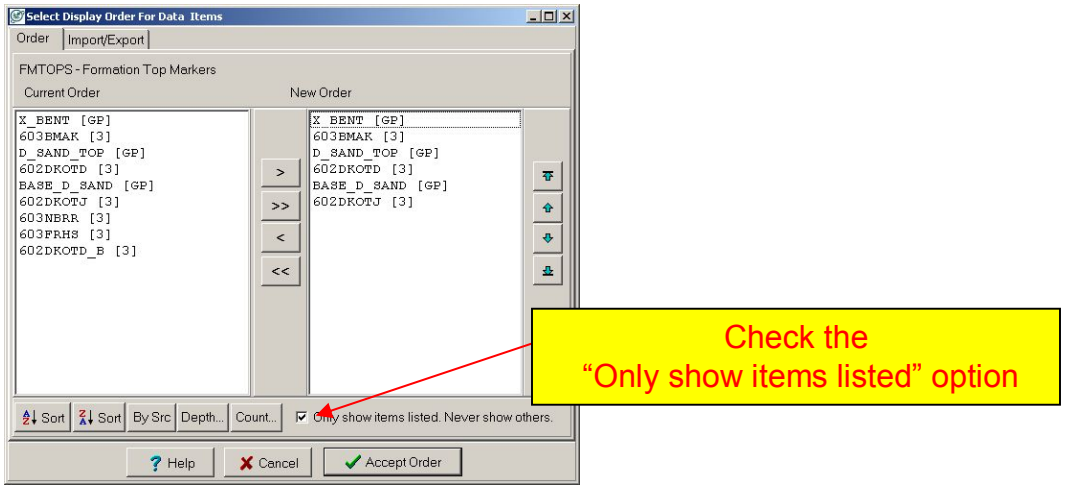
to store the alias list. Click on the 

to end the “Assign Formation Top Alias” session.

We will also alias the Top of D Sand in our exercise.

Reordering Formation Tops

We can reorder the list to put the names in a preferred order. Click the ReOrder... button located at the bottom of the screen.

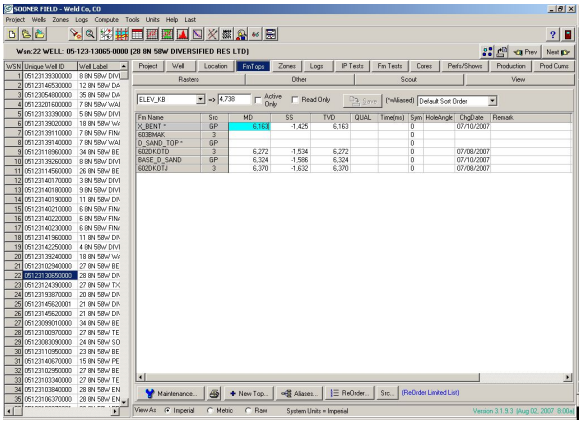


Double-click the four tops in the following order: XBENT, 603BMAK[3], Top of D Sand, 602 DKOTD[3], BASE D_SAND and 602DKOTJ[3]. Click "on" the option that states "Only show items listed..." and click the "Accept Order" button.

One common way to reorder is by Stratigraphic Order. You may save the order list for use in your daily work.

Click on the "OK" button on the confirmation dialog screen that is displayed as a "Warning" about your selection.

The "FM Tops" Tab now shows only our selected tops as displayed to the left. All unwanted tops are now hidden from view:

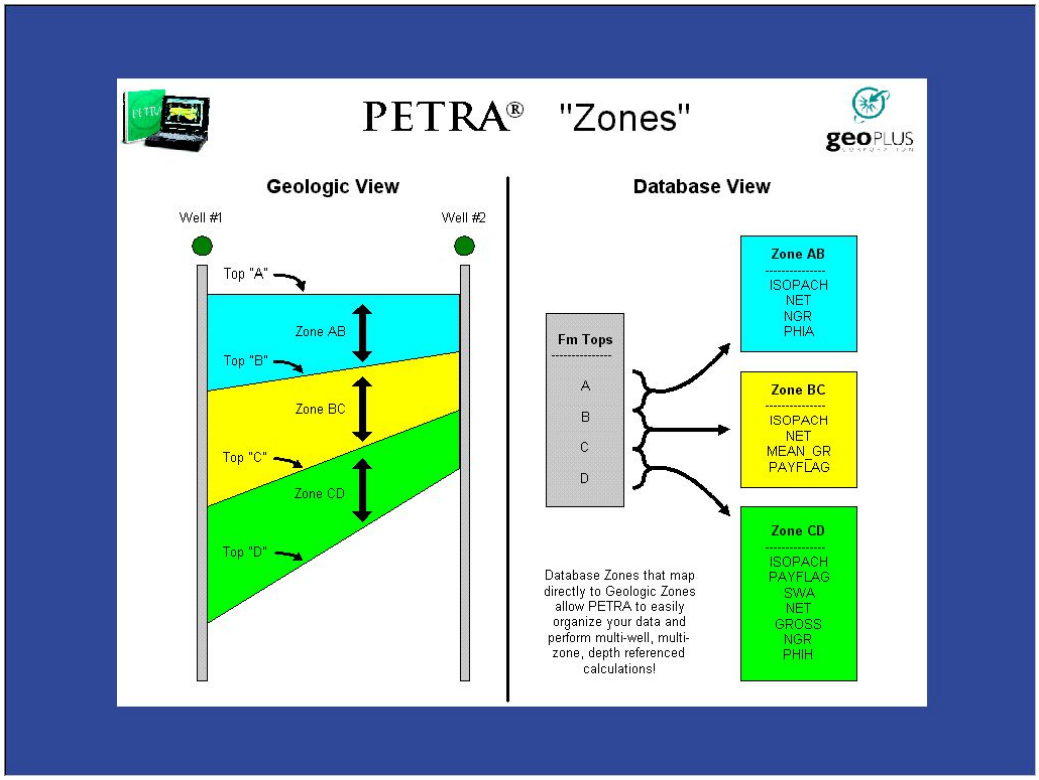


CREATING ZONES

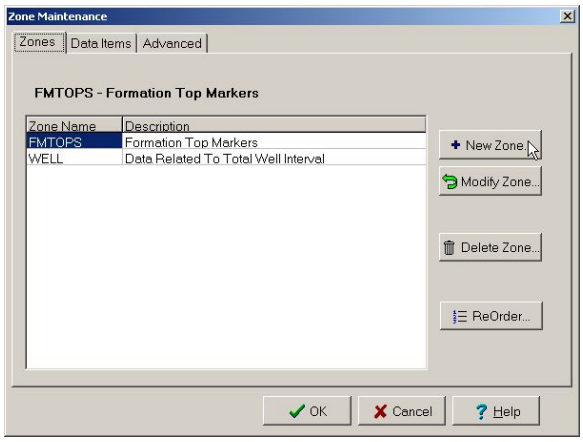
We wish to organize our project so that the attributes or reservoir properties for the D sand can be easily computed and stored together in a single database table. We can do this by creating what PETRA calls a “Zone Table”. We will define a zone table for the D sand interval. This table will be depth-referenced using the formation top and base of the D sand. The zone definition will be used to quickly compute properties over the D sand depth interval.

PETRA has 3 types of “Zones”:
1. FMTOPS – Elevation- automatically converted to TVDSS using the datum
2. WELL – Data specific to the wellbore.
3. Geologic Zone or “User-Defined”

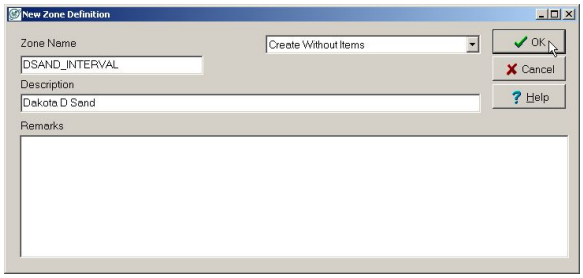
Look at the diagram below. See how the “geologic zones” correlate to the “database zones” using the formation tops table as the depth interval.



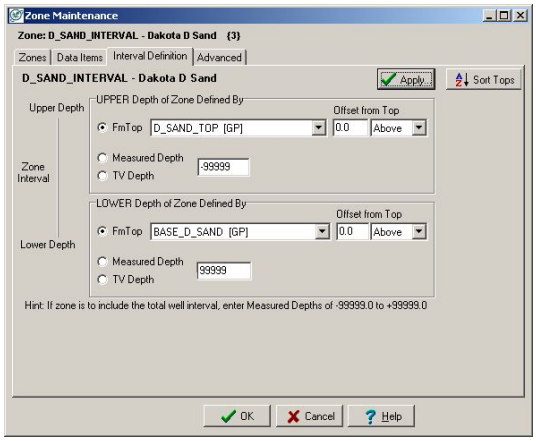
To create a zone, use the “Main” module’s “Zones>Add/Modify Zones” menu or use the “Maintenance” button located at the bottom of the “Zones” Tab. Both functions will display the zone maintenance dialog screen



Click on the “New Zone” button and enter the zone name DSAND_INTERVAL and zone description of Dakota D Sand.

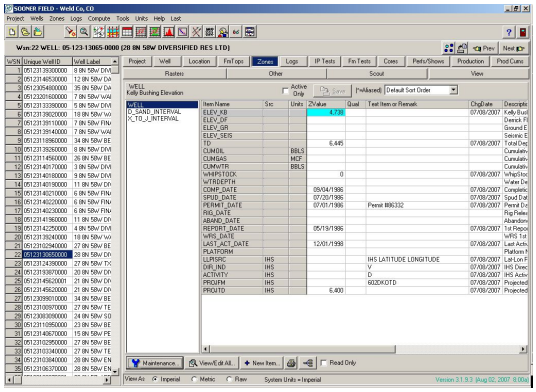


The next screen will be to define the depth interval for the zone. Select the formation top D_SAND_TOP for the upper depth and the formation top D_SAND_BASE for the lower depth. Click the “APPLY” button.

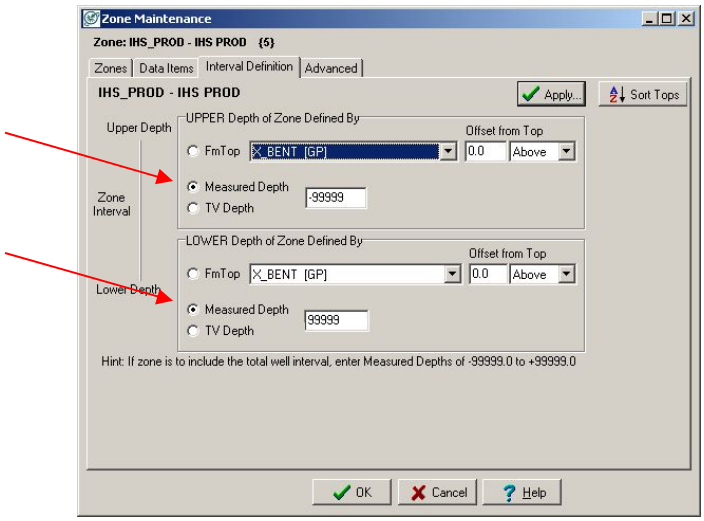


Click on the “Zones” tab and repeat the above process to define a zone called XJ that covers the interval from the XBENT down to the 602DKOTJ[3]. We will use this interval later for various log calculations.

The two new zone names will be listed on the “Zones” Tab.



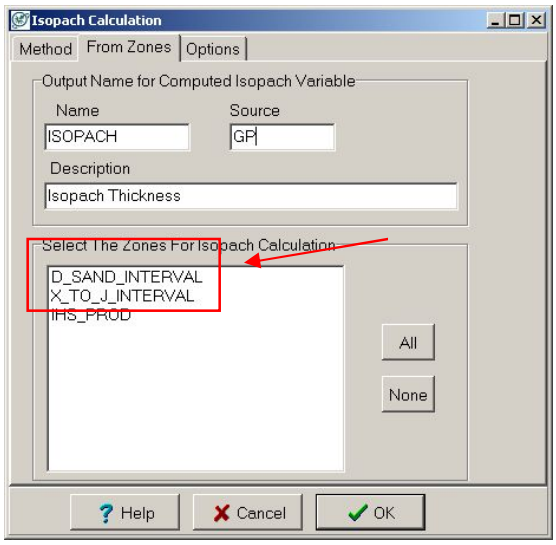
Create a third zone “IHS Production” using measured depth values of “0” or the default -9999. We will use this zone to place the cumulative oil, gas, and water, of the individual reservoir production streams.



COMPUTING ISOPACH VALUES FOR A ZONE

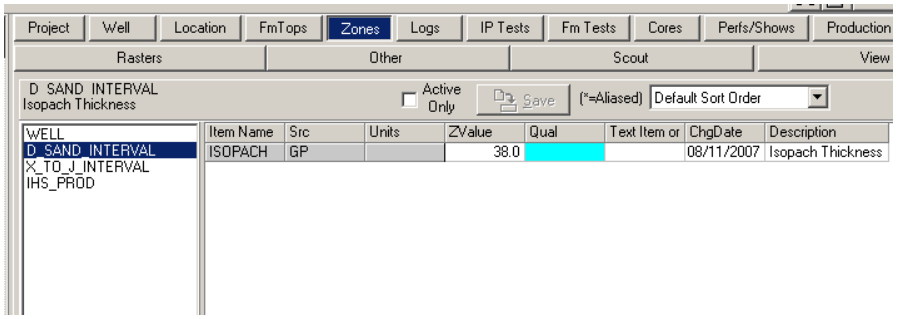
A good way to check to see if our zones are defined correctly is to compute the isopach values for them. This will check to see if the intervals are defined correctly and if there are any problems with the tops.

Select the "Main" menu called "Compute>From Zones>Isopach".



Choose the Zones Definitions method, and then select both D SAND INTERVAL and X TO J zones. The value (item) names will be ISOPACH for both zones. You can change the name if you wish.

Check the "Options" Tab for any additional options you might need to activate. Look at WSN #26 and D SAND INTERVAL zone on the "Zones" Tab. The correct value for the DSAND_INTERVAL isopach is 38. The correct value for the XJ isopach for this well is 197. If you have different values, check your zone definitions and top values. If the tops are wrong, reload the spreadsheet csv values with the correct format.



NOTE: – These isopach values are not dynamic. If you change a top or base you will need to re-compute the isopach. You must compute and refresh the database to reflect a change in a top or base in the isopach values.

IMPORTING DIGITAL LOG DATA (LAS Files)

Digital log curves can be imported into the PETRA database with one or more log formats including LAS, LIS and tabular ASCII files. We will load our curve data from LAS files, one of the most common formats for digital logs used in the industry.

PETRA can load LAS files either one file at a time or in batch load mode. We will do both. First, we will load a single LAS file to see what options are available, and then we'll load the remaining LAS files in batch mode.

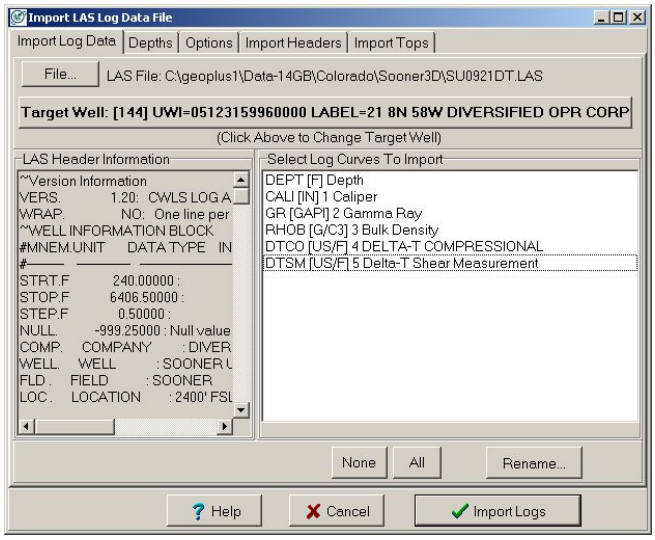
LAS batch import requires the UWI (API number) to be present in the LAS file header. Otherwise, the file cannot be matched to a well in the PETRA project and must be loaded using the single file load method.

LOADING A SINGLE LAS FILE

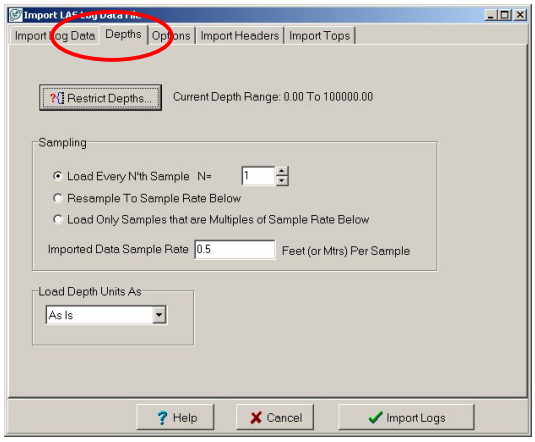
If you know which well you wish to load the LAS file into, then click on that well in the "Main" well list.

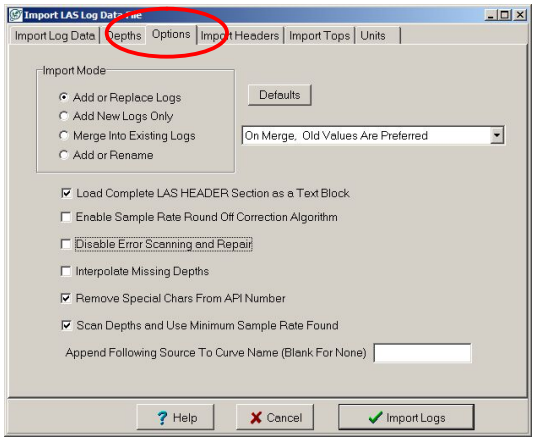
Choose the menu entitled "Project>Import>Digital Logs From>LAS File..." Select the single file called SU0921DT.LAS. Note: you will receive a warning if the file cannot be matched to any well in the database, in which case you'll need to select the well from the "Target Well" button as instructed. However, if the LAS file contains the API number in the header, the well will be chose as the target well.

In our case, the file matches well WSN 144 and the header data and curve names are displayed. Click the "ALL" button to select all curves to be loaded. Note that you can select which curves are loaded and those curve names can be renamed.



Next, click the “Depths” Tab. The option is available to restrict the depths of the curve that are loaded. Maybe you don’t need the entire logs but only the interval over your “pay” zone. We’ll load the entire curve depth range, which is the default.
Next, click the “Options” Tab and set the Import Method.

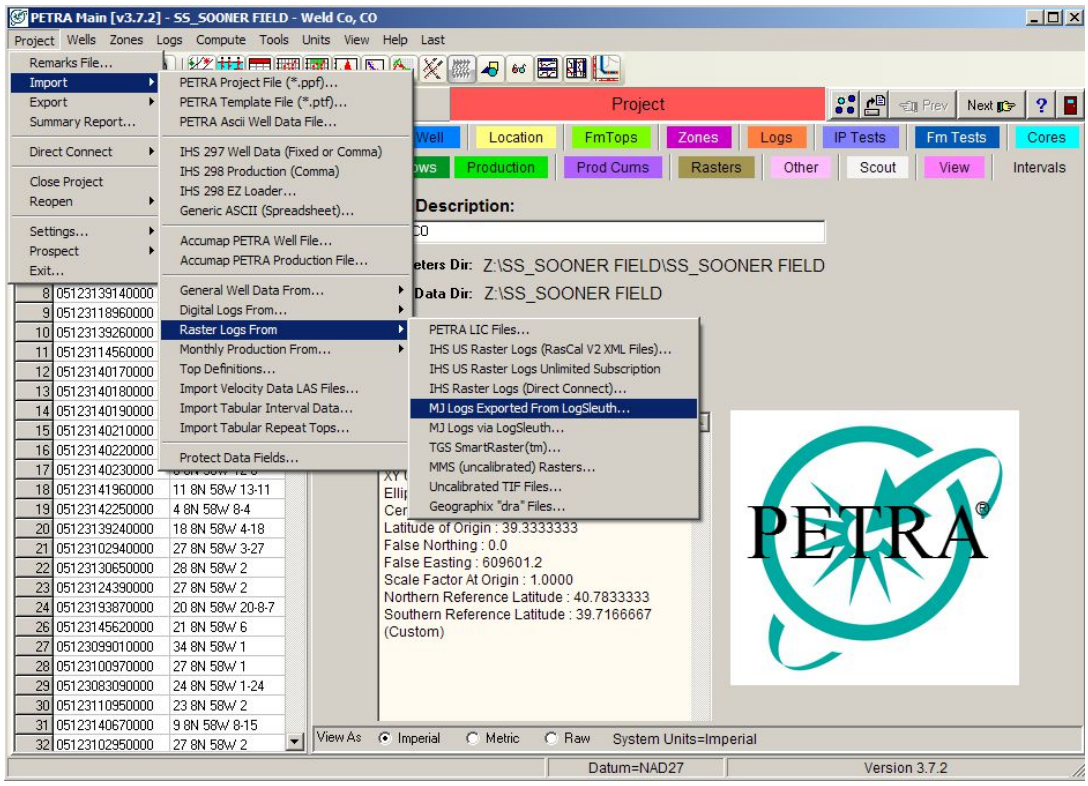




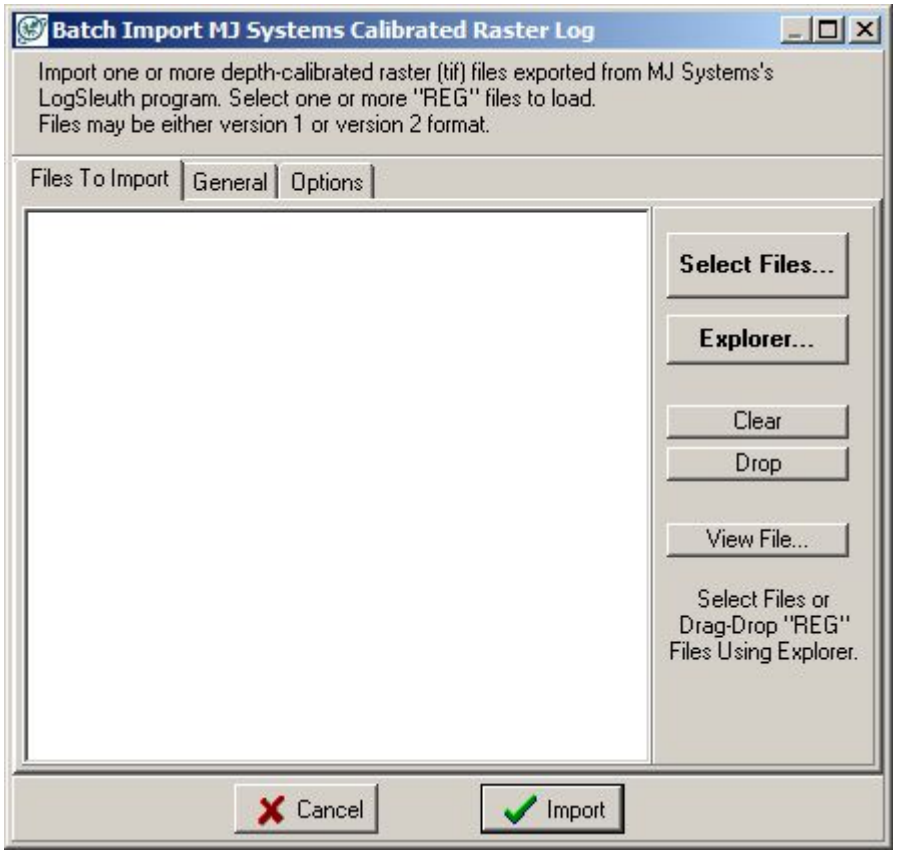
The Import Method determines what to do when you attempt to load a duplicate curve. For example, let’s assume you already have a GR curve for this well. Since the LAS file also has GR curve, we have to tell PETRA what to do with it. We can replace the one in the database with this new one. We can ignore it and keep the one in the database. We can merge it by depth with the one in the database. Or, finally, we can rename it to GR_1 and add it to the database so that we have both gamma ray curves.

IMPORTING RASTER LOGS

Raster logs can be imported into the Petra data base in several formats. We will load rasters exported from MJ systems shown below.



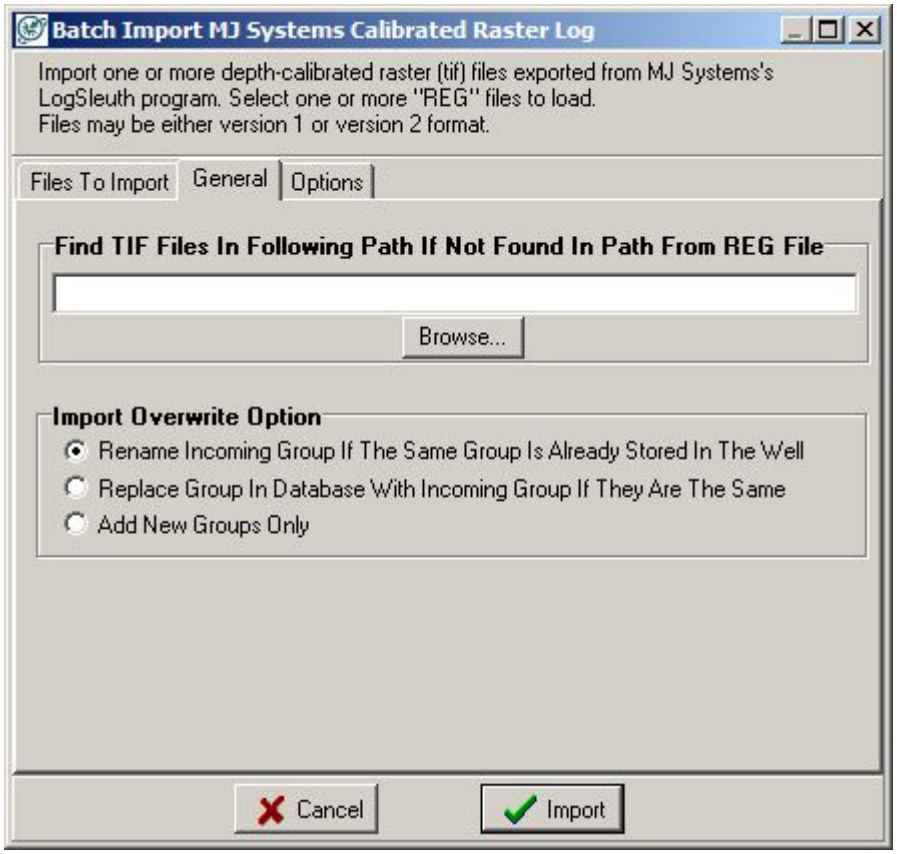
Choose the menu titled: “Project>Import>Raster Logs from> MJ logs exported from LogSleuth…”



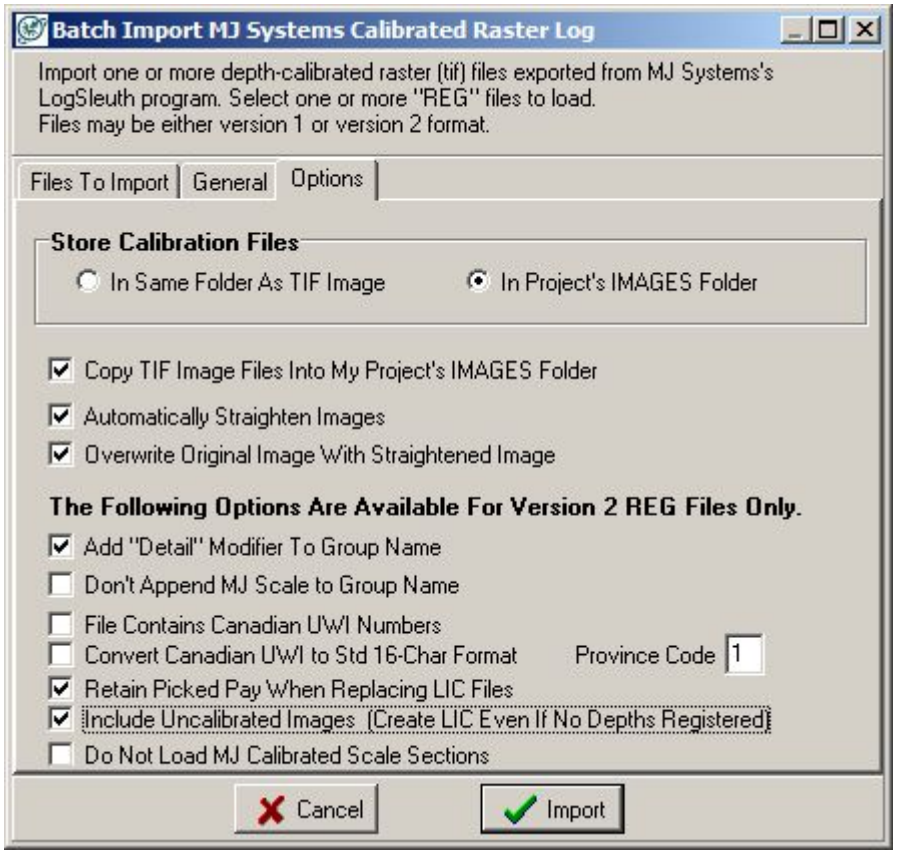
Go to:

Y:\GE\Common\Courses\ssonnenb\SOONER FIELD

Copy the SOONER FIELD folder onto your C drive, into a folder called 551.



Click the above button if wells have previously been imported.

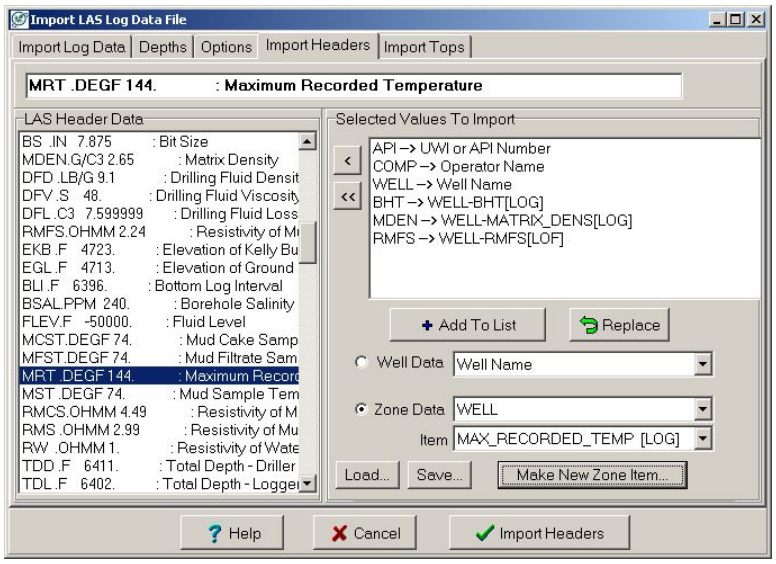


Have the above boxes checked before importing.

Import logs.

IMPORTING LAS HEADERS

To import “Header” data and save a header load file, click on the “Import Headers” tab. Click on the line in the “LAS Header Data” field that you want to load as a item into the WELL. For example, click on the API line on the left and click on the “Well Data: “UWI or API Number” on the right and click on the “+ Add To List” button to add the item to the “Selected Values To Import” data field. Continue the process until you have selected the items that need to be loaded from the “LAS Header”. You may wish to create a new zone to place data from the log header.

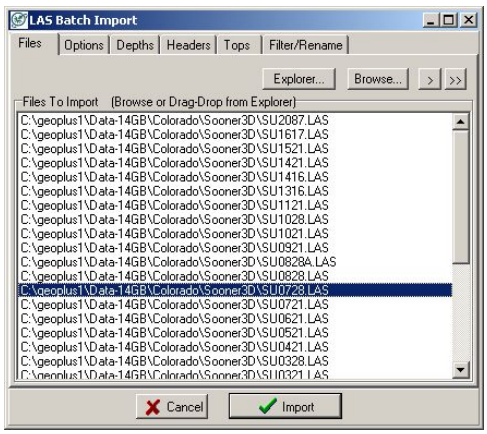


Save your Header Template for use in loading additional LAS files with the associated header data.

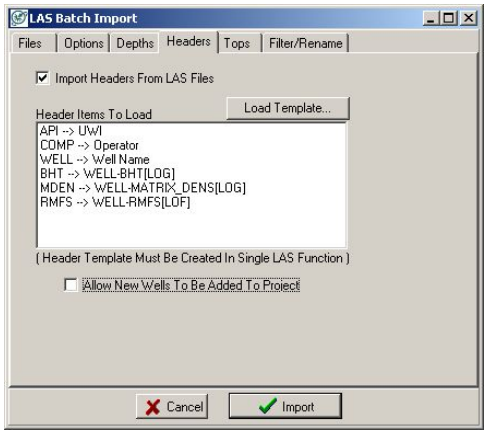
BATCH LOADING LAS FILES

Choose the menu entitled “PROJECT>IMPORT>DIGITAL LOGS FROM>LAS Batch Import...” Select all of the LAS files except the one we previously loaded. Note the depths and import options are the same as with the single file loader. The main difference is that you cannot select which curves are loaded. They will all be loaded.

Click the “Import” button to begin loading the LAS files. Upon completion, you will see a report showing the import status of each LAS file. Some files cannot be loaded because of missing or incorrect API numbers in the LAS file header. These files must be loaded using the single file loader, which we will skip for this class.

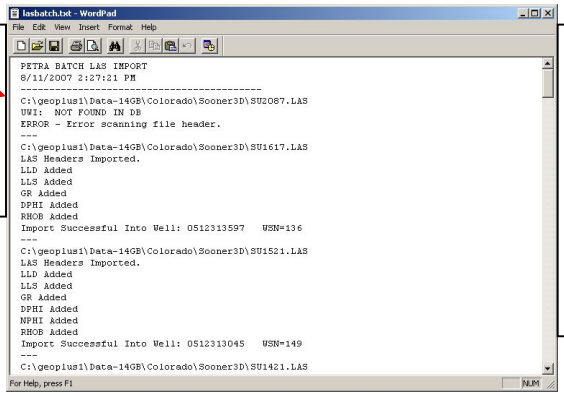


Batch Loading Screen



Load Header template

This file did not contain the UWI for the well.



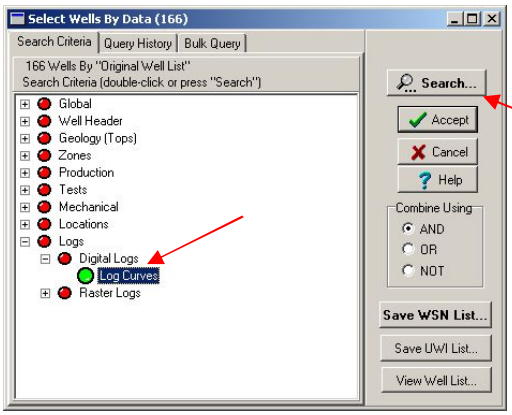
After Loading is complete, a report will be generated to show which curves were loaded, replaced, or

PREVIEWING DIGITAL LOG CURVES

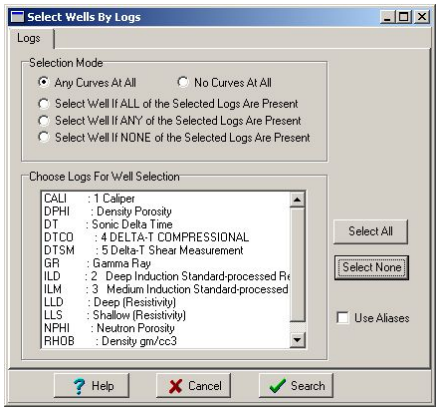
Click on the “Wells→Select Wells By Data Criteria” menu or the  “Select Wells By Data” icon. Double click on the “Log Data…” item. Click on the “Radio” button to the left of “Any Curves At All”, and then click on the “Search” button with the

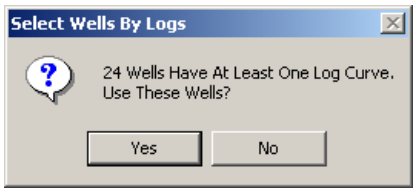
“Green Check” on it. Click on the “Yes” button to accept the 24 wells that have curve data.

We can take a quick look at the log curves we just imported using the log preview function. First we might select only those wells which have the curves.
Select from the Menu items, WELLS>SELECT>WELLS BY DATA CRITERIA, or the icon: 

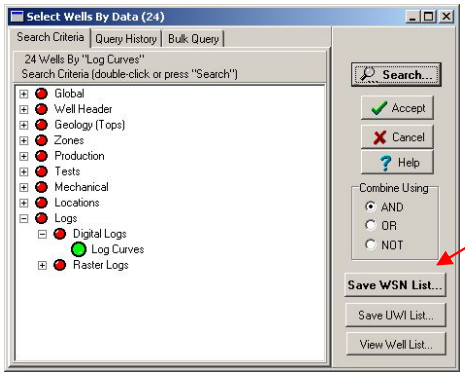


Next select LOGS>DIGITAL LOGS>LOG CURVES. Press the search button and from the log selection, choose “Any Curve at all”. After the wells are selected, Save the WSN (Well Sequence Number) List:



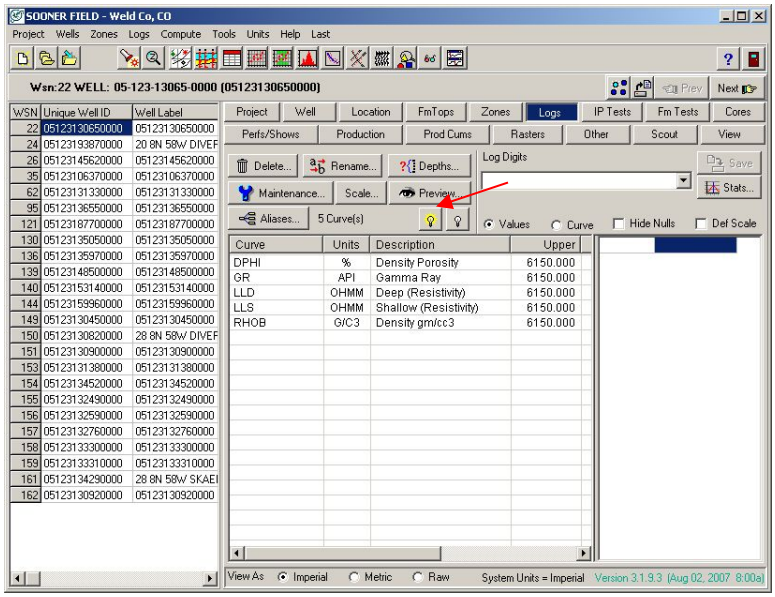


You may select one or more logs for your purposes, the number of wells with the log curves will appear once you have selected “search”.

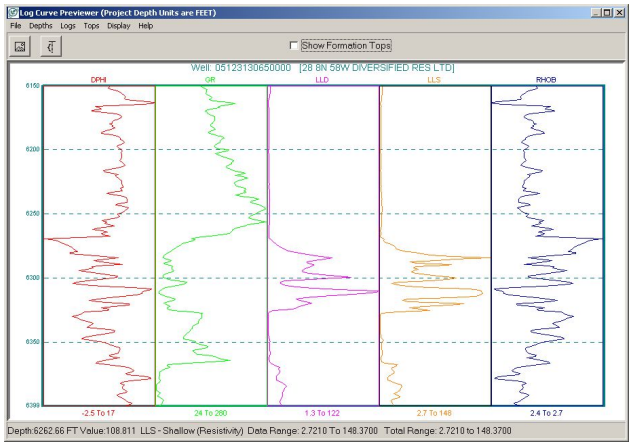


Be sure to save the WSN List for future use. The WSN List will be stored in your Personal Parms Folder.

Click to select well WSN 22 and click on the “Logs” Tab. Click on the “Light bulb” icon to select all of the curves.



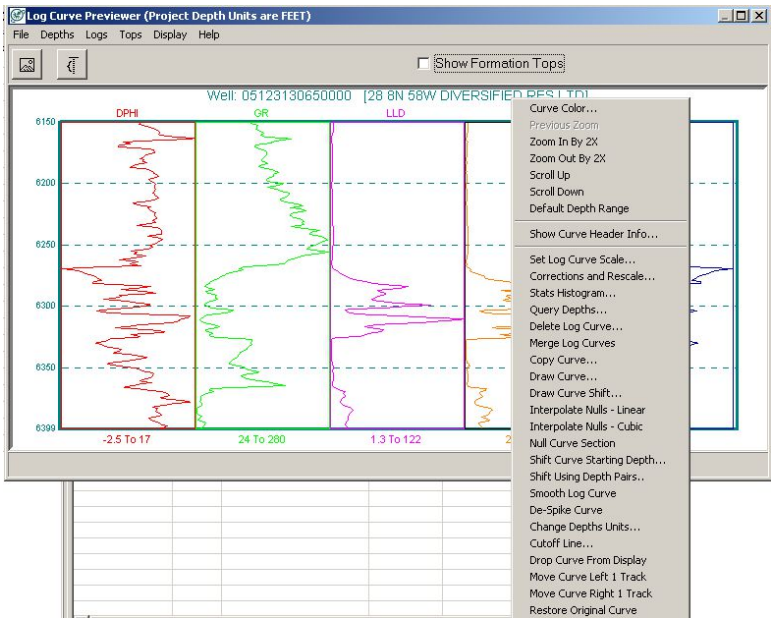
Next click the “Preview” button.



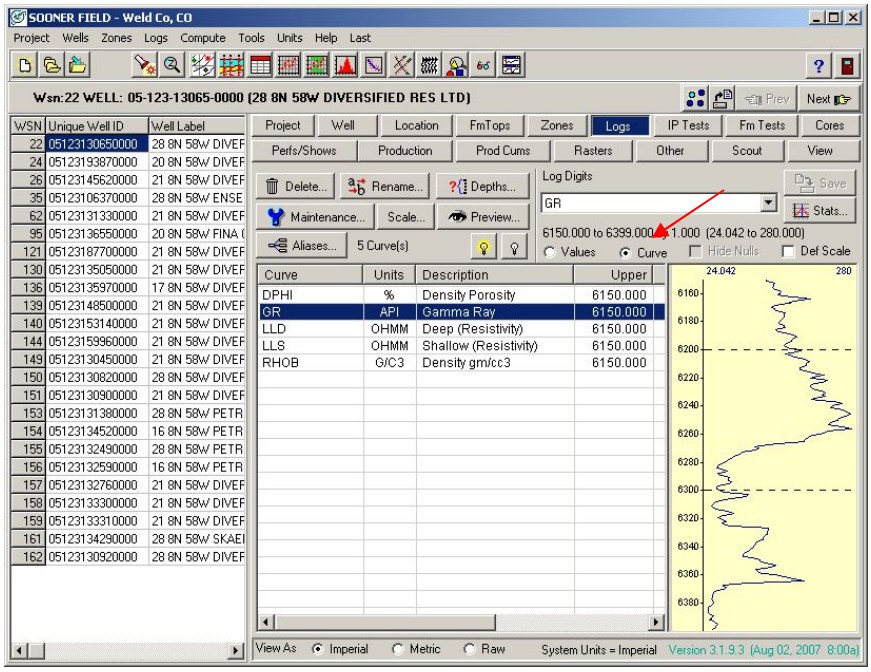
This will show all of the curves for this well. The curves are auto-scaled from the data with the min-max values displayed below each curve. To see the curve editing tools available, position the mouse over a curve and click the “Right Mouse” button to bring up the curve-editing menu.

NOTE – While you are working in the preview function, changes are temporary and will only be saved to the database after you exit and tell PETRA to save the changes.

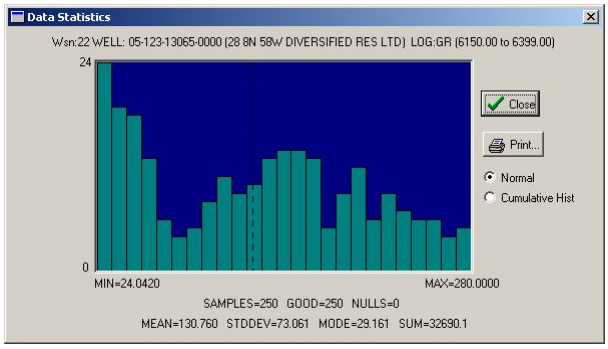
In general, these editing functions allow digital curves to be rescaled, clipped, shifted, and modified in several other ways.



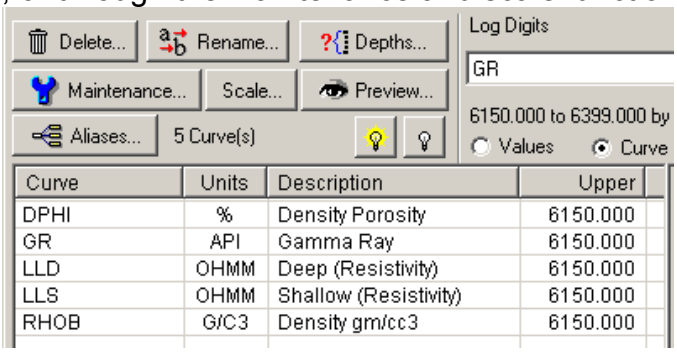
From the Main Module Log screen you may select a curve (double left click), and view the curve, or values for individual curves:



You may also view the statistics of the curve:

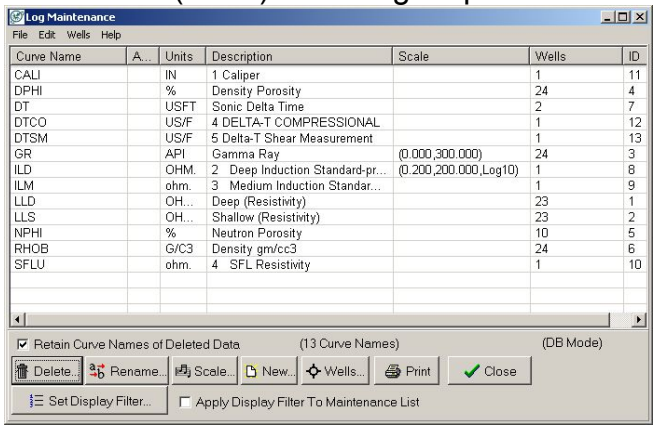


Additional information regarding the Log data may be accessed through the menus, or through the maintenance and scale functions shown as buttons:



Curve	Units	Description	Upper
DPHI	%	Density Porosity	6150.000
GR	API	Gamma Ray	6150.000
LLD	OHMM	Deep (Resistivity)	6150.000
LLS	OHMM	Shallow (Resistivity)	6150.000
RHOB	G/C3	Density gm/cc3	6150.000

The log maintenance screen provides functions for creating new log definitions, for deleting log definitions and all data associated with its LSN, or by simply changing the name, scale, and descriptions of any log definition. Logs are defined by a name, description, units, service id and remarks section. Each well log trace or curve, stored in the database, contains a reference to a well sequence number (WSN) and a log sequence number (LSN) or ID.



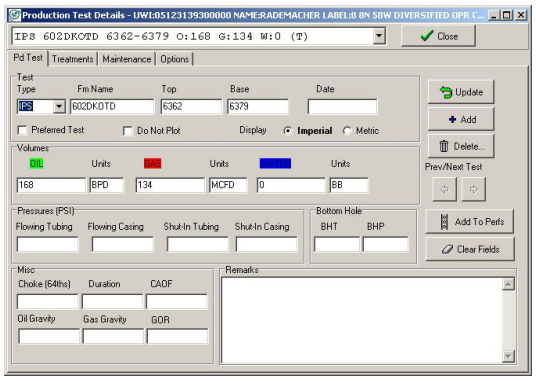
Curve Name	A...	Units	Description	Scale	Wells	ID
CALI		IN	1 Caliper		1	11
DPHI		%	Density Porosity		24	4
DT		USFT	Sonic Delta Time		2	7
DTCO		US/F	4 DELTA-T COMPRESSIONAL		1	12
DTSM		US/F	5 Delta-T Shear Measurement		1	13
GR		API	Gamma Ray	(0.000,300.000)	24	3
ILD		OHM.	2 Deep Induction Standard-pr...	(0.200,200.000,Log10)	1	8
ILM		ohm.	3 Medium Induction Standar...		1	9
LLD		OH...	Deep (Resistivity)		23	1
LLS		OH...	Shallow (Resistivity)		23	2
NPHI		%	Neutron Porosity		10	5
RHOB		G/C3	Density gm/cc3		24	6
SFLU		ohm.	4 SFL Resistivity		1	10

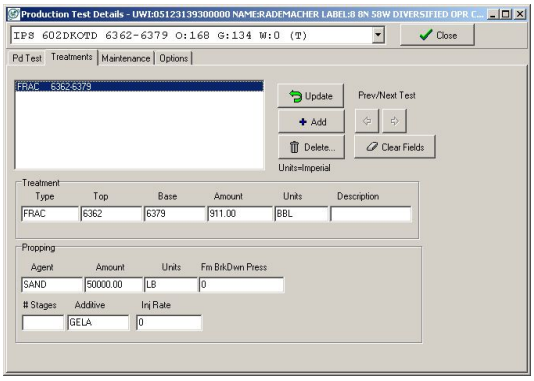
Each log definition is displayed in a list accompanied by the number of wells containing each log through the menu item: WELLS>INCLUDE WELL COUNT.

IP and FM TESTS, CORES, PERFS and SHOWS TABS

IP TESTS

Data for various production tests, perforations, shows and cores are stored in the tabs of the main module. Data from initial production and tests while producing are located in the IP TESTS tables:

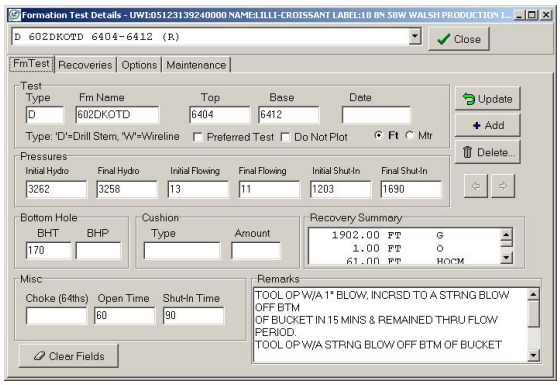


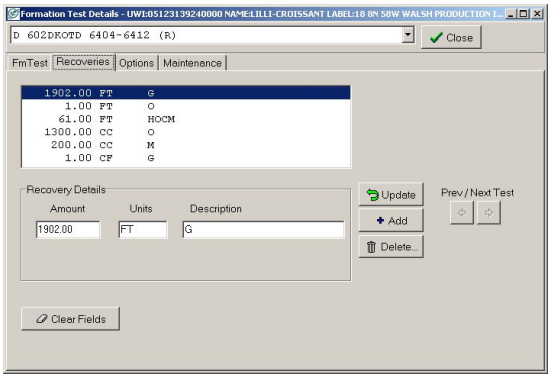


Treatments to the well bore, such as Frac, Acidizing, and Staging, should be stored in the treatment section.

FM TESTS

Formation Tests (Drill Stem and Wireline) are stored under the FmTests tab. Recoveries are listed for the different tests and additional data is often found under the remarks section:



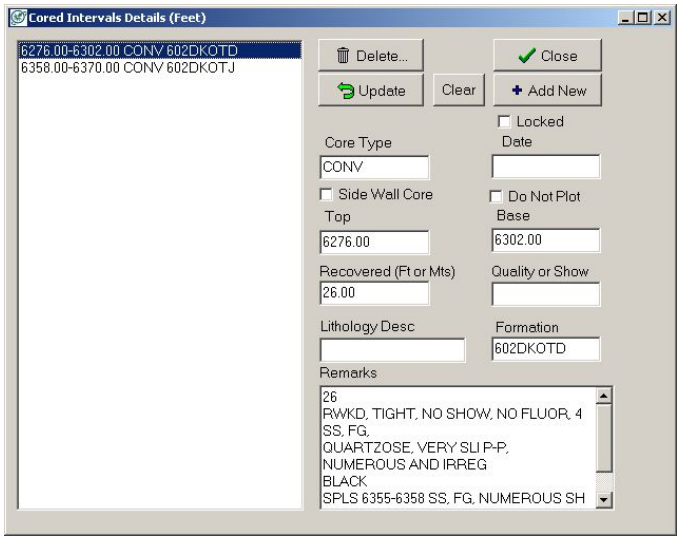


Exercise:
Select Wells by Data Criteria>Production>Producing Fm Name>
Highlight 602DKOTD and D Sand click search, click accept
Select Wells by Data Criteria>Tests>Any Formation Tests (DST)
Click accept
Examine D Sandstone DST data!

CORES

Select Wells by Data Criteria>Mechanical>Any Cored Intervals

Core data is presented as core type (Conventional or Wireline), top and base, recovery, shows, quality, lithology, and remarks:

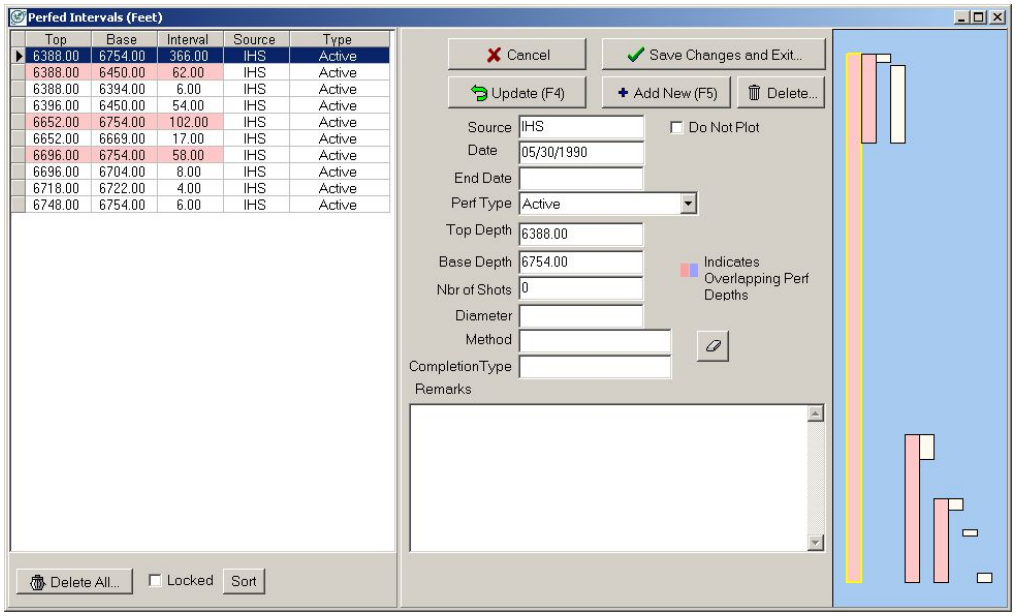


A helpful website to find cores: http://geology.cr.usgs.gov/crc/
Click on well catalog; Enter state CO; Township 8N; Range 58W
The USGS has one core in Sec. 7 8N-58W!

PERFS/SHOWS

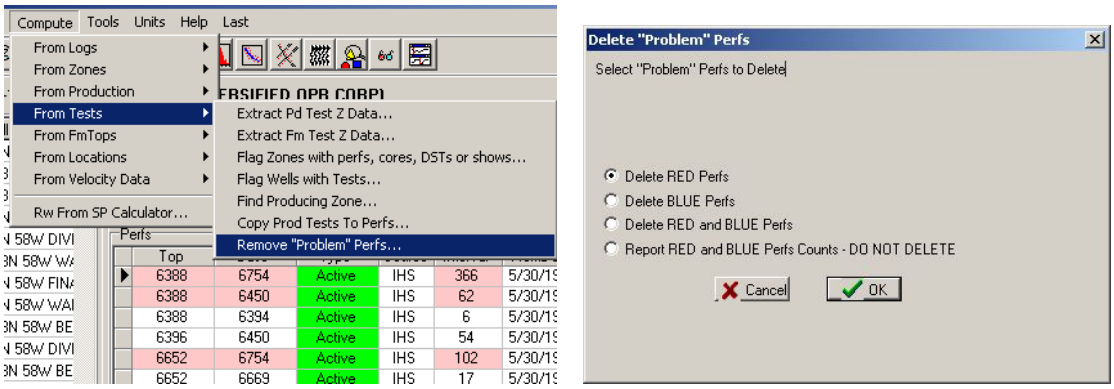
Select wells by data criteria>Production>Any perfs

Perforations can be shown, selected by source, type, and interval.



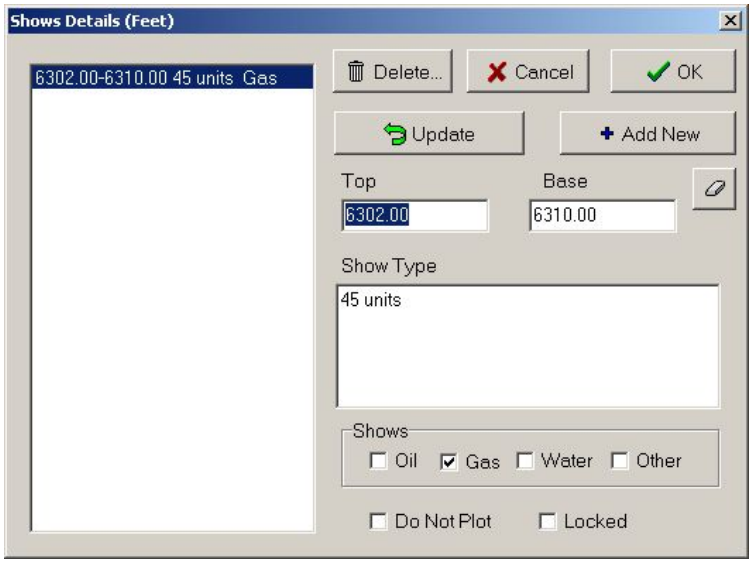
Overlapping perforations can be chosen to be deleted, or chosen not to be plotted. The color scheme in the program allows the user to make the selection as to which perforations to keep, delete, show, or change.

To initiate the correction option for overlapping perforations, select from the main menu under COMPUTE>FROM TESTS>REMOVE PROBLEM PERFS:



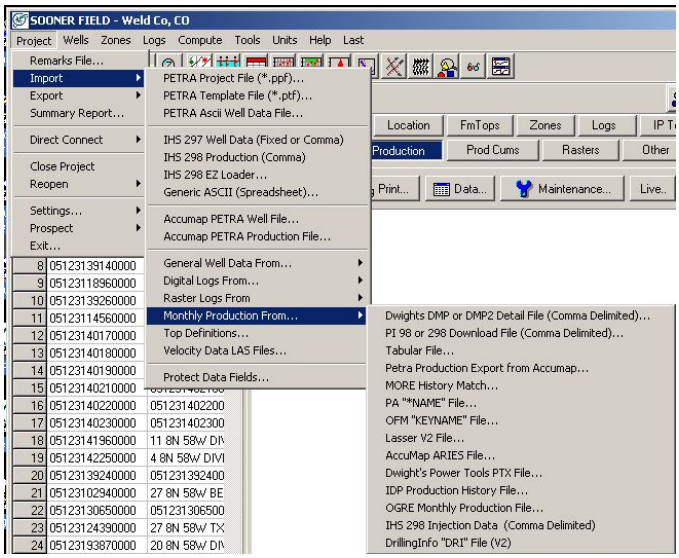
You will be prompted for your choice of reporting or deleting perfs that appear as overlapping by depth in the database. Perforations are coded as active, inactive, openhole, etc, to enable the user to post on maps, extract for gridding and computations, or for use in the cross section module.

Shows are displayed in the main module, map, and cross sections. The show data may included the top and base, the show type (such as gas units), and the option for symbols to be used in the cross section:



IMPORTING MONTHLY PRODUCTION DATA

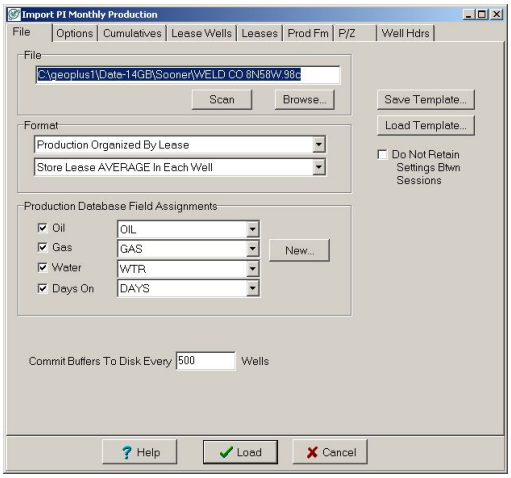
Monthly production (decline curve) data can be loaded from a variety of sources. This option is found under the Main Module, “PROJECT>IMPORT>MONTHLY PRODUCTION FROM…”. Several options are available, but we will use the IHS 298 comma delimited file.



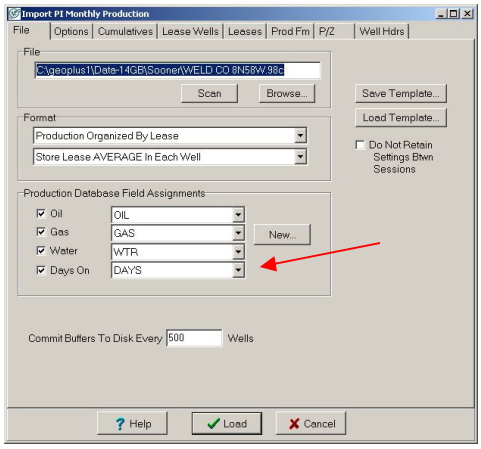
For those of you continuing to use the IHS CD formats, select the IHS 298 Production (Comma) file from the Import function.

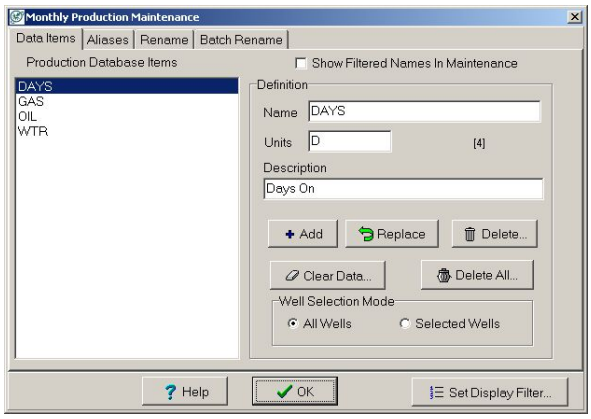
Click the “Browse” button and select the IHS file called **8n 58w2010.98c** located in the *c:\program files\geoplus1\data\sooner* folder. This file is in the “Lease Format”, rather than having the production organized by API number. This option is controlled by the state in which the wells are drilled and their reporting formats and conventions.

The file will automatically be scanned to display the producing formation names contained in the file. We will review the loading options:



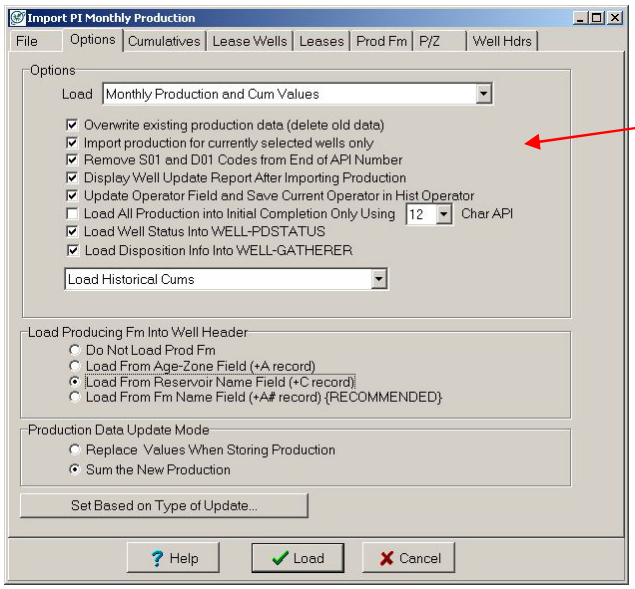
You may wish to include a new database field, “DAYS ON”. Select the “New” button and create a new field:





Select the “Production Organized By Lease” format option. This file has multiple API numbers listed for a single production stream. We can either load the average of this production into each of the wells or all production into each well. When the average is loaded, each well in the lease will receive 1/nth of the total lease production. Likewise, the cumulative values for the well will also be 1/nth of the total cumulative production value. Loading the average insures that if we later sum the “field production” stream we will have a more accurate value.

The following options may be of interest in updating your data:

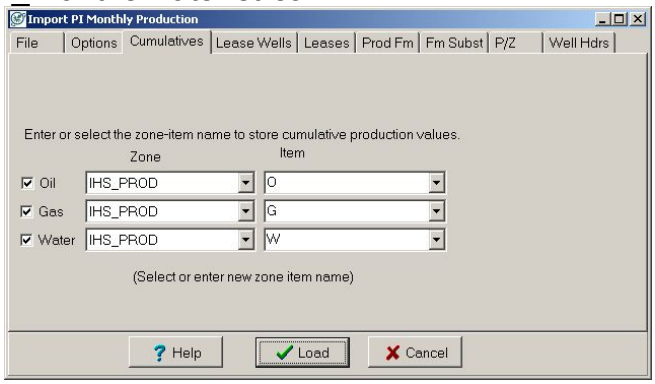


Review the update options

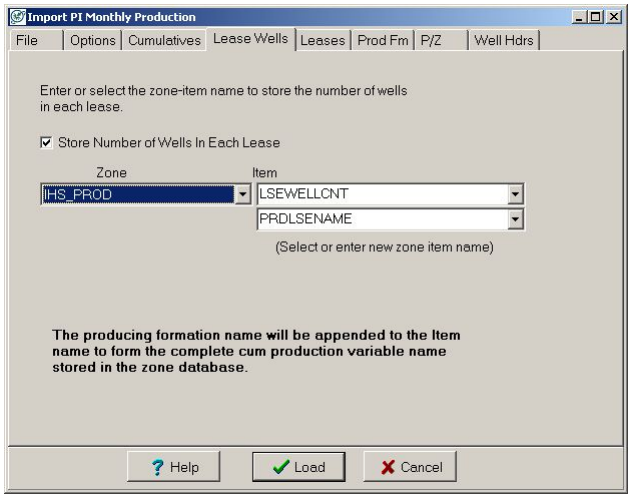
You may wish to overwrite existing production data, sum or replace the data within the zone and production tables. It is suggested that you also include the Production status and Well Gatherer if the data is available.

We can load the project from this file “by formation” meaning the IHS production data is loaded into individual decline curves for each formation, or we can combine or co-mingle the production into a single decline curve.

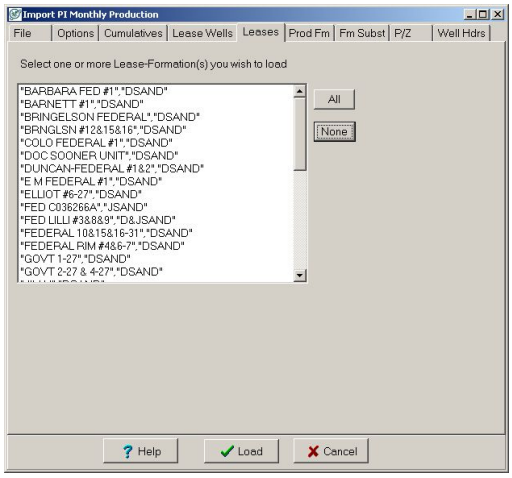
The individual formation “Oil” streams can be displayed and the Cumulatives for the formations will be located in the “IHS PROD” zone with a prefix of “O_” followed by the formation name. The gas and water streams would follow the same format, with the formation name being preceded by “G_” for the gas steam and “W_” for the water stream.



We will also load the data items for Lease Well Count, and Production Lease Name.

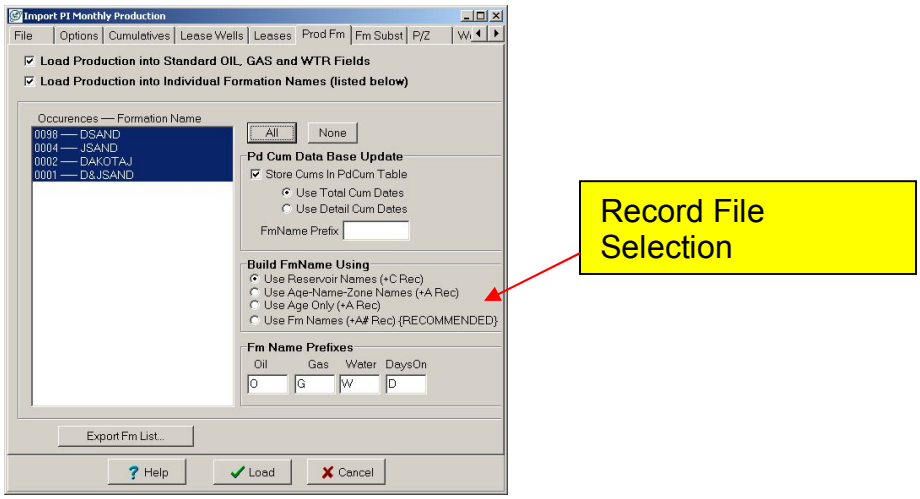


You must also select which leases are selected. Click on the “Leases” tab. For this example, select “All” by clicking on the “All” button. The “Lease Wells” Tab allows you to specify a zone item to capture the number of wells in a lease and the lease name. This number can be referenced later to check how many wells made up the lease production.



From the Producing Formation tab, select the “Load Production in to Standard Oil, Gas, and Wtr fields, and Load Production in to Individual Formation Names.

Select the “All” button to select all formations to be loaded. Instead of loading a single decline curve for oil, for example, we will be loading 4 decline curves, one for each producing formation. Each decline curve will be named using the formation name and the appropriate prefix, i.e., oil for DSAND is loaded as O_DSAND and gas is loaded as G_DSAND.

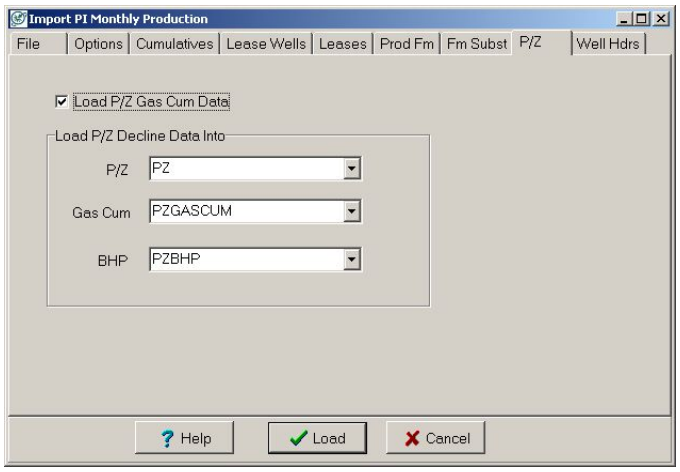


When building the formation name listing in the database, it will be critical to always load the same “record” files – verify which of the record files were used previously to avoid confusion:
+A = Age, Name, and Zone (i.e. 602DKOTD)
+A#= Formation Name (i.e. DAKOTAD/DAKOTADSA)

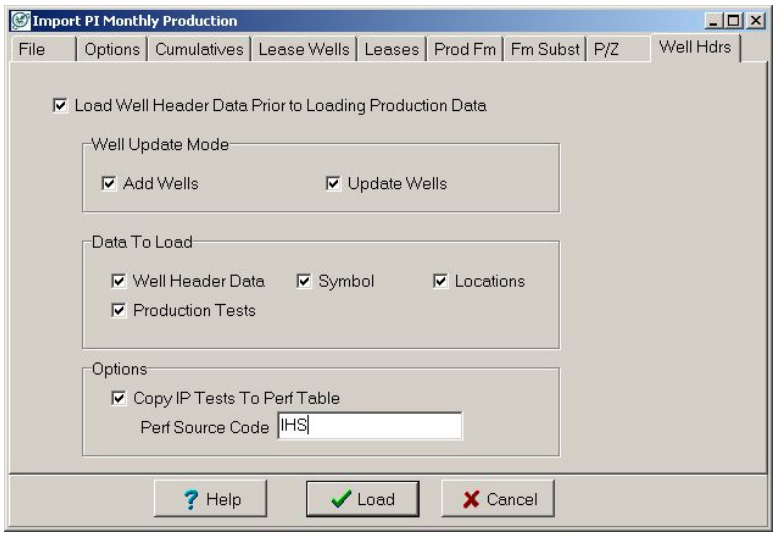
+C= Reservoir Name (i.e. DSAND)

The production data is generally loaded by “Producing Formation”, then by “OIL”, “GAS”, and “WATER” to obtain the “Total Cums” for the well, or they can be calculated in the “Main” module under the “Compute>From Production>Cumulative and Average Production Rates…” menu.

You also may load the P/Z, or gas compressibility data for the wells, if it is available.



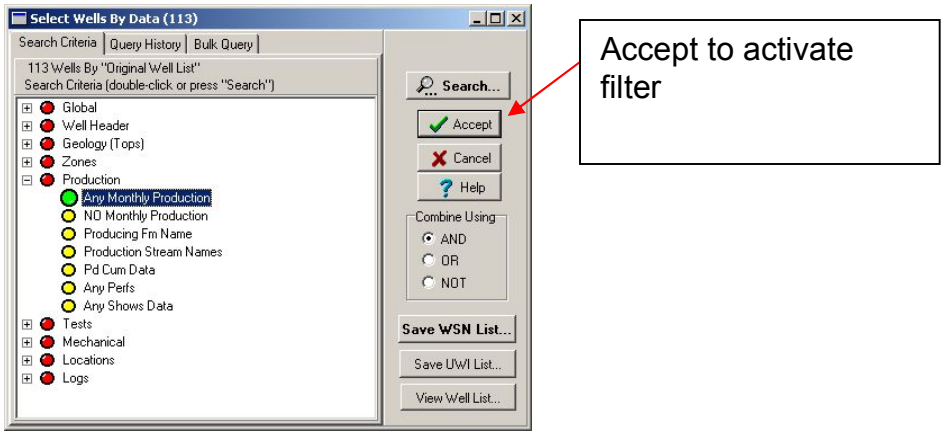
The Well Header data allows updates to the operator, well symbol (Gas Well to Water Injector, for example), updates to locations, more recent Production tests and updates to the perf records.



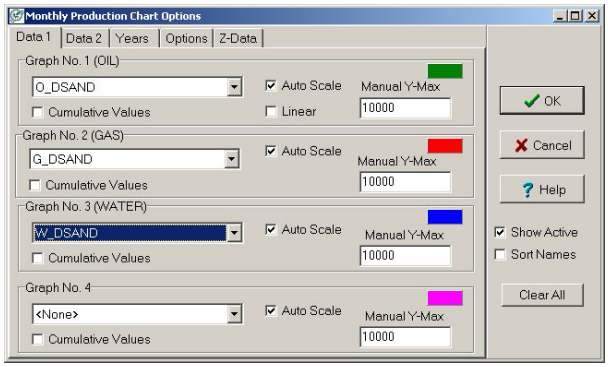
DISPLAY PRODUCTION FOR WELLS

The “Production “ Tab displays the decline curve data for a well. The default is to display OIL, GAS, and WTR. Since we loaded data into O_DSAND, G_DSAND, and W_DSAND we must change the display options to show these values.

Click on “Wells>Select>Wells By Data Criteria” menu and double click on the “Any Monthly Production” option and click on the “Select” the green button and press Accept to select those wells that have production:

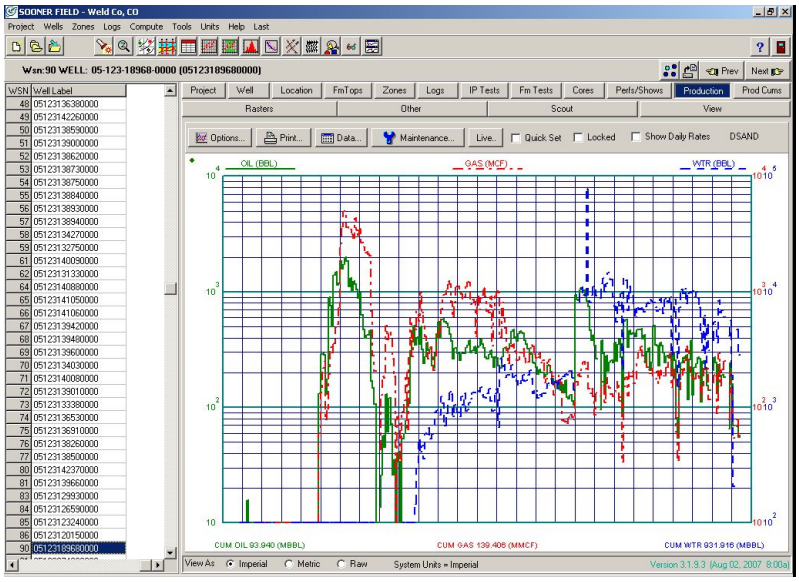


Select the OPTIONS button on the Production Tab:

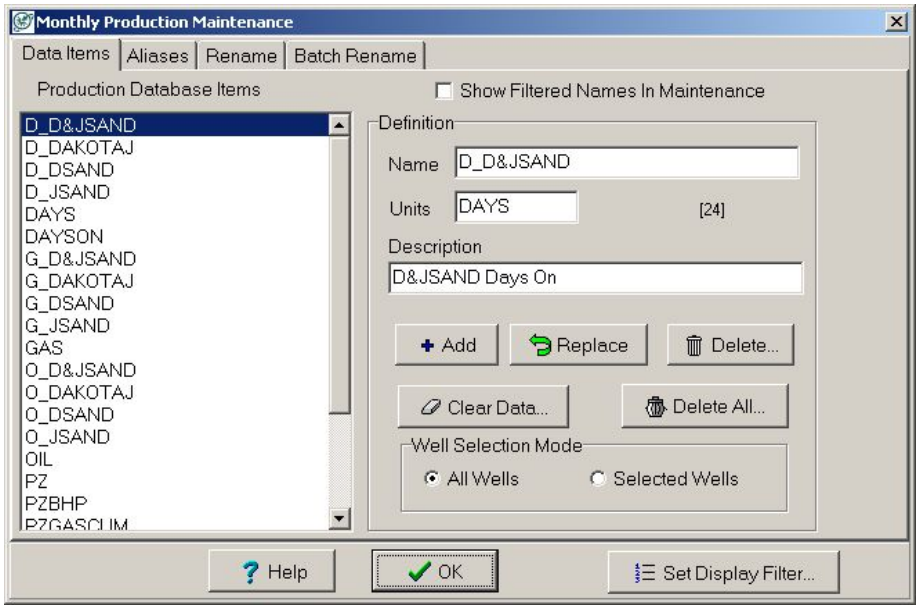


You may choose eight (8) different reservoir flow streams to show on the screen. You also have options in scaling, colors, and cumulative vs monthly rates.

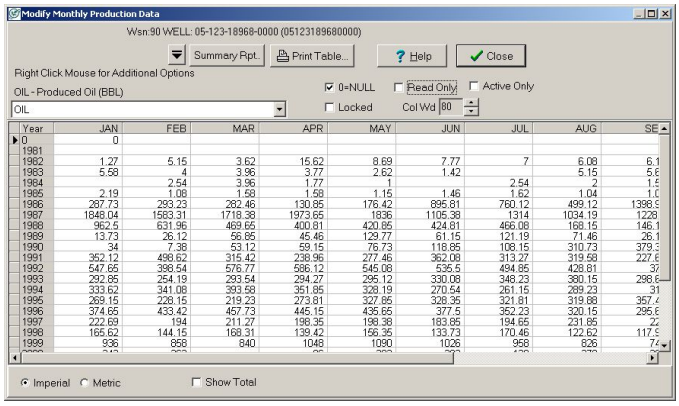
The Monthly Production charts are easily displayed, and can be shown in the main module, maps, and cross sections.



The maintenance icon of the Monthly Production tab allows for renaming and aliasing the production streams from the PI 298c file.

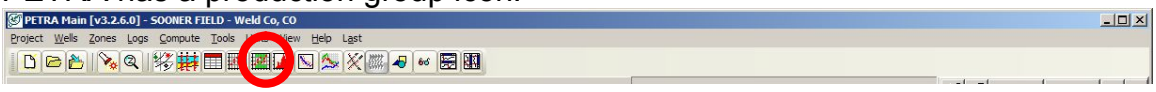


The raw data values may be seen through the DATA option:

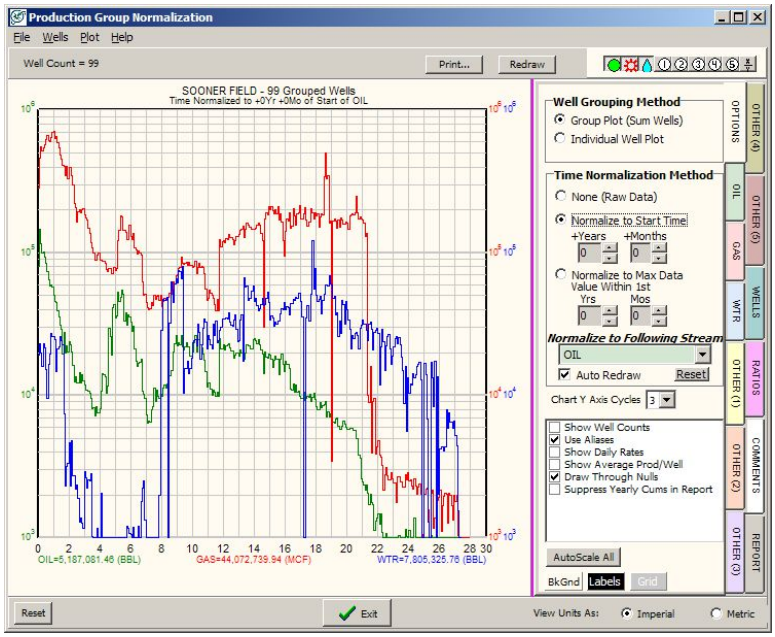


PRODUCTION GROUP PLOT

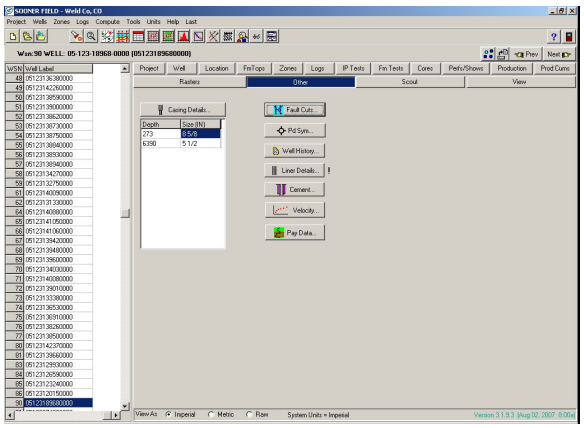
PETRA has a production group icon:



Click on the icon to see how all the production can be grouped.
The production can be 'normalized" to the start time!



THE “OTHER” TAB



Casing, Liner, and Cement data may be found in the “Other” tab. Fault cuts added to the well database may also be stored and extracted to the formation tops table for use in fault plane maps, gridding, cross sections and mapping processes. Production Symbols are depth referenced well symbols stored in each well. These well symbols can be plotted on cross sections on the depth track to indicate various producing zones. Optionally, each well symbol can have a remark posted beside it on the cross section.

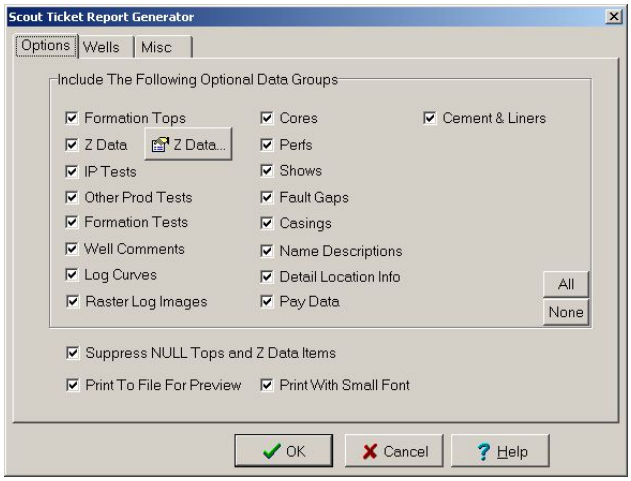
Velocity functions can be added to the database to assist in viewing and manipulating well data in relation to the time-depth function used in seismic interpretations.

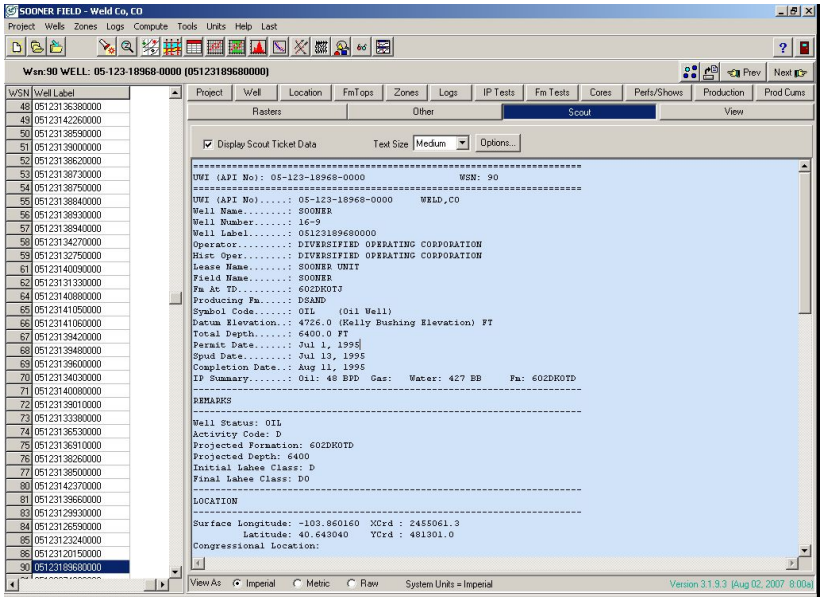
Pay intervals may be managed and stored in the Pay Table. Pay may be picked in the cross section, through calculations, or from the raster tab.

The Well History files may be used for capturing data relative to the specific well history – such as daily drilling reports, hyperlinks to engineering spreadsheets, land plats, figures, or photographs. This section may also be used to store items such as the vendors associated with drilling the well, plans, and processes associated with the field activities or maintenance of the well.

THE SCOUT TICKET

This tab allows the user the option to extract all of the pertinent data of the well to be viewed in one screen. You may also print this report through the menu item WELLS>SCOUT TICKET REPORT:





The scout ticket report is commonly used for well prognoses and reporting of information on the well to interested parties.

THE “VIEW” TAB

The view tab shows basic well data on a borehole plot. Items included are Tops, IPs, DSTs, Perfs, and Casing.